Hot Stone Technology at Bucklers Park, Crowthorne, Berkshire: The Use and Re-use of a Persistent Place During the Bronze and Iron Ages

By HELEN CHITTOCK, ROBERT MASEFIELD, ENID ALLISON, ANNE CRONE, DEREK HAMILTON, SUZI RICHER, JACKALINE ROBERTSON *and* ALEX WOOD

APPENDIX S.1. BUCKLERS PARK: INSECT REMAINS FROM TWO PREHISTORIC WELLS
(Enid Allison)

AOC Archaeology Group undertook a programme of archaeological investigation in advance of development at the site of Bucklers Park, Crowthorne, Berkshire (NGR 484672 165395). Following evaluation, excavations were undertaken in three mitigation areas between October 2016 and July 2017. Wells or waterholes that were in use between the Middle Bronze Age and Middle Iron Age (*c.* 1500–100 BC) were revealed in all three areas. They were associated with extant or disturbed mounds of burnt flint and with 'troughs', features associated with the heating and/or boiling of water using fire-heated flint. Such 'burnt mounds' dating to the later prehistoric period occur across Britain, but their functions are currently uncertain. At Bucklers Park, the dating of the burnt mounds themselves is uncertain but the evidence indicates that their presence is related to the use of the wells. Mitigation Area 2 contained a number of other features, including another possible well, which were overlain by a possible roundhouse or small penannular enclosure dating to the Middle Iron Age. Finds collected from the site included prehistoric pot sherds, lithics, fired clay, and ceramic loom weight fragments. Wooden objects were recovered from the well in Mitigation Area 1, including an *in situ* Middle Bronze Age ladder, which would have been used for access. Environmental and soil micromorphology evidence shows that parts of the surrounding environment were probably cleared of vegetation, and there may have been a settlement or cultivated farmland. Grassland and woodland environments were also indicated (Westall & Chittock 2019).

Four samples from the waterlogged fills of well [6731] in Mitigation Area 1 and well [1543] in Mitigation Area 2 were submitted for examination of insect remains.

Methods

The volumes of sediment processed from each sample are shown in Table S.1. The samples were initially wet-sieved to 0.3 mm, with the organic fraction separated from the considerable sand component by carrying out a 'washover'. The organic fraction from each sample was then subjected to paraffin flotation to extract insect remains following the methods of Kenward *et al.* (1980), with recovery also on 0.3 mm mesh. Each flot was examined in industrial methylated spirits (IMS) in a petri dish and sclerites of beetles (Coleoptera) and bugs (Hemiptera) were removed onto moist filter paper for identification under a low-power stereoscopic zoom microscope (×10–×45). Determinations were by comparison with modern insect material and by reference to standard published works. Minimum numbers of individuals and taxa of beetles and bugs were recorded. Taxa were divided into broad ecological groups to aid interpretation based on Kenward *et al*. (1986), Kenward (1997) and Smith *et al*. (2020). Statistics were calculated for assemblages consisting of over a hundred individuals. Aquatic taxa were subtracted from the rest of the assemblage to calculate percentages for various ecological groups among the terrestrial fauna; waterside taxa were included among the terrestrial group. Insects other than beetles and bugs were recorded semi-quantitatively on a four-point scale: + 1–3 individuals; ++ 4–10 individuals; +++ 11–50 individuals; ++++ >50 individuals. Other invertebrates were recorded as present (P), common (C), or abundant (A).

Nomenclature of Coleoptera and Hemiptera follows Duff (2018) and the systematic lists compiled from various sources on the British Bugs website (Bantock & Botting 2018). Information on host plants of plant-feeding species has been obtained from Southwood and Leston (1959), Le Quesne (1960), Jessop (1986), Morris (1997; 2002; 2012), Cox (2007), Duff (2012; 2016), and Foster *et al*. (2014), unless otherwise stated. The extracted insects are currently stored in vials of IMS.

The insect assemblages

The assemblages from each feature are described below, beginning with the earliest samples. Details of individual samples are provided in Table S.1. Proportions of various ecological groups in the two assemblages consisting of over a hundred individuals are presented in Table 4.

Area 1: Pit [6731], a waterhole-type feature, was established in the Middle Bronze Age. Radiocarbon dating, a wooden ladder, and a pot sherd all indicate that the two fills sampled for insect remains also accumulated during the Middle Bronze Age. Plant litter in both deposits has been interpreted as representing separate disposal events, with the composition of the plant assemblages perhaps suggesting seasonality (Robertson 2019).

The earliest of the two samples was from context (6742) (sample <26>) at the base of the feature. The deposit was described as mid-grey–green clay silt containing occasional fragments of burnt flint and charcoal flecks, and a large amount of varied plant litter that included wood, bark and tree buds, alder and birch fruits, roundwood, twigs, leaves, bracken, and moss (Robertson 2019). A large paraffin flot (70 ml) mainly consisting of decayed leaf fragments was produced. Insect remains were well-preserved but only sparsely represented relative to the amounts of leafy material (65 beetles and bugs of 56 taxa from a 2.5 litre sample; 26 individuals litre^{-1}). Aquatic deposition was indicated by common *Daphnia* ephippia (resting eggs) and seven species of aquatic beetles. *Hydraena testacea*, found in moss and litter by stagnant water or muddy streams (Friday 1988, 149; Duff 2012, 320), was the most numerous species in the assemblage with five individuals.

Caladromius spilotus and *Carpophilus sexpustulatus*, both associated with wood and bark, may have been introduced with woody material. *C. sexpustulatus* is a saproxylic species, and recent records include under the bark of a felled oak (Nash 2002) and in sappy timber (Denton 2013). A number of other taxa are suggestive of vegetation growing close to the feature. *Simplocaria semistriata* is found in moss and *Conomelus anceps* on rushes (*Juncus*), and there were suggestions of disturbed ground from *Chaetocnema concinna* or *picipes* found on members of the knotweed family (Polygonaceae) including *Polygonum* and docks (*Rumex*), and *Psylliodes*, a genus that is typically associated with Brassicaceae. Several ground beetles (Carabidae) suggest that ground surrounding the feature was relatively dry and open (*Amara* ?*ovata*, *Amara* sp., *Calathus fuscipes*, *Calathus* sp.). Scarabaeoid dung beetles were well represented relative to other terrestrial insects, the group consisting of several dor beetles (Geotrupinae sp.), *Aphodius fimetarius* and two other Aphodiinae species suggesting that dung, and by inference grazing animals, was present locally. *Phyllopertha horticola*, a small chafer, is characteristic of permanent grassland on light soils, where its larvae feed on turf roots.

Although most of the taxa represented are from natural habitats, a head of a human flea (*Pulex irritans*) was strongly suggestive that some of the debris deposited in the pit included material from within buildings. Perhaps tying in with this were records of white-marked spider beetle (*Ptinus fur*) and *Enicmus*, both indicative of relatively dry, mouldering organic matter, and perhaps woodworm beetle (*Anobium punctatum*) and powder post beetle (*Lyctus linearis*), both of which frequently bore in structural timber. Although these beetles all occur in natural situations, they all have synanthropic associations, and in archaeological deposits they are often associated with a 'house fauna' and litter from ancient buildings (Kenward & Hall 1995; Carrott & Kenward 2001).

Sample <3> was from context (6730), a dark brown peaty layer containing frequent burnt flint fragments, and a less varied range of plant litter compared to context (6742), consisting of large quantities of wood and tree buds with smaller amounts of bark and leaves. Timbers were also recovered (Westall & Chittock 2019, 15). A substantial assemblage of aquatic and terrestrial beetles and bugs was recovered from a 2.50 litre sample (199 individuals of 119 taxa; concentration 80 litre^{-1}). The aquatic element (43% of the whole assemblage) was dominated by *Helophorus* species which readily invade a variety of water bodies even if small and temporary. *Hydraena testacea* and *Hydrochus angustatus* or *nitidicollis* were both common, each with nine individuals, suggesting still, shallow water with an at least partially exposed muddy substrate. *Elmis aenea*, a riffle beetle (Elmidae), necessarily found in clean, clear well-oxygenated water was also recorded, and *Ochthebius bicolon* is usually found in mud by running water. The riffle beetle in particular is at odds with the rest of the aquatic component and may indicate the dumping of waste water originally obtained from a running channel. Taxa associated with damp ground were not very well-represented (4% of terrestrial insects).

A significant group of insects associated with trees may have predominantly been introduced with leafy material, although some could have entered the pit from overhanging trees. The parent bug (*Elasmucha grisea*) is associated with birch (*Betula*), and *Crepidodera fulvicornis* usually with willows (*Salix*). *Aphrophora alni*, a spittle bug, and the weevil *Phyllobius glaucus* occur on a wide range of trees and bushes, and other weevils associated with woody vegetation (*Orchestes*, *Rhamphus* and *Curculio*) were not identified closely enough to provide details of particular trees or shrubs. In addition, the very fragmentary remains of *Phyllobius* or *Polydrusus* weevils, identified as representing several species mainly from scale morphology, could potentially also have been associated with leaves. *Dromius agilis*, a small ground beetle, and *Rhinosimus* cf *planirostris* are both associated with trees, especially bark, and may have been introduced with either wood or bark.

Taxa probably representing vegetation growing close to the feature included *Notaris acridulus*, which is primarily associated with reed sweet-grass (*Glyceria maxima*) and perhaps with other semi-aquatic grasses, and a range of ground beetles (Carabidae). Among the latter, *Oxypselaphus obscurus* is found in litter in damp places, but most species were indicative of relatively dry, open grassland or possibly cultivated ground (eg, *Harpalus rufipes*, *Paradromius linearis* and *Calathus melanocephalus*). The chafers *Phyllopertha horticola* and *Serica brunnea* are also suggestive of grassland. Scarabaeoid dung beetles (Geotrupinae, Aphodiinae spp.) accounted for 3% of the terrestrial fauna, probably suggesting a low-level presence of grazing herbivores. Decomposer beetles other than dung beetles were poorly represented (8% of the terrestrial fauna).

An indeterminate abdomen of a biting louse (Mallophaga) was recorded. Since this could not be identified there are no indications where this might have originated. Most species live on birds, so it could potentially have come from a nest associated with the woody vegetation, but a small group are ectoparasitic on mammals, including domestic species.

Area 2: Well [1543] in Mitigation Area 2 was originally in use in the Middle Bronze Age, but it appears to have been disturbed or re-established during the Early Iron Age. The two samples examined were from deposits that accumulated in the Early to Middle Iron Age.

Sample <14> was from context (1551), described as a mid brown-grey sandy clay containing flecks of charcoal, very occasional fragments of fire-cracked flint, and a single sherd of Early to Middle Iron Age pottery. A limited range of wood, roundwood, bark, tree buds and leaves was interpreted as being an incidental accumulation rather than deliberate disposal (Robertson 2019). An assemblage of 137 beetles and bugs of 85 taxa was recovered from a 5-litre sample (a concentration of 34 individuals litre^{-1}). Water beetles, dominated by *Helophorus* species, accounted for 35% of the total insect fauna, and *Daphnia* ephippia were abundant, together indicating that standing water was present for at least some of the time.

The ground around the well may have been quite damp since taxa characteristic of such conditions accounted for 12% of the terrestrial fauna. *Dryops* is indicative of wet mud. Several ground beetles typical of damp ground were recorded, including *Dyschirius globosus*, *Pterostichus vernalis* and *Acupalpus*. *Scolytus intricatus*, a bark beetle found in the decaying wood of deciduous trees, especially oak (*Quercus*), could have arrived in the deposit with wood or bark or from a dying overhanging tree. Other taxa, notably a number of ground beetles, suggested that local conditions, perhaps further away from the well, were probably relatively dry and open, with some, together with the chafer *Phyllopertha* *horticola*, suggesting grassland habitats. Scarabaeoid dung beetles were relatively common (9% of the terrestrial fauna) and they included a dor beetle (Geotrupinae), *Onthophagus*, and several Aphodiinae species (*Aphodius fimetarius*, *Calamosternus granarius*, *Melinopterus prodromus* or *sphacelatus* and *Heptaulacus testudinarius*). *H. testudinarius* occurs in sandy areas in dry dung and also in decaying vegetable matter. Its current status is 'Endangered' and there are very few modern records (Hyman & Parsons 1992, 392).

Decomposers other than scarabaeoid dung beetles accounted for 18% of the terrestrial fauna, most of them having synanthropic associations. Most of these fall into the category of 'facultative synanthropes', ie common in natural situations but clearly favoured by human habitats (Kenward 1997; Smith *et al*. 2020). While proportions of decomposer beetles are not at the levels typical of urban occupation sites, the numbers and range of taxa seen here may suggest human activity or occupation with accompanying accumulations of organic litter in the environs of the well.

Sample <13> was from context (1545) which was described as a thick deposit of brown-grey sandy silt containing occasional fire-cracked flint fragments, which was also thought to be of Early to Middle Iron Age date. The limited plant macrofossil assemblage was interpreted as an incidental accumulation. Identifiable insect remains recovered from a 5-litre sample consisted of 30 beetles of 27 taxa; a concentration of six individuals litre^{-1}). Indeterminate scraps of insect cuticle were quite common, however, suggesting that preservation was less good in this sample, possibly because there was incomplete anoxia due to fluctuating water levels. Despite the small size of the identifiable assemblage, a range of aquatic taxa and abundant *Daphnia* ephippia indicated standing water in the well, for at least some of the time. *Scolytus rugulosus* is a bark beetle associated with woody Rosaceae and may have come from an adjacent tree or shrub. Several dung beetles (Aphodiinae spp. and *Onthophagus*) suggested an availability of dung locally. Decomposer beetles appeared to be well represented relative to other terrestrial insects. The taxa represented are suggestive of human occupation and activity in the vicinity and perhaps the limited disposal of occupation litter, but given the small size of the assemblage this should be interpreted with caution. A record of *Stegobium paniceum*, a strong synanthrope colloquially known as the bread beetle, was of particular interest. It is a member of a family of beetles that includes the common furniture beetle (*Anobium punctatum*), but instead of attacking wood it feeds on stored foodstuffs, especially cereal-based products.

Discussion & conclusions

The abundance of aquatic beetles in all the samples was indicative of the presence of standing water in both features for at least some of the time during the periods that the deposits accumulated. Preservation was less good in the uppermost of the two samples from the Early–Middle Iron Age well [1543], which might perhaps reflect less complete waterlogging such as periodic reductions in water level.

Remains of terrestrial insects recovered from small water bodies generally reflect the ecological conditions in their near vicinity. A modern study of insect remains from sediments in a well in Kent, for example, found that they provided a good representation of known habitats in its immediate surroundings (Hall *et al*. 1980, 132). Another more recent study of insect remains in small water bodies has shown that even very mobile taxa such as scarabaeoid dung beetles will have arrived from within a 100–200 m radius (Smith *et al*. 2010). While some insect remains in both features almost certainly represent local habitats and vegetation, there was good evidence from plant macrofossils in Middle Bronze Age pit [6731] that there had been distinct deliberate events where substantial amounts of material associated with woody vegetation appeared to have been dumped into the feature. Many of the insects associated with the foliage of trees and shrubs, and with wood and bark, in sample <3> from context 6730 could have arrived with this material, although it seems likely that trees and shrubs were also present close by. There was no evidence of the deliberate deposition of such material in the Iron Age well [1343], but bark beetles suggesting the nearby presence of oak and woody Rosaceae were recorded.

Ground conditions close to both features were probably somewhat damper than the surrounding land. There were indications that rushes (*Juncus*) and semi-aquatic grasses, such as reed sweet-grass (*Glyceria maxima*), grew close to pit [6731]. Insects generally associated with damp ground were more common in the samples from well [1543] than they were in the pit. Pits and wells often function as pitfall traps for ground beetles (Carabidae), and the range of species identified reflects both rather damp conditions close to well [1543] and generally relatively dry, open ground in the vicinity of both features. There were hints of disturbed ground in the assemblages from well [6731], and various species in both features were particularly suggestive of grassland. *Phyllopertha horticola*, a small chafer recorded from three of the samples, is characteristic of permanent grassland on light soils, where its larvae feed at turf roots.

Scarabaeoid dung beetles in the two larger samples from the Bronze Age well [6731] and Iron Age well [1543] accounted for 3% and 9% of the terrestrial fauna respectively. Modern studies suggest that proportions lower than 5% relate to low-level or 'naturalistic' grazing activity, such as in the vicinity of well [6731], while the greater proportion of dung beetles from the later deposits in the well could indicate either that herbivores were in closer proximity or that there was more intensive use of nearby land for grazing by the time the well was in use (Smith *et al*. 2010; 2014). The scarabaeoid beetles represented are all primarily associated with herbivore dung, but some of the species represented will also exploit other foul matter (Jessop 1986, 19–25), so it is conceivable that the higher proportion in well [1543] might relate to the proximity of settlement as well as to the presence of livestock.

There were hints in the Bronze Age well [6731] in particular that some of the litter dumped within it was associated with buildings from records of human flea (*Pulex irritans*) and a few beetles suggestive of a 'house fauna'. A riffle beetle (*Elmis aenea*) found exclusively in clean, clear, running water may suggest the disposal of waste water, as the species would not naturally occur in a still water body. A bread beetle (*Stegobium paniceum*), a strongly synanthropic species primarily associated with cereal products, was recorded from the uppermost sample from well [1543] together with a range of decomposer taxa suggestive of occupation. However, the insect evidence on its own was insufficient to suggest direct dumping of substantial amounts of organic occupation waste.

Bibliography

Bantock, T. & Botting, J. 2018. *British Bugs: An online guide to UK Hemiptera:* www.britishbugs.org.uk [Accessed 19/02/2021]

Carrott, J. & Kenward, H. 2001. Species associations among insect remains from urban archaeological deposits and their significance in reconstructing the past human environment. *Journal of Archaeological Science* 28, 887–905

Cox, M.L. 2007. *Atlas of the Seed and Leaf Beetles of Britain and Ireland.* Newbury: Pisces Publications

Denton, J. 2013. *A Provisional Checklist of Berkshire Coleoptera*: http://azrefs.org/a-provisional-checklist-of-berkshire-coleoptera-dr-jonty-dento.html [Accessed 22/12/2019]

Duff, A.G. 2012. *Beetles of Britain and Ireland, Volume 1: Sphaeriusidae to Silphidae*. West Runton: A.G. Duff

Duff, A.G. 2016. *Beetles of Britain and Ireland, Volume 4: Cerambycidae to Curculionidae*. West Runton: A.G. Duff

Duff, A.G. (ed). 2018. *Checklist of Beetles of the British Isles*. 3rd edn. Iver: Pemberley Books

Foster, G.N., Bilton, D.T. & Friday, L.E. 2014. *Keys to Adults of the Water Beetles of Britain and Ireland (Part 2)*. Telford: Handbooks for the Identification of British Insects 4(5b)

Friday, L.E. 1988. *A Key to the Adults of British Water Beetles*. Field Studies 7, 1–151

Hall, A.R., Kenward, H.K. & Williams, D. 1980. *Environmental Evidence from Roman Deposits in Skeldergate*. London: The Archaeology of York 14(3)

Hyman, P.S. & Parsons, M.S. 1992. *A Review of the Scarce and Threatened Coleoptera of Great Britain, Part 1.* Peterborough: UK Conservation Series Report 3

Jessop, L. 1986. *Dung Beetles and Chafers. Coleoptera: Scarabaeoidea*. London: Royal Entomological Society

Kenward, H. 1997. Synanthropic decomposer insects and the size, remoteness and longevity of archaeological occupation sites: Applying concepts from biogeography to past 'islands' of human occupation. In A.C. Ashworth, P.C. Buckland & J.T. Sadler (eds), *Studies in Quaternary Entomology: An inordinate fondness for insects*, 135–52. Chichester: Quaternary Proceedings 5

Kenward, H.K. & Hall, A.R. 1995. *Biological Evidence from Anglo-Scandinavian Deposits at 16-22 Coppergate*. York: The Archaeology of York 14(7)

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

Kenward, H.K., Hall, A.R. & Jones, A.K.G. 1986. *Environmental Evidence from a Roman Well and Anglian Pits in the Legionary Fortress*. London: The Archaeology of York 14(5)

LeQuesne, W.J. 1960. *Handbooks for the Identification of British Insects 2(3): Hemiptera Fulgoromorpha*. London: Royal Entomological Society

Morris, M.G. 1997. *Handbooks for the Identification of British Insects 5(17a): Broad-nosed weevils. Coleoptera Curculionidae (Entiminae)*. London: Royal Entomological Society

Morris, M.G. 2002. *Handbooks for the Identification of British Insects 5(17b): True weevils (Part 1), Coleoptera Curculionoidea (Subfamilies Raymondionyminae to Smicronychinae)*. London: Royal Entomological Society

Morris, M.G. 2012. *Handbooks for the Identification of British Insects 5(17d): True weevils (Part 3) (Coleoptera: Curculioninae, Baridinae, Orobitinae).* London: Royal Entomological Society

Nash, D.R. 2002. Notes on the Suffolk list of Coleoptera: 9; 18 species new to the Suffolk list with significant records from the year 2001. *Transactions of the Suffolk Naturalists' Society* 38, 107–23

Robertson, J. 2019. Environmental assessment. In Westall & Chittock 2019, 59–61

Smith, D., Nayyar, K., Schreve, D., Thomas, R. & Whitehouse, N. 2014. Can dung beetles from the palaeoecological and archaeological record indicate herd concentration and the identity of herbivores? *Quaternary International* 341, 1–12

Smith, D., Whitehouse, N., Bunting., M.J. & Chapman, H. 2010. Can we characterize 'openness' in the Holocene palaeoenvironmental record? Modern analogue studies of insect faunas and pollen spectra from Dunham Massey deer park and Epping Forest, England. *The Holocene* 20(2), 215–29

Smith, D., Hill, G., Kenward, H. & Allison, E. 2020. Development of synanthropic beetle faunas over the last 9000 years in the British Isles. *Journal of Archaeological Science* 115, https://doi.org/10.1016/j.jas.2020.105075 [Accessed 05/05/2021]

Southwood, T.R.E. & Leston, D. 1959. *Land and Water Bugs of the British Isles*. London: Warne

Westall, S. & Chittock, H. 2019. *Land at the Transport Research Laboratory, Crowthorne, Berkshire: Post-excavation assessment report*. London: unpublished report AOC Archaeology Group

TABLE S.1. A TABLE OF INSECTS AND OTHER INVERTEBRATES RECORDED FROM THE SAMPLES

Feature	*Pit [6731]*	*Pit [6731]*	*Well [1543]*	*Well [1543]*
Context	*6742*	*6730*	*1551*	*1545*
Sample	*<26>*	*<3>*	*<14>*	*<13>*
Sample volume	*2.5L*	*2.5L*	*4L*	*5L*
CRUSTACEA				
Daphnia sp. ephippia	C	P	A	A
INSECTA				
DERMAPTERA (earwigs)				
Dermaptera sp. [u]	+	+	–	–
HEMIPTERA: HETEROPTERA (true bugs)				
Acanthosomatidae (shield bugs)				
Elasmucha grisea (Linnaeus) [oa-p-t]	–	1	–	–
Pentatomoidea sp. [oa-p]	–	2	1	–
Lygaeidae (ground bugs)				
Lygaeidae spp. [oa-p]	–	2	1	–
?Heteroptera sp. (water bug) [oa-w]	1	–	–	–
HEMIPTERA: HOMOPTERA				
Aphrophoridae (spittle bugs)				
Aphrophora alni (Fallén) [oa-p-t]	–	1	–	–
Cicadellidae (planthoppers)				
Megophthalmus sp. [oa-p]	–	2	–	–
Delphacidae (leafhoppers)				
Conomelus anceps Germar [oa-p]	1	–	–	–
Delphacidae spp. [oa-p]	–	2	–	–
Auchenorhyncha spp. [oa-p]	3	10	3	–
Psylloidea (jumping plant lice)				
Psylloidea sp. nymph skin [oa-p]	–	+	–	–
PHTHIRAPTERA (lice)				
Mallophaga sp.	–	+	–	–
COLEOPTERA (beetles)				
Dytiscidae (diving beetles)				
Agabus bipustulatus (Linnaeus) [oa-w]	1	2	1	1
Agabus or *Ilybius* spp. [oa-w]	–	3	1	–
Acilius cf *sulcatus* (Linnaeus) [oa-w]	–	1	–	–
Hydroporinae spp. [oa-w]	1	5	4	1
Dytiscidae spp. [oa-w]	–	1	–	–
Carabidae (ground beetles)				
Clivina sp. [oa]	–	1	–	–
Dyschirius globosus (Herbst) [oa]	–	–	1	–
Trechus obtusus or *quadristriatus* [oa]	1	1	–	–
Bembidion spp. [oa]	1	2	2	–
Pterostichus vernalis (Panzer) [oa-d]	–	–	1	–
Pterostichus madidus (Fabricius) [ob]	–	1	1	–
Amara ?ovata (De Geer) [oa]	1	–	–	–
Amara sp. [oa]	1	–	2	–
Harpalus rufipes (De Geer) [oa]	–	1	–	–
Acupalpus sp. [oa-d]	–	–	1	–

Bradycellus sp. [oa]	–	1	–	–
Calathus fuscipes (Goeze) [oa]	1	–	1	–
Calathus melanocephalus (Linnaeus) [oa]	–	1	1	–
Calathus sp. [oa]	1	–	–	–
Oxypselaphus obscurus (Herbst) [oa-d]	–	1	–	–
Calodromius spilotus (Illiger) [oa-t]	1	–	–	–
Dromius agilis (Fabricius) [oa-t]	–	1	–	–
Paradromius linearis (Olivier) [oa]	–	1	1	–
Microlestes or *Syntomus* sp. [oa]	–	1	–	–
Carabidae spp. and sp. indet. [ob]	1	4	3	3
Helophoridae (grooved water scavengers)				
Helophorus aequalis or *grandis* [oa-w]	–	–	4	–
Helophorus spp. [oa-w]	2	38	26	3
Hydrochidae				
Hydrochus angustatus or *nitidicollis* [oa-w]	1	9	1	–
Hydrophilidae				
Laccobius sp. [oa-w]	–	1	–	–
Hydrobius fuscipes (Linnaeus) [oa-w]	–	4	2	1
Anacaena globulus (Paykull) [oa-w]	–	3	–	–
Anacaena sp. [oa-w]	–	2	1	–
Hydrophilinae spp. [oa-w]	–	1	–	1
Cercyon haemorrhoidalis (Fabricius) [rf-sf]	–	1	1	–
Cercyon nigriceps (Marsham) [rf-st]	–	1	1	1
Cercyon pygmaeus (Illiger) [rf-st]	1	–	1	–
Cercyon analis (Paykull) [rt-st]	–	–	1	–
Cercyon sp. indet. [u]	–	1	–	2
Cercyon or *Megasternum* (rotted specimen) [u]	–	–	1	–
Megasternum concinnum (Marsham) [rt-sf]	–	1	3	1
Histeridae (clown beetles)				
Onthophilus striatus (Forster) [rt-sf]	–	–	1	1
Histerinae sp. [rt]	–	–	1	–
Hydraenidae				
Hydraena testacea Curtis [oa-w]	5	9	–	–
Hydraena spp. [oa-w]	–	–	–	–
Limnebius spp. [oa-w]	1	3	5	–
Ochthebius bicolon Germar [oa-w]	–	1	–	–
Ochthebius minimus (Fabricius) [oa-w]	–	1	3	–
Ochthebius sp. indet. [oa-w]	–	–	–	1
Ptiliidae (featherwing beetles)				
Ptenidium sp. [rt]	–	–	–	1
Acrotrichis sp. [rt]	–	1	–	1
Silphidae (sexton beetles)				
Phosphuga atrata Linnaeus [u]	–	1	–	–
Silphidae sp. and sp. indet. [u]	–	1	1	–
Staphylinidae (rove beetles)				
Dropephylla vilis (Erichson) [l]	1	–	–	–
Olophrum sp. [oa]	–	1	1	–
Lesteva longoelytrata (Goeze) [oa-d]	2	2	5	–
Omaliinae spp. [u]	–	3	1	–

Metopsia clypeata (Müller) [rt]	–	2	–	–
Micropeplus fulvus Erichson [rt-sf]	1	–	–	–
Pselaphinae spp. [u]	–	1	1	–
Sepedophilus sp. [u]	–	–	1	–
Tachyporus sp. [u]	1	2	1	–
Tachinus rufipes (Linnaeus) [sf]	–	–	1	–
Tachinus sp. and sp. indet. [u]	–	1	1	–
Cypha sp. [u]	1	–	–	–
Drusilla canaliculata (Fabricius) [rt]	1	–	–	–
Aleocharinae spp. [u]	3	10	6	–
Carpelimus sp(p). [u]	–	1	1	–
Platystethus cornutus group [oa-d]	–	–	1	–
Platystethus arenarius (Geoffroy in Fourcroy) [rf]	–	1	–	–
Anotylus nitidulus (Gravenhorst) [rt-d]	–	–	2	–
Anotylus rugosus (Fabricius) [rt-sf]	–	–	1	–
Anotylus sculpturatus group [rt-sf]	–	–	1	–
Stenus spp. [u]	2	–	1	–
Lathrobium spp. [u]	1	–	1	–
Gyrohypnus fracticornis (Müller)	–	1	–	–
Xantholinus sp. [rt]	2	–	1	–
Xantholinini sp. [u] (very large species)	–	–	1	–
Staphylininae spp. [u]	–	2	1	–
Geotrupidae (dor beetles)				
Geotrupinae sp. [oa-rf]	3	1	1	–
Scarabaeidae (dung beetles and chafers)				
Aphodius fimetarius (Linnaeus) [ob-rf]	1	–	1	–
Calamosternus granarius (Linnaeus) [ob-rf-sf]	–	–	3	–
Heptaulacus testudinarius (Fabricius) [oa-rf]	–	–	1	–
Melinopterus prodromus or *sphacelatus* [ob-rf]	–	–	1	–
Aphodiinae spp. [ob-rf]	2	2	–	3
Onthophagus sp. [oa-rf]	–	–	1	1
Serica brunnea (Linnaeus) [oa-p]	–	1	–	–
Phyllopertha horticola (Linnaeus) [oa-p]	1	1	1	–
Melalonthinae or Rutelinae sp. indet. [oa-p]	–	–	–	1
Scirtidae (marsh beetles)				
Contacyphon sp. [oa-d]	–	1	–	–
Byrrhidae (pill beetles)				
Simplocaria semistriata (Fabricius) [oa-p]	1	–	–	–
Elmidae (riffle beetles)				
Elmis aenea (Müller) [oa-w]	–	1	–	–
Dryopidae (long-toed water beetles)				
Dryops sp. [oa-d]	–	–	1	–
Elateridae (click beetles)				
Elateridae spp. [ob]	1	6	2	1
Elateridae sp. (larval apex) [ob]	–	+	–	–
Cantharidae (soldier beetles)				
Cantharidae spp. [ob]	–	1	–	–
?Cantharidae sp. [ob]	–	1	–	–
Bostrichidae (powderpost beetles)				

Lyctus linearis (Goeze) [l-st-h]	1	–	–	–
Ptinidae (spider and woodworm beetles)				
Ptinus fur (Linnaeus) [rd-sf-h]	1	–	–	–
Stegobium paniceum (Linnaeus) [rd-ss]	–	–	–	1
Anobium punctatum (De Geer) [l-sf]	1	–	–	–
Anobium ?punctatum (De Geer) [l-sf]	–	2	–	–
Anobium sp. indet. [l]	–	–	–	1
Monotomidae				
Monotoma picipes Herbst [rt-st]	–	–	–	1
Monotoma sp. [rt-st]	–	–	1	–
Phalacridae				
Phalacridae sp. [oa-p]	1	–	–	–
Nitidulidae (sap and pollen beetles)				
Carpophilus sexpustulatus (Fabricius) [u]	1	–	–	–
Meligethes sp. [oa-p]	–	1	4	–
Latridiidae (minute brown scavenger beetles)				
Enicmus sp. [rd-sf]	1	1	–	–
Corticaria ?punctulata Marsham [rt-sf]	–	1	1	–
Corticariinae spp. [rt]	4	–	–	–
Salpingidae				
Salpingus cf *planirostris* (Fabricius) [l]	–	1	–	–
Anthicidae (ant-like flower beetles)				
Omonadus floralis or *formicarius* (Goeze) [rt-st]	–	–	1	–
Scraptidae (false flower beetles)				
Scraptidae spp. [u]	–	1	–	–
Cerambycidae (longhorn beetles)				
Cerambycidae sp. [l]	–	1	–	–
Chrysomelidae (seed and leaf beetles)				
Crepidodera fulvicornis (Fabricius) [oa-p-t]	–	1	–	–
Chaetocnema concinna or picipes [oa-p]	1	–	–	–
Psylliodes sp. [oa-p]	1	–	–	–
Longitarsus sp. [oa-p]	–	1	–	–
Alticini sp. [oa-p]	–	–	1	–
Chrysomelidae spp. and sp. indet. [oa-p]	1	–	1	–
Apionidae				
Apionidae spp. [oa-p]	1	3	2	–
Erirhinidae (wetland weevils)				
Notaris acridulus (Linnaeus) [oa-p-d]	–	1	–	–
Curculionidae (weevils)				
Curculio sp. [oa-p-t]	–	1	–	–
Mecinini sp. [oa-p]	–	1	–	–
Orchestes sp. [oa-p-t]	–	1	–	–
Rhamphus sp. [oa-p-t]	–	1	–	–
Phyllobius glaucus (Scopoli) [oa-p-t]	–	1	–	–
Phyllobius or *Polydrusus* spp. [oa-p]	–	5	1	–
Entiminae sp.	–	–	–	1
Scolytus intricatus (Ratzeburg) [l]	–	–	1	–
Scolytus rugulosus (Müller) [l]	–	–	–	1
Curculionidae spp. and sp. indet. [oa-p]	1	4	3	1

?Curculionidae sp. [oa-p]	–	1	–	–
Coleoptera spp. and sp. indet. [u]	1	1	2	+++
DIPTERA (flies)				
Bibionidae sp. leg spine	–	+	–	–
Diptera spp. adults	+	–	–	–
Diptera spp. puparia	–	+	–	–
HYMENOPTERA (bees, wasps and ants)				
Formicidae spp.	–	+	–	–
Hymenoptera Parasitica spp.	+	++	+	+
SIPHONAPTERA (fleas)				
Pulex irritans Linnaeus [ss]	+	–	–	–
Siphonaptera sp. indet. body segments	–	–	+	–
TRICHOPTERA (caddis flies)				
Trichoptera sp. wing fragments	–	–	+	–
ARACHNIDA				
Acarina spp. (mites)	P	C	C	P
Aranae sp. (spiders)	–	P	P	P
TOTAL ADULT BEETLES AND BUGS	65	199	137	30
Concentration beetles and bugs per litre of sediment	26 litre–1	80 litre–1	34 litre–1	6 litre–1

Ecological codes shown in square brackets are: d – damp ground/waterside; h – house/building; l – wood/timber; oa – outdoor taxa not usually found within buildings or in accumulations of decomposing matter; ob – probable outdoor taxa; p – plant-associated; sf – facultative synanthropes; ss – strong synanthropes; st – typical synanthropes; t – tree-associated; u – uncoded; w – aquatic. Abundance of insects other than adult beetles and bugs has been estimated as + 1–3, ++ 4–10, +++ 11–50. Abundance of other invertebrates has been recorded as present (P), common (C) or abundant (A). see also Table 4.

APPENDIX S.2. BUCKLERS PARK: POLLEN ANALYSIS

(Suzi Richer)

Summary

Pollen was examined from the well in Area 2 at Bucklers Park, Crowthorne, Berkshire (NGR 484672, 165395). A 1.28 m sequence was examined from a well (Well 2) that measured 4.0 m wide by 1.50 m deep; subsamples were examined every 4.0 cm. The pollen was generally well preserved in high concentrations. The sequence spans from the Bronze Age to the medieval period and shows the landscape becoming increasingly open, but with periods of both increased human activity and woodland regeneration. Mixed woodland composed of alder, birch, lime, oak, and hazel pervaded at the start of the sequence in the Middle Bronze Age, however even at this time there is evidence of disturbance in the landscape and limited evidence for cereal agriculture. Human activity increases around 1000 cal BC seen through a rise in burning activity, limited evidence of agriculture, and a decline and the disappearance of small-leaved lime. Throughout the Iron Age the landscape continued to open up and evidence of cereal cultivation in the area is present. The late Roman/post-Roman period sees a temporary resurgence in tree pollen as secondary woodland takes over before a dramatic decrease in tree pollen and an increase in cereal pollen in the medieval period. The wooded landscape does not recover after this time; instead, the exploited (and likely degraded) soils allow for the expansion of heather in the area.

Aims

The initial pollen assessment (Westall & Chittock 2019) undertaken indicated the presence of well-preserved pollen from trees, shrubs, and herbaceous taxa, including indicators of aquatic environments from the deposits in Well 2 [1543] in Area 2. More detailed palynological analysis of these deposits will contribute to our understanding of the landscape surrounding the archaeological features and may detect more subtle anthropogenic signals through vegetation change in the local landscape and variations in microscopic charcoal occurrence.

Therefore, the aim of the pollen analysis undertaken here, in-line with Project Aim 1, which was specified in the Post-Excavation Assessment (Westall & Chittock 2019, 34), was to provide high-resolution vegetation information about the site, in particular relating to human activity. This increase in resolution was to be achieved by increasing the number of:

- subsamples analysed in the profile to a resolution of 4.0 cm
- land pollen grains counted within each subsample to a minimum of 300 land pollen grains, to observe rare pollen types
- radiocarbon dates, to allow the pollen to be discussed in both a temporal and spatial context (see Appx S.3).

These measures allowed a more detailed understanding of how the vegetation changed over time on the site, and importantly how these changes related to the excavated and dated archaeological features, allowing them to be further contextualised. This also gave the opportunity for the detection of any cereal agriculture, therefore permitting questions to be answered around the evidence (or lack of) for agriculture in the Bronze and Iron Ages, in line with Project Aim 3a, which was specified in the Post-Excavation Assessment (Westall & Chittock 2019, 36).

Methods

Sampling: Area 2 contained Well 2 (the feature of this analysis), measuring *c.* 4 m in diameter and *c.* 1.50 m in depth. This was established in the Middle Bronze Age and then re-established in the Iron Age; another possible well and a possible round house/penannular enclosure which dated to the Middle Iron Age were also located in Area 2 within 10 m of Well 2. Well 2 was sampled by the excavation team as Monolith 22, which was composed of seven 0.25 m monolith tins (Boxes 1–7). Subsamples at 4.0 cm resolution were provided by the AOC Archaeology; these were further cleaned (where necessary) by the author and submitted for preparation to the University of Aberdeen for pollen preparation.

The soils on the site consisted of loams and clays formed on sands, which are generally poor and can lead to the accumulation of surface water during the winter. The sediments in the well are a combination of sands, sandy silts, and clays; full sediment descriptions can be found in Westall and Chittock (2019). Context numbers for the fills of the well are marked on the pollen diagrams (Figs 10 & 11).

Three radiocarbon determinations have been used to provide an age-depth model for the well, and full discussion of these can be found in Appendix S.3. These determinations have provided modelled estimated dates for the following levels:

- 0.120–0.125 m: *cal AD 1030–1170* (*95% probability*; SUERC-90225)
- 0.750–0.755 m: *540–400 cal BC* (*95% probability*; SUERC-90226)
- 1.04–1.05 m: 1045–905 cal BC (*95% probability*; SUERC-90227).

Processing and analysis: Thirty-two subsamples were submitted to the laboratories of the Department of Geography & Environment, University of Aberdeen for chemical preparation. The full methodology is described on page 8. Nine of these initial subsamples were fully counted for this report.

An Olympus binocular polarising microscope was used for identification at ×400 magnification. The pollen reference manuals by Moore *et al.* (1991) and Beug (2004) were used to aid in pollen identification alongside the author's own reference collection. Nomenclature for pollen follows Beug (2004). Reference photographs and criteria from van Geel (1978) and van Geel *et al.* (2003) were used to aid in the specific identification of NPPs. Types of microscopic charcoal were identified according to Courtney Mustaphi and Pisaric (2014).

The results of the pollen analysis have been presented as percentage diagrams (Fig. 9) using Tilia 2.1.1 (Grimm 2017). The pollen from trees and shrubs and herbs have been presented as percentages of Total Land Pollen (TLP); this excludes spores, aquatics, non-pollen palynomorphs (NPPs), and microcharcoal, which have been calculated as a percentage of terrestrial pollen plus the sum of the component taxa within the respective category. The depth of the subsample depicted on the pollen diagram is the depth from the top of the monolith. An exaggeration factor of x2 has been applied as a shadow. Associated context numbers and estimated ages based on modelled radiocarbon dates (see Appx S.3) are marked on the pollen diagrams. The pollen diagrams have been divided into local pollen assemblage zones (LPAZ) using the programme CONISS (Grimm 1987) to create a stratigraphically-constrained cluster analysis for zonation.

Pollen results

The results of the initial pollen assessment, which included Well Mitigation 1 (Monolith/Box 27) and Well Mitigation 3 (Monolith/Box 39) can be found in Westall and Chittock (2019).

The pollen grains in most subsamples were well preserved and present in high concentrations. However, many grains were also folded and some were broken, suggesting that the grains had been physically transported or the sediments had been compacted and water extruded from them (Delcourt & Delcourt 1980).

Full counts (300 land pollen grains) were achieved for all samples.

The pollen diagrams shown in Figures 10 and 11 represent the pollen, NPPs, and other information analysed from monolith <22>. Pollen taxa are grouped into six categories to aid description and interpretation, comprising (1) trees and shrubs, (2) heaths, (3) herbs, (4) spores, (5) non-pollen palynomorphs (NPPs), and (6) microcharcoal. All the sequences are summarised below.

LPAZ CR-1, 1.28–1.10 m, CONTEXTS 1551 & 1550

Five subsamples form LPAZ CR-1. The pollen grains were well preserved with some being folded and faded, and the spike of broken grains at 1.16 m. Lycopodium spores (exotic marker added during preparations) was present in consistently high numbers suggesting that sedimentary build-up at this time was fairly slow.

The zone is characterised by high levels of tree and shrub pollen (70–83%), dominated by rising levels of *Betula* (up to 34%) and high but falling percentages of *Alnus* (33–17%). *Corylus* (7–14%), *Tilia* (12–5%), and *Quercus* (2–6%) are present continuously in this zone.

Heaths are represented by occasional pollen grains from *Calluna vulgaris* (≤1% TLP).

Herbaceous pollen is present in low amounts (16–30%) but is dominated by Poaceae (3–13%) and Cyperaceae (<1–15%). Other prominent herbaceous taxa include *Plantago lanceolata*-type (1–3%), *Crepis*-type (0–2%), and Chenopodiaceae (up to 1%). Rarer types (<1%) include: Apiaceae, Brassicaceae, *Centaurea jacea*-type, *Cerastium*-type, *Ranunculus acris*-type, *Senecio*-type, *Silene*-type, *Succisa*-type, and Urticaceae.

Cereal pollen is present in low amounts (<1%).

Polypodium spores are at their highest levels in this zone and are present along with *Pteridium* and indeterminate *Pteropside*. A chironomid mouth part was recorded in this zone along with the NPP *Valsaria*-type. Microcharcoal was at a low level.

LPAZ CR-2, 1.10–0.77 m, CONTEXT 1550, 1545 & 1555

Eight subsamples form LPAZ CR-2. The pollen grains in all subsamples were generally well preserved in high concentrations; many pollen grains were folded, but fewer were faded. Lycopodium was present in low numbers, suggesting that the sediments built-up relatively quickly in this zone.

This zone is characterised by high but falling levels of tree and shrub pollen (max. 94% min. 72%). *Alnus* (26–36%) and *Betula* (32–48%) continue to dominate the tree and shrub pollen. *Quercus* increases during this zone to a maximum of 15% before falling to a minimum of 3%. *Tilia* declines significantly to <1% and *Corylus* remains stable between 7–14%.

Herbaceous pollen fluctuates over the course of the zone, but gradually increases from a low of 6% to a high of 28%, this is composed predominantly of Poaceae (6–22%) and Cyperaceae (1.2%–5%). Other herbaceous taxa include *Plantago lanceolata*-type, *Crepis*-type, and Chenopodiaceae in amounts up to 1.6%. Rarer types (<1%) include: Apiaceae, Brassicaceae, *Centaurea jacea*-type, *Cerastium*-type, *Ranunculus acris*-type, Rhinanthus-type, *Senecio*-type, *Silene*-type, *Succisa*-type, and Urticaceae.

Cereal pollen is present in low amounts (<1%) and a single grain of *Triticum*/*Avena* pollen was observed at 0.84 m.

Polypodium and indeterminate *Pteropside* spores reduce in this zone compared to CR-1, and *Pteridium* remains present in the same proportions as the previous zone. *Sphagnum* appears for the first time in small numbers. The NPP *Sordaria*-type was present in low quantities. Microcharcoal from burning wood (rather than leaves or grasses) was present in sustained high levels during this zone.

LPAZ CR-3, 0.77–0.34 m, CONTEXTS 1544,1542, 1541, 1540 & 1539

Eleven subsamples form LPAZ CR-3 and two subzones have been defined within it: CR-3a (0.77–0.46 m) and CR-3b (0.46–0.34 m), with eight and three subsamples in each, respectively. The pollen grains in all subsamples were generally well preserved with a large number folded and some faded in the upper subsamples of this zone, particularly at 0.36 m. The number of lycopodium spores counted was relatively high in CR-3a, suggesting that sedimentation had become slower again in this zone in comparison to CR-2, but then quickened again in CR-3b.

This zone continues to be marginally dominated by tree and shrub pollen, contributing large fluctuations of between 36% and 80% of total land pollen, and herbaceous pollen contributes 14–68% of total land pollen. *Alnus* (min. 11%) and *Betula* (min. 6%) are both present in lower numbers in the first half of the zone (CR-3a) but recover to their former levels by the end of the zone (CR-3b), 20–35% and 22–42%, respectively. *Corylus* maintains a strong presence in the zone, with a peak of 32% in the middle of the zone. *Quercus*, *Tilia*, *Pinus sylverstris*, and *Ulmus* are present in trace amounts.

Heaths are represented by increasing levels of *Calluna vulgaris* (0–4% TLP).

Herbaceous pollen fluctuates over the course of the zone and gradually decreases at the top of the zone (CR-3b) to a range of 14–37%, from a high of 68%. Poaceae (4–29%) remains the dominant taxa, but Cyperaceae has spikes in this zone that reach a maximum of 36% of TLP. Other notable herbaceous taxa include *Plantago lanceolata*-type which has a 14% spike at 0.64 m and *Crepis*-type, which has a spike of 18% at 0.52 m – both taxa remain strong in the lower half of the zone (CR-3a) before dropping in numbers. Other herbaceous taxa include Apiaceae, *Artemisia*-type, Brassicaceae, *Centaurea jacea*-type, *Cerastium*-type, *Ranunculus acris*-type, *Rhinanthus*-type, Rubiaceae, *Rumex* sp., *Senecio*-type, *Silene*-type, *Succisa*-type, and Urticaceae.

Cereal pollen is present in low amounts (≤1%) and a single grain of *Triticum*/*Avena* pollen was observed at 0.52 m.

Polypodium, *Sphagnum*, and indeterminate *Pteropside* spores are present in very low amounts. *Pteridium* remains present in the same proportions as the previous zone, but after a peak in CR-3a it then disappears in CR-3b. NPPs are absent. Microcharcoal is present in very low amounts in CR-3a and then almost disappears in CR-3b.

LPAZ CR-4, 0.34–0.18 m, CONTEXT 1539

Four subsamples form LPAZ CR-4. The pollen grains in all subsamples were generally well preserved in high concentrations; many pollen grains were folded, but pollen grains ceased to be faded in this zone. Lycopodium was present in low numbers, suggesting that the sediments built-up relatively quickly in this zone.

This zone is characterised by falling levels of tree and shrub pollen (to a min. of 16%), *Alnus* falls to 5%, and *Betula* drops to 2%. *Corylus* also declines, but not as steeply, and ends the zone at 8%. *Quercus*, *Tilia*, and *Pinus sylvestris* are present in trace amounts.

Herbaceous pollen increases substantially over the course of the zone to a high of 80%; this is composed predominantly of Poaceae (max. 66%). The other main herbaceous taxa include *Plantago lanceolata*-type (1–4%), Cyperaceae (0–4%), *Crepis*-type (1–5%), *Ranunculus acris*-type (0–1.6%), and Chenopodiaceae (spike of 2.3%). Rarer types (<1%) include: Apiaceae, Brassicaceae, *Centaurea jacea*-type, *Cerastium*-type, *Filipendula*, Rhinanthus-type, Rubiaceae, *Succisa*-type, and Urticaceae.

Sphagnum, *Polypodium*, and indeterminate *Pteropside* spores disappear during the zone.

Cereal pollen increases throughout the zone to 4%. Microcharcoal is largely absent.

LPAZ CR-5, 0.18–0.04 m, CONTEXTS 1539 & 1513

Four subsamples form LPAZ CR-5. The pollen grains in all subsamples were generally well preserved in high concentrations; many pollen grains were folded and some were broken. Lycopodium was present in increasing numbers, suggesting that the sedimentation rate was slowing in this zone.

This zone is characterised by fluctuating, but generally declining, levels of tree and shrub pollen (27–74%). This is composed predominantly of *Corylus*, which is present in its highest amounts in this zone (16–57%). *Alnus* falls to 6–18% and *Betula* drops to its lowest amounts 3–4%. *Quercus*, *Tilia*, and *Pinus* sylvestris are present in trace amounts.

Calluna vulgaris dominates the non-tree and shrub pollen, rising to 54% of TLP by the top of the zone.

Herbaceous pollen drops considerably compared to previous zones, from 33% at the start of the zone to 6–8% over the rest of the zone. This is composed predominantly of Poaceae (22% dropping to 3–6%) and Cyperaceae (1–2%). The other main herbaceous taxa present across the zone include *Plantago lanceolata*-type (3% dropping to <1%), Chenopodiaceae (0–1%), and *Senecio*-type (<1%). The lowest subsample in the zone contained a variety of taxa in small amounts of <1%: Apiaceae, Brassicaceae, *Centaurea jacea*-type, *Crepis*-type, *Ranunculus acris*-type, and *Succisa*-type.

Sphagnum, *Polypodium*, and indeterminate *Pteropside* spores disappear during the zone.

Cereal pollen decreases during the zone (from 5% to 1%), with *Triticum*/*Avena* pollen being recorded in the lowest subsample (0.16 m). Microcharcoal has its largest spike at 0.08 m, however it is only present in low quantities on either side of this.

Discussion

The pollen diagram is likely to cover from the Bronze Age until the medieval period. A summary of the main pollen results and their interpretations can be found in Table 1; the interpretations are discussed in more detail alongside other evidence in the section below.

Pollen zone CR-1 has one radiocarbon date from within it (SUERC-90227), estimated to date to *1045–905 cal* BC (*95% probability*; see Appx S.3) and probably *1005–935 cal* BC (*68% probability*; see Appx S.3). During this zone the site was likely to have been within or close to woodland, composed of alder, birch, hazel, lime, oak, and ferns, with wet flushes around where sedges were established. The presence of the chironomid also attests to the damp nature of the area at this time. The woodland interpretation is largely consistent with the woodland plant remains found during the assessment phase in Area 1 (Westall & Chittock 2019) and pollen evidence seen at Wagbullock Bottom (Scaife & Allen 1992). Wagbullock Bottom is located approximately 3.5 km away from the site, where a former forest of oak, lime, alder, elm, and hazel existed into the later Bronze Age. Lime produces a lot of pollen in the summer and is insect-pollinated. The combination of these facts, especially that the pollen is produced when the tree is in full leaf, prevents much of the pollen reaching the ground, and those grains that do get through the canopy are relatively dense (compared to wind-pollinated grains), so they only fall close to the tree. Therefore, the high percentages of lime pollen suggest that it was growing locally at this time. Despite the landscape being largely wooded, there is some evidence for human activity at this time as well. This comes in the form of occasional cereal pollen grains, the disturbance indicator (plantain), and low levels of microcharcoal. The continual presence of alder throughout this zone (and subsequent zones) attests to the presence of locally wet, boggy ground, however, the oak and hazel pollen suggests the presence of well-draining soils. This combination of wet and dry land in close proximity to burnt mound sites has been found at other sites. For example, at Meriden in the West Midlands (Richer 2020) the main period of burnt mound activity was found to have occurred during a drier phase of a mainly wet landscape. Towards the top of the zone (context 1550) there is some evidence for a decline in alder, oak, and lime suggesting some temporary opening-up of the landscape around the site. This is also consistent with micromorphological results for this context (Westall & Chittock 2019), which suggest a surface cleared of vegetation. Whether this activity is associated with the burnt mounds in Area 2 is uncertain, but the pollen assemblage here is similar to other burnt mounds in England and Ireland (eg, Best *et al.* 2007; Brown *et al.* 2016; Mann & Jackson 2018). The key features are that they i) are located within damp areas often dominated by alder; ii) have evidence of cereal cultivation close by; iii) can have evidence of woodland regenerating after the use of the mound.

The Wagbullock Bottom pollen profile (Scaife & Allen 1992) primarily covers the period up to and including the Bronze Age, after this point hiatuses and compaction make specific interpretations more problematic. Therefore, the remaining Crowthorne sequence plays a key role in understanding the Bronze Age and post-Bronze Age landscape development in the area. CR-2 is likely to cover the mid–later Bronze Age and the first half of the Iron Age and is most likely to be contemporary with the other features in this area. After a brief increase in tree pollen, the rest of the zone shows the landscape was opening up again, as the tree pollen declines and the number of grasses increases. There is also a strong presence of microcharcoal throughout this zone, which is likely to be associated with the presence of people in the area. This is further supported by low levels of cereal pollen and a grain of wheat/oat at the top of the zone. This zone also witnesses a sharp decline in lime pollen and by 108 cm it has almost disappeared. This level has been estimated to date to *1180–905 cal BC* (*95% probability*; *Charcoal+*/*Tilia–*, see Appx S.3) and probably *1065–940 cal BC* (*68% probability*). Expansion of wetland areas and human clearance of trees are thought to be the primary reasons for the sudden decline in lime that is seen across Britain between the late Neolithic and late Bronze Age (Grant *et al.* 2011). Given the presence of microcharcoal and cereal pollen grains and the general lack of evidence suggesting an increase in wetness, an anthropogenic reason for the drop in lime pollen is most likely here. Interestingly, oak, alder, birch, and hazel values remain similar to the previous zone suggesting that lime trees may have been targeted or that it was more susceptible to the human changes in the landscape.

With a radiocarbon determination from the base of zone CR-3a providing an estimate of *540–400 cal BC* (*95% probability*; SUERC-90226, see Appx S.3) and probably *480–405 cal BC* (*68% probability*; SUERC-90226, see Appx S.3), this zone represents the later part of the Iron Age and probably the transition to the Roman period. At this time a distinct drop in woodland taxa occurs, especially alder and birch, and oak almost disappears, however hazel takes advantage of the canopy opening-up. Floristic diversity in the herbaceous taxa also increases, and indicators of disturbance such as plantain and goosefoot (Behre 1981) reach their highest levels here, alongside the presence of cereals suggesting that more activity was occurring here in the Iron Age in the form of clearance and agriculture. Interestingly, the microcharcoal levels, whilst still present, do decline in this period, suggesting that whilst burning activity was occurring, it was likely to be of a different nature/frequency or occurring further away compared to the Bronze Age burning activity.

CR-3b is likely to correspond to the later Roman period or the post-Roman period. Towards the end of this zone there appears to be a phase of scrubby woodland regeneration with birch and alder both expanding again. Cereal pollen temporarily disappears before making a slight resurgence, microcharcoal levels decline and disappear, and the indicators of disturbed ground seen in the previous zone all decline and/or cease to be present – this all suggests that people were not as active in this area to the point where trees could start to regenerate again. A regrowth in secondary woodland has been found across Europe (Roberts *et al.* 2018), which would suggest that the end of this zone corresponds to the post-Roman period.

Whilst zone CR-3b suggests that people had temporarily stopped, or dramatically reduced, using the area, the pollen evidence for medieval activity in zone CR-4 implies they came back with a vengeance. Over the course of the zone, tree pollen plummets to the lowest levels across the whole profile; even hazel shows a temporary decline here, though it survived well during previous periods of tree clearance. Other indicators of disturbance (whether by people or animals) are also high in this zone. Cereal pollen was also present in its highest levels here, suggesting that the primary economic use of the land was for agriculture.

CR-5 has a radiocarbon determination within the zone that places it within the medieval period *cal AD 1030–1170 cal BC* (*95% probability*; SUERC-90225, see Appx S.3) and probably *cal BC 1040–1095* (*68% probability*; SUERC-90225, see Appx S.3). During this period the landscape witnesses one of the largest changes in the vegetation composition, and unlike the earlier changes, tree cover does not spring back to former levels. Tree species and cereals all decline at this time, with the exception of alder, this suggests that damp patches remained close by. The main change to occur was the massive increase in heather, which had been present in small amounts from the late Iron Age but now starts to dominate the landscape. The soil is likely to have become degraded as deforestation occurred, therefore leaving the sandy acidic soils that are still present today, allowing heather to thrive.

Bibliography

Behre, K-E. 1981. The interpretation of anthropogenic indicators in pollen diagrams. *Pollen et Spores* 23, 225–45

Best, J., Gent, T., Bronk Ramsey, C., Brunning, R., Cook, G., Friendship-Taylor, D., Hamilton, W.D., Jones, J., Marshall, P.D., van der Plicht, H., Punti, I., Quinnell, H., Taylor, R. & Tyers, I. 2007. Bronze Age burnt mounds and early medieval timber structures at Town Farm Quarry, Burlescombe, Devon. *Archaeological Journal* 164(1), 1–79

Beug, H-J. 2004. *Leitfaden der Pollenbestimung*. Munich: Dr Friedrich Pfeil

Brown, A.G., Davis, S., Hatton, J., O'Brien, C., Reilly, F., Taylor, K., Dennehy, K.E., O'Donnell, L., Bermingham, N., Mighall, T., Timpany, S., Tetlow, E., Wheeler, J. & Wynne, S. 2016. The environmental context and function of burnt-mounds: New studies of Irish *Fulachtaí Fiadh*. *Proceedings of the Prehistoric Society* 82, 259–90

Courtney Mustaphi, C.J. & Pisaric, M.F.J. 2014. A classification for macroscopic charcoal morphologies found in Holocene lacustrine sediments. *Progress in Physical Geography: Earth and Environment* 38(6), 734–54

Delcourt, P. & Delcourt, H. 1980. Pollen preservation and Quaternary environmental history in the southeastern United States. *Palynology* 4, 215–31

Grant, M.J., Waller, M.P. & Groves, J.A. 2011. The *Tilia* decline: Vegetation change in lowland Britain during the mid and late Holocene. *Quaternary Science Reviews* 30, 394–408

Grimm, E.C. 1987. CONISS: A FORTRAN 77 program for stratigraphically constrained cluster analysis by the method of incremental sum of squares. *Computers & Geosciences* 13, 13–35

Grimm, E. 2017. Tilia and TGView 19 version 2.1.1. software. Springfield IL: Illinois State Museum Research and Collection Center

Mann, A. & Jackson, R. 2018. *Clifton Quarry, Worcestershire. Pits, Posts and Cereals*: *Archaeological investigations 2006–2009.* Oxford: Oxbow Books

Moore, P.D., Webb, J.A. & Collinson, M.E. 1991. *Pollen Analysis*. 2nd edn. Oxford: Blackwell Scientific

Richer, S. 2020. *Analysis of pollen from Meriden Quarry, Solihull, West Midlands*. Kendal; unpublished report 20/04, Richer Environmental

Roberts, N., Fyfe, R.M., Woodbridge, J., Gaillard, M.-J., Davis, B.A.S., Kaplan, J.O., Marquer, L., Mazier F., Nielsen, A.B., Sugita, S., Trondman, A-K. & Leydet, M. 2018. Europe's lost forests: A pollen-based synthesis for the last 11,000 years. *Nature Scientific Reports* 8(716), doi:10.1038/s41598-017-18646-7

Scaife, R.G. & Allen, M.J.A. 1992. *Wagbullock Bottom, Crowthorne: Vegetational and land-use history*. Salisbury, unpublished report 33815, Wessex Archaeology

van Geel, B. 1978. A palaeoecological study of Holocene peat bog sections in Germany and the Netherlands. *Review of Palaeobotany and Palynology* 25, 1–120

van Geel, B., Buurmanb, J., Brinkkemper, O., Schelvis, J., Aptroot, A., van Reenen, G. & Hakbijl, T. 2003. Environmental reconstruction of a Roman Period settlement site in Uitgeest (The Netherlands), with special reference to coprophilous fungi. *Journal of Archaeological Science* 30(7), 873–83

Westall, S. & Chittock, H. 2019. *Land at the former Transport Research Laboratory, Crowthorne, Berkshire: Post-Excavation Assessment Report*. London: unpublished report AOC Archaeology Grup

Pollen preparation method: floatation method for pollen preparation using sodium polytungstate
(Timothy Mighall)

Protective clothing must be worn throughout the procedure. Breathing masks must be used when making up Sodium polytungstate.

This process is carried out in a fume hood and uses:

- 10% HCl and NaOH: this is an irritant and may cause burns. If spilt on skin or splashed in eyes, wash with copious cold running water and seek medical advice.
- Acetic acid: this is highly corrosive and harmful in contact with skin. Spills and splashes should again be washed with running water. Acetic Anhydride/Sulphuric acid is volatile when mixed with water. These may cause severe burns when in contact with skin or splashes in eye. Again use copious cold, running water to rinse and seek medical advice. Sodium polytungstate should be disposed of by storing in a waste bottle and dispose of using a recognised waste disposal company.

1. Take large, round-bottomed, screw-capped tubes and add 1–3 g of sample to them, make a note of amounts used.
2. Add 1 lycopodium tablet to each tube along with a small amount of distilled water.
3. When tablet fully dissolved, vortex and add 10% NaOH.

HUMIFICATION

4. Tubes are then placed in a hot water bath for 20 minutes.
5. Tubes are then centrifuged at 3800 rpm for 3 minutes and decant supernatant.
6. Add a small volume of distilled H2O and sieve into a beaker. Wash tube and sieve through with more water.
7. Centrifuge, decant, and wash with distilled water twice more.
8. Add 10% HCl to residue and again place in the water bath for 3 minutes. Vortex, centrifuge, and decant.
9. Wash, centrifuge, and decant.
10. Add approximately 5 ml of Acetic acid; vortex and centrifuge again.

ACETOLYSIS (WEAR MASKS)

11. Make up acetolysis mixture. Add 6 ml of Sulphuric Acid to 54 ml of Acetic Anhydride; slowly and carefully stir. This is a 1:9 mixture ratio.
12. Add this mixture to tubes and place in a boiling water bath for 2 minutes.
13. Top up tubes with glacial Acetic Acid, then centrifuge, decant into beaker containing acetic acid.
14. Wash, centrifuge, and decant twice more. Transfer residue to small, clear, round-bottomed tubes.
15. Make up sodium polytungstate solution in a plastic beaker. Add 56 g of sodium polytungstate to 44 ml of distilled water; stir until dissolved. Wear face mask and gloves.
16. Add 6 ml of polytungstate solution to each tube. Mix and centrifuge for 20 minutes.
17. Pipette off the supernatant from round-bottomed tubes into conical tubes already containing distilled water.
18. Centrifuge for 10 minutes at 2500 rpm. Decant.
19. Wash, spin, and decant twice more.

DEHYDRATION

20. Transfer residue into microfuge tubes, centrifuge, and decant 3000 for 5 minutes.
21. Add 100 ml ethanol; stir, centrifuge, and decant.
22. Add TBA, stir, centrifuge, and decant.
23. Pour off TBA and add a layer of silicon oil; leave alcohol to evaporate overnight.

APPENDIX S.3. BUCKLERS PARK: RADIOCARBON DATING AND BAYESIAN MODELLING
(Derek Hamilton)

Twelve radiocarbon results are available from excavations at Bucklers Park, Crowthorne, Berkshire. The samples were comprised of charcoal, waterlogged wood, and organic sediment. The samples were submitted for radiocarbon dating at the Scottish Universities Environmental Research Centre (SUERC). The samples were pre-treated and measured by accelerator mass spectrometry (AMS), following the methods of Dunbar *et al.* (2016). The SUERC lab maintains rigorous internal quality assurance procedures, and participation in international inter-comparisons (Scott 2003) indicate no laboratory offsets, thus validating the measurement precision quoted for the radiocarbon ages.
The results are presented (Table 3) as conventional radiocarbon ages (Stuiver & Polach 1977). In the modelling, they have been calibrated using the internationally agreed terrestrial calibration curve (IntCal13) of Reimer *et al.* (2013) and the OxCal v. 4.3 computer program (Bronk Ramsey 2009). Simple calibrated results are presented in plain text and rounded outward to 10 years. The *italicised* dates presented in the text below are posterior density estimates derived from mathematical modelling of archaeological problems and have been rounded outward to five years. These dates can change with the addition of new data or when the modelling choices are varied.

Methodological approach
A Bayesian approach has been applied to the interpretation of the chronology of some of the Middle Bronze Age activity at Crowthorne (Buck *et al.* 1996). Although simple calibrated dates are accurate estimates of the radiocarbon age of samples, this is not, usually, what archaeologists really wish to know. It is the dates of the archaeological events represented by those samples that are of interest. At Crowthorne, for example, it is the start and end of the associated activity that is of interest. The chronology of this activity can be estimated not only by using the absolute dating derived from the radiocarbon measurements, but also by using the stratigraphic relationships between samples and the relative dating information provided by the archaeological phasing.
Methodology is now available which allows the combination of these different types of information explicitly, to produce realistic estimates of the dates of archaeological interest. It should be emphasised that the posterior density estimates produced by this modelling are not absolute. They are interpretative estimates, which can and will change as further data become available and as other researchers choose to model the existing data from different perspectives. The technique used is a form of Markov Chain Monte Carlo sampling and has been applied using the program OxCal v. 4.3 (http://c14.arch.ox.ac.uk/). Details of the algorithms employed by this program are available in Bronk Ramsey (1995; 1998; 2001; 2009) or from the online manual. The algorithm used in the models can be derived from the OxCal keywords and bracket structure shown in Figure 12.

The samples and models
The excavation and radiocarbon dating at Crowthorne can be defined as four discrete areas for consideration – Areas 1, 2, and 3, and the pollen sequence. The radiocarbon dating is presented below spatially related to these areas, and with the later prehistoric dates in Area 1 and the pollen sequence subsequently modelled within OxCal v. 4.3.

Area 1: There are four radiocarbon dates available from features in Area 1. The samples were associated with either a well (SUERC-77774 and -80280) or a burnt mound (SUERC-88430) and trough (SUERC-88431). The two samples from the well [6731] were initially considered to have a stratigraphic relationship. SUERC-80280 is from a birch ladder <6749> in the well, while SUERC-77774 is from a fragment of charcoal in the well fill (6733). The fill is actually earlier than the ladder and suggests the charcoal and associated sediment are redeposited from earlier activity on site. As such, no stratigraphic relationship is modelled. However, the four dates can be modelled together, following the simple Bounded Phase model described in Hamilton and Kenney (2015), to provide a robust date for the associated later prehistoric activity in Area 1. The model has good agreement (Amodel=104) and estimates the activity here started in *1815–1410 cal BC* (*95% probability*; Fig. 12; *start: Area 1 later prehistoric*), and probably in *1565–1435 cal BC* (*68% probability*). The activity ended in *1405–970 cal BC* (*95% probability*; Fig. 12; *end: Area 1 later prehistoric*), and probably in *1375–1215 cal BC* (*68% probability*). The overall temporal span of this dated activity was *35–765 years* (*95% probability*; Fig. 15; *span: Area 1 later prehistoric*), and probably *95–360 years* (*68% probability*).

Area 2: Six radiocarbon dates come from features in Area 2. Three of these dates are on single fragments of charcoal from the fill (1545) of well [1543] (SUERC-77775) and the primary fill (1535) of pit [1514] (SUERC-88432 and -88433). Additionally, there are three measurements (SUERC-90225–7) on the humic fractions of highly organic sediment samples from within well [1543]. The aim of these samples was to provide a chronology for the pollen analysis through the feature.

The two results from pit [1514] are statistically consistent (T'=3.2; ν=;1 $T'(5\%)$=3.8; Ward & Wilson 1978) and could be the same actual age. The later date (SUERC-88433) provides the best estimate for the date of this feature in either 360–280 cal *BC* (37% probability; Fig 12; SUERC-88433: 1535) or 260–90 cal BC (58% probability).

The charcoal sample from well [1543] produced a Bronze Age result (Fig 12; SUERC-77775: 1545) in the 14th–12th century cal BC, whereas the sediment sequence within which it was recovered dates from the 11th century cal BC to the medieval period. The charcoal corresponds to a depth of ~94 cm in the pollen sequence, which would equate to the Early Iron Age. Given the nature of the deposit and the likelihood that residual fragments of charcoal could be incorporated into the fills, this result is excluded directly from the age-depth model that was created for the sequence of dates on organic sediment. The age-depth model follows the approach laid out in Bronk Ramsey (2008), and most of the samples derived from the sediment at the depth of particular interest. The lowest result (SUERC-90227) came from a depth of ~105 cm, yet a rise in charcoal and rapid decrease in Tilia were noted at 108 cm, so the age-depth model provides an estimate for when that 'event' occurred.

At 108 cm depth there is a rise in charcoal and the disappearance of Tilia, suggesting the landscape was being opened up at this time. The modelling estimates this occurred in *1180–905 cal BC* (*95% probability*; Fig. 16; *Charcoal+/Tilia–*), and probably in *1065–940 cal BC* (*68% probability*). There are further indicators of increasing human activity from about 75 cm depth. From here all the tree species, with the exception of hazel, decrease dramatically while there is a rise in Plantago. This period of deforestation and disturbance begins in *540–400 cal BC* (*95% probability*; Fig. 16; *SUERC-90226: 75–75.5 cm*), and probably *480–405 cal BC* (*68% probability*). The well continued infilling throughout the Iron Age and Roman periods with the sample from near the top of the sequence at 12 cm indicating that for all intents and purposes it was completely infilled by *cal AD 1030–1170* (*95% probability*; Fig 16; *SUERC-90225: 12–12.5 cm*), and probably either *cal AD 1040–1095* (*52% probability*) or *cal AD 1120–1160 (16% probability).*

Area 3: There are two radiocarbon dates in Area 3. The first (SUERC-78139) is on a fragment of alder charcoal in recovered from the charcoal-rich upper fill (54113) of well [54108]. This result calibrates to 790–540 cal BC (95% probability; Fig. 12; SUERC-78139: 54113). The second (SUERC-89310) is on a fragment of oak charcoal that was recovered from the fill (54110) of the trough [54104] of a burnt mound. The single measurement on oak charcoal, which has not been clearly identified as roundwood or blocky heartwood, provides a *terminus post quem* for the infilling of this feature in or after 1890–1740 cal BC (95% probability; Fig. 12; SUERC-89310: 54110).

Bibliography

Bronk Ramsey, C. 1995. Radiocarbon calibration and analysis of stratigraphy: The OxCal program. *Radiocarbon* 37, 425–30

Bronk Ramsey, C. 1998. Probability and dating. *Radiocarbon* 40, 461–74

Bronk Ramsey, C. 2001. Development of the radiocarbon calibration program. *Radiocarbon* 43, 355–63

Bronk Ramsey, C. 2008. Deposition models for chronological records. *Quaternary Science Reviews* 27, 42–60

Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51, 337–60

Buck, C.E., Cavanagh, W.G. & Litton, C.D. 1996. *Bayesian Approach to Interpreting Archaeological Data.* Chichester: Wiley

Dunbar, E., Cook, G.T., Naysmith, P., Tripney, B.G. & Xu, S. 2016. AMS ^{14}C dating at the Scottish Universities Environmental Research Centre (SUERC) Radiocarbon Dating Laboratory. *Radiocarbon* 58, 9–23

Hamilton, D. & Kenney, J. 2015. Multiple Bayesian modelling approaches to a suite of radiocarbon dates from ovens excavated at Ysgol yr Hendre, Caernarfon, North Wales. *Quaternary Geochronology* 25, 72–82

Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Buck, C.E., Cheng, H., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, I., Hatté, C., Heaton, T.J., Hoffmann, D.L., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., Manning, S.W., Niu, M., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Staff, R.A., Turney, C.S.M. & van der Plicht, J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon* 55, 1869–87

Scott, E.M. 2003. The Third International Radiocarbon Intercomparison (TIRI) and the Fourth International Radiocarbon Intercomparison (FIRI) 1990–2002: Results, analysis, and conclusions. *Radiocarbon* 45, 135–408

Stuiver, M. & Polach, H.A., 1977. Reporting of ^{14}C data. *Radiocarbon* 19, 355–63

Ward, G.K. & Wilson, S.R. 1978. Procedures for comparing and combining radiocarbon age determinations: A critique. *Archaeometry* 20, 19–32

APPENDIX S.4. BUCKLERS PARK: THE WOOD ASSEMBLAGE

(Anne Crone & Alex Wood, with species identifications by Jackaline Robertson)

Seventeen small finds of wood were recovered from well [6731] in Area 1, ranging from the notched log ladder to bags of small splinters and woody debris. The assemblage is catalogued below. Several finds were considered suitable for dendrochronological analysis and the results are also presented. In the summary, the assemblage is placed in context.

6730; roundwood fragments

Item 6730 consists of a collection of nine fragmentary pieces of oak (*Quercus* sp.) roundwood and 19 roundwood fragments/splinters. The largest piece of roundwood present is 245 mm long and 35 mm in diameter. None of the fragments bear any evidence of woodworking.

6732; plank fragment

Item 6732 survives as a damaged oak plank fragment which has been radially split. It measures 210 mm long, 125 mm wide, and 18 mm thick. A small area of bark edge survives. On the interior face there is a possible blade facet.

6733; splinters and fragments

Item 6733 consists of a collection of roundwood splinters (50%), flat fragments (30%), and larger oak fragments (20%). The roundwood splinters are all birch (*Betula* sp.), and the largest is 193 mm long and 35 mm in diameter. There are nine thin, flat fragments, also of birch, which probably formed a radially split plank with maximum dimensions of length 158 mm, width 54 mm, and thickness of 8 mm. The oak fragments are the remains of a single radially split plank, the largest fragment of which is 0.58 m long, 50 mm wide, and 20 mm thick. None of the wood in this collection bears woodworking marks, although the radially-split oak planks had clearly been converted from the round.

6735; stake

Item 6735 is an oak roundwood stake, 0.665 m long, cleft from a quarter section of roundwood. In cross-section the stake is triangular, with a maximum width of 85 mm. The bark edge survives on the exterior surface, but no bark is present. One end is pointed, with one clear facet present, but heavy charring for 250 mm from the tip up the length of the stake obscured any further woodworking marks.

6736; stake

Item 6736 is an oak roundwood stake, 0.635 m long, cleft into a quarter section from a log roughly 110 mm in diameter. In cross-section the stake is roughly triangular, with faces 50–56 mm in width. The bark edge is present, although no bark remains. The ridge running down the interior face marks the pith at the centre of the log. The stake is charred at its tip and for some 75–210 mm up its length, thus obscuring any woodworking marks. However, one facet can be seen at the tip. The stake seems to have warped slightly down its length, causing it to bow slightly.

6737; stake

Item 6737 is as an oak roundwood stake, slightly degraded forming an amorphous shape in cross section. The grain orientation suggests it was converted by cleaving a log radially with some facets demonstrating further work to roughly point one end. The stake is 0.55 m long with a maximum width of 55 mm. The stake is charred on one face and in patches near the tip.

6738; stake
Item 6738 consists of a radially split stake, roughly triangular in profile, cleft from a small diameter oak roundwood. It is 355 mm long with a maximum width of 50 mm. One end is slightly pointed, but there are no clear woodworking marks due to some minor charring. There are some possible degraded facets on the cleft faces.

6739; plank
Item 6739 survives as a flat plank-like piece, likely from a single radially split timber. It is 0.58 m long, 210 mm wide, with a maximum thickness of 18 mm. The plank is in a very dried out condition, with numerous splits down its length. It was too dried out to be able to identify the wood to species.

6740; cleft fragment
Item 6740 consists of a single cleft piece of oak 125 mm long, 100 mm wide, and 50 mm thick. Although there were no woodworking marks present, the outer edge and one end appear to have been dressed roughly square. This may be an offcut from a larger plank. There were some small, localised areas of charring on one face.

6741; plank
Item 6741 is a fragmented radially split oak plank. It consists of one large intact piece 190 mm long, 115 mm wide and 8 mm thick. There are >20 small fragments which are all likely to be from the same original plank.

6747; cleft splinter
Item 6747 is a radially cleft splinter of birch 342 mm long, 78 mm wide, and 28 mm thick. There are possible woodworking facets at one end.

6748; plank
Item 6748 contains a single large fragment of birch 0.67 m long, 200 mm wide, and 35 mm thick and eight smaller fragments. The plank appears to have been radially split, with bark edge present along one edge. One face is heavily charred, and there is some charring around the decayed end. There are no woodworking marks present.

6749; log ladder (Fig. 5)
The largest and most significant object in the assemblage is a log ladder which survives in four pieces. It is 2.23 m long overall and has been fashioned from a birch log with a diameter of 210 mm. The log splits into two branches at one end and these have been used to create stabilising legs, 0.51 m and 0.425 m long, and 120 mm and 170 mm in diameter, respectively. The branches have been heavily modified by axe to taper them and form flat ends. The back of the log has been dressed to a flat surface, presumably to help prevent the ladder rolling from side to side, while the front of the log has been left undressed, possibly to allow the largest possible depth for the steps.

The main shaft of the ladder is 1.715 m long and three notched steps have been carved into the outer surface. The lowermost step is cut some 0.62 m above the branch junction and some 1.13 m above the tips of the branches. This suggests that the branches, or legs, were inserted fully into the ground leaving a height of only 0.62 m from step to ground. The second step lies some 360 mm above the lower step and the uppermost step some 385 mm above that. The upper part of the ladder is very decayed, but there is no evidence that there had been another step.

The three steps have been fashioned by chopping perpendicularly into the log and then cleaving from above to carve out a step. This has left an abundance of small chopmarks in the angle at the back of the tread. The steps are all between 50 mm to 55 mm deep and the wood has been cleft out to a height of 360 mm to 385 mm above the step.

The lower half of the ladder is in the better condition, presumably because it remained below the standing water table, while the upper half was exposed to increasingly aerobic conditions. Consequently, the toolmarks are better preserved on the lower half. However, although there were many facets, no complete blade profiles were identified. The largest surviving facet identified was 50 mm across.

6750; degraded roundwood
Item 6750 consists of a very degraded oak fragment, probably cleft off a larger radially split piece, with numerous smaller fragments. The largest fragment is 130 mm long, 90 mm wide, and 35 mm thick.

1562; roundwood fragments
Item 1562 consists of 10 small fragments of oak roundwood, with bark surviving on some pieces. The two largest fragments join to form a fragment 210 mm long and 25 mm in diameter. All the fragments probably originated from the same length of roundwood.

1564; fragments
Item 1564 consists of a selection of small highly desiccated wood fragments. Due to their condition, it is not possible to discern conversion or species.

15101; fragmentary stake
Item 15101 is a highly decayed oak roundwood stake in 18 pieces with additional smaller fragments. The maximum length of the largest fragment is 230 mm with a width of 35 mm. The original stake length was potentially up to 370 mm. There are no clear signs of woodworking amongst the fragments.

Dendrochronology
The assemblage contained four pieces of oak which were considered suitable for dendrochronological analysis (Table 2). None retained their outermost rings, either because they had been trimmed off or had decayed. Although the two stakes, 6735 and 6736, were small, they were slow-grown with a similar growth-rate to the offcut, 6740. In contrast, the plank 6732 was relatively fast-grown.

The four sequences were compared against each other. This produced only one acceptable correlation, between 6735 and 6736 (t= 4.33) and a sub-chronology, *35_36 mn*, 76 years long was constructed. The subchronology *35_36 mn* was compared with all available prehistoric chronologies in England, but this did not produce any significant correlations and so it remains undated. This is probably because *35_36mn* is a short, poorly replicated sequence (ie with only two components) and dendrochronological coverage in the Bronze Age is patchy (Cathy Tyers pers. comm.).

Summary
The most significant object in the assemblage is the ladder, which appears to have been *in situ* lying up against the sides of the well. It has been radiocarbon-dated to 1114–1263 cal BC (3074 ± 28; SUERC-80280). Ladders with simple notched steps down one face seem to have been the commonest design for accessing field wells and waterholes during the Bronze Age and Iron Age in England, many of which have been revealed in recent years during large open-area excavations for major housing and infrastructure projects (ie Allen 2010, 11–15).

The species of wood used varied. For instance, there are Bronze Age ladders of hazel and maple from Briggs Farm, Priors Fen (Bamforth 2011), and alder ladders are known from Fengate (Pryor 1978) and Heathrow T5 (Allen 2010, 11, 14). A ladder of poplar/willow was found at the Early Iron Age 'marsh fort' of Sutton Common, South Yorkshire (Parker-Pearson & Sydes 1997, 233–4; Fig. 14). However, oak was probably the species most commonly used. While the non-oak ladders were all fashioned from roundwood logs, both oak roundwood and cleft oak had been used. Examples include a Late Bronze Age ladder of oak roundwood from Eight-Acre Field, Radley, Oxfordshire (Taylor 1995), a Middle Bronze Age ladder of radially-cleft oak from Bishops Cleeve, Gloucestershire (Bamforth 2020), and a

Middle Bronze Age/Late Bronze Age ladder of quartered oak from Heathrow T5 (Allen 2010, 12). Two large 2.5 m long ladders of radially-cleft oak with notches cut regularly into one split face were found in an Iron Age pit at Milton Keynes (Crank 2013), while a cleft half-log of oak had been used to make a notched ladder in an Iron Age waterhole at Turing College, University of Kent, Canterbury (Goodburn 2020).

The forked base of the Bucklers Park ladder is unusual. Most of the examples mentioned above have bases which have been sharpened to a point, presumably for insertion into the base of the well or waterhole. The ladder from Bishops Cleeve had a blunt base, but it had been set into a small stone-filled pit to ensure stability (Bamforth 2020).

Apart from the ladder, the assemblage consists of debris apparently thrown into the well. The only species present are oak and birch, oak accounting for two-thirds of the assemblage and birch for a third. Many of the finds are of the category of unworked woody debris frequently found in ditches and wells, but there are also some groups of finds which display distinctive characteristics. One such group includes 6735, 6736, 6737, and 6738 which are all stakes cleft from small oak roundwood with simply facetted tips and charring on and above the tips. Stakes are common finds in waterholes (cf Allen 2010) and may originally have formed part of the lining or shoring of the holes. There are also a handful of radially-cleft oak fragments, ie 6732, 6740, and 6741 which might represent woodworking offcuts from the working of larger timbers. Some of the birch has also been radially split, such as the plank 6740 and splinter 6747; the latter might also be a woodworking offcut.

Bibliography

Allen, S. 2010. Woodworking technology. In J. Lewis, M. Leivers, L. Brown, A. Smith, K. Cramp, L. Mepham & C. Phillpotts, *Landscape Evolution in the Middle Thames Valley: Heathrow Terminal 5 Excavations Volume 2 (CD-Rom)*, Section 11. Oxford/Salisbury: Framework Archaeology Monograph 3

Bamforth, M. 2011. Appendix 5: The wood. In A. Pickstone & R. Mortimer, *The Archaeology of Brigg's Farm, Prior's Fen, Thorney, Peterborough, Project Report*, 38–46. Cambridge: unpublished report, Oxford Archaeology

Bamforth, M. 2020. Appendix K: Waterlogged worked wood. In J. Hart, T. Havard & P. Guarino, *Cleevelands (Phase 1a/2a, Phase 1-4b, Pond D, Swales), Bishop's Cleeve, Glos: Archaeological Excavation*, 233–45. Cirencester: unpublished report, Cotswold Archaeology

Crank, N.A. 2013. Archaeology in Milton Keynes 2012. *South Midlands Archaeology* 43, 27–8

Goodburn, D. 2020. Late prehistoric woodwork. In R. Lane, *An Iron Age enigma. Archaeological excavations at Turing College, Canterbury, Kent, 2013*, 195–201. Canterbury: Canterbury Archaeological Trust Technical Report 3

Parker Pearson, M. & Sydes, R. 1997. The Iron Age enclosures and prehistoric landscape at Sutton Common, South Yorkshire. *Proceedings of the Prehistoric Society* 63, 221–59

Pryor, F.M.M. 1978. *Excavation at Fengate, Peterborough, England: The second report*. Toronto: Royal Ontario Museum Archaeology Monograph 5

Taylor, M. 1995. The worked wood. In A. Mudd, The excavation of a Late Bronze Age/Early Iron Age site at Eight-Acre Field, Radley, 40–1. *Oxoniensia* 60, 21–65