SECTION 3

ENVIRONMENTAL EVIDENCE

CHAPTER 15

THE ANIMAL REMAINS

By Claire Ingrem with a contribution by Kate Clark

A considerable quantity of animal bone was recovered from late Iron Age deposits in Insula IX. This area has been the focus of continuing investigation since 1997 and, consequently, some of the material recovered from the Roman phases of occupation has already been published (Ingrem 2006; 2011; 2012).

This report considers the animal remains recovered from the late Iron Age pits, wells and Ditch 11631, all of which are associated with the earliest phase of occupation at the site. Later material which had slumped into the pits and wells was excluded from the analysis; however, it is possible that the top of the ditch was truncated by features that were not identified during excavation and, as a result, the ditch material may contain some bone that is intrusive (p. 17).

METHODOLOGY

Anatomical elements were identified to species where possible with the exception of ribs and vertebrae which were assigned to animal size categories. Mandibles and limb bones were recorded using the zonal method developed by Serjeantson (1996) to allow the calculation of the minimum number of elements (MNE) and individuals (MNI); this is based on the most numerous zone of a single element taking into account side. Percentage survival of selected elements is based on the minimum number of elements (MNE) calculated as a percentage of the maximum number possible according to MNI. In order to visually assess the expected survival these elements have been listed in their expected order of survival taking into account bone density, element size and the age of the animal when the epiphysis fuses following the method of Grant (2000). In addition, all bone fragments over 10 mm in the hand-recovered material and over 2 mm in the sieved samples were recorded to species or size category to produce a basic fragment count of the Number of Identified Specimens (NISP). Fragments categorised as large mammal are likely to belong to horse or cattle, those in the medium mammal category to sheep/goat or pig.

A selected suite of elements was used to consider the spatial representation of carcass units as follows: head — mandible, atlas and axis; major limbs — scapula, humerus, radius, ulna, pelvis, femur and tibia; feet — astragalus, calcaneus, metapodials and phalanges.

The presence of gnawing and butchery together with the agent responsible was recorded. Evidence for burning was also noted but should be treated with caution as bones can become stained black and brown by other processes such as waterlogging (Lyman 1994).

Measurements were taken according to the conventions of von den Driesch (1976) and Bull and Payne (1982) for mammals, and Cohen and Serjeantson (1986) for birds. The wear stages of the lower cheek teeth of cattle, caprines and pig were recorded using the method proposed by Grant (1982) and age attributed according to the method devised by Payne (1973), Legge (1982) and Hambleton (1999). The fusion stage of post-cranial bones was recorded and age ranges estimated according to Getty (1975). Measurements of the crown height of horse teeth were recorded and age estimated according to the method of Levine (1982).

A selected suite of elements was used to differentiate between sheep and goat (Boessneck 1969; Payne 1985): the distal humerus, proximal radius, distal tibia, distal metapodials, astragalus, calcaneus and deciduous fourth premolar. No elements were positively identified to goat, so for the purposes of this report the caprine remains are referred to as sheep.

CONDITION OF THE BONE AND TAPHONOMY

In order to estimate the potential of an assemblage to provide taphonomic information, the condition of the bone is graded on a scale of 1 to 5. That assigned to '1' is deemed to be in excellent condition, demonstrating little post-depositional damage, whilst bone material classed as '5' has suffered severe surface erosion and can be identified only as 'bone'. The condition of the bone recovered by hand from late Iron Age deposits at Silchester is given in Table 17 and shows that the majority of the assemblage is in poor (Grade 4) or moderate (Grade 3) condition. Consequently a lower proportion of the assemblage is likely to preserve evidence for gnawing and butchery than is the case for other assemblages from Silchester and sites where enhanced conditions for bone preservation existed.

The survival of bone is generally density dependent and consequently species and anatomical representation will almost certainly have been biased as a result of the various taphonomic processes that seek to destroy bone from the moment it is deposited. In particular, the bones of smaller animals such as sheep and pig are less likely to survive than those derived from larger animals such as horse and cattle. Bones that are comprised of dense cortical bone such as limb-bone shafts are also more likely to survive than those comprised of cancellous bone such as limb-bone ends, ribs and vertebrae. Similarly, porous juvenile bones are likely to have suffered preferential destruction.

TABLE 17. CONDITION OF THE HAND-COLLECTED BONE ACCORDING TO FEATURE OR PIT GROUP (NISP)

Condition	Well 8328	Well 10421	Well 13965	PG1	PG2	PG3	PG4	PG5	PG6	PG7	PG8	PG9	PG10	PG11	PG12	PG14	Ditch 11631	Total
1																		
2	18	19	3	16												1		57
3	21	85	20	51	2	158	11			11	16	153	129	25	11	158	317	1168
4	5	7		96	14	46	15	8	7	16	20	49	156		12	98	166	715
5	2				13			4	7	1	1	1					4	33
Total	**46**	**111**	**23**	**163**	**29**	**204**	**26**	**12**	**14**	**28**	**37**	**203**	**285**	**25**	**23**	**257**	**487**	**1973**

DATA

TAXA REPRESENTATION

A total of 7,815 pieces of animal bone was collected by hand of which 23 per cent are identifiable (Appendix 5, Table 72i). Cattle remains comprise more than half (57 per cent) of the assemblage and are more than twice as numerous as sheep (27 per cent) whilst pig specimens are relatively scarce. A small number of bones (1 per cent or less) belong to horse, dog and galliform; one bone probably belongs to woodcock (*Scolopax rusticola*). The only other species present is rabbit (*Oryctolagus cuniculus*), but this is probably intrusive. The largest sample came from Ditch 11631, although the pits and wells that comprise Pit Groups 1, 3, 9, 10 and 14 all produced more than a hundred identifiable specimens.

The sieved samples contain 26,430 fragments of bone but only a very small proportion (2 per cent) is identifiable (Appendix 5, Table 72ii). In contrast to the hand-collected assemblage, sheep (38 per cent) and pig (32 per cent) are present in similar frequencies and are more numerous than cattle (22 per cent), thus providing a clear indication of the effects of recovery bias on taxa representation. Horse is represented by two specimens. In addition, odd bones belong to galliform, thrush (*Turdidae spp.*), house mouse (*Mus musculus*), frog (*Rana spp.*) and salmonid. The largest identifiable samples came from Well 10421, Pit Groups 3 and 9 and Ditch 11631.

Sixteen articulating or paired specimens were recovered by hand collection and two came from the sieved samples. They have been included in Table 72 but are listed separately in Table 74 according to the Pit Group to which they belong.

Cattle

The cattle assemblage consists of 1,026 specimens recovered by hand collection and a further 87 pieces from the sieved samples (Table 72i). According to NISP, elements from most parts of the body are present (Table 75), although mandibles, metapodials (metacarpals and metatarsals) and 1st phalanges are particularly numerous. Isolated teeth are also numerous which probably reflects preservation conditions since enamel is generally denser than bone. Calculation of the minimum number of elements indicates that a minimum of 14 individuals are represented (Table 73) and suggests that in addition to metapodials, scapulae and humeri are relatively frequent. Two articulating cattle bones, an astragalus and a calcaneus, came from layer 9592 in Pit 8580 (Pit Group 14).

The percentage survival of selected elements is shown in FIG. 125i with the bones listed in descending order according to the likelihood of their surviving the effects of density-mediated taphonomic processes. Once again this indicates that some elements, most notably scapulae, mandibles, astragali, distal metatarsals, distal radii, distal femora and 1st and 2nd phalanges are over-represented. Other elements such as distal tibiae, proximal radii, pelves, proximal femora, proximal tibiae and proximal humeri are under-represented.

According to tooth eruption and wear a large proportion (41 per cent) of cattle were slaughtered between the ages of 26 and 36 months when they would have produced prime beef (Table 76ii). A large proportion (45 per cent) also survived past three years and more than half of these were quite old (6–8 years) when they died. Bone fusion data similarly indicate that almost half of the cattle remains are from animals slaughtered before they reached three years and that a good proportion survived into adulthood (Table 77i).

Evidence for gnawing is preserved on a few bones (<1 per cent; Table 78i). A higher proportion (4 per cent) display evidence for butchery in the form of cut and chop marks with cuts more numerous than chops (Table 78ii). A similar proportion is burnt (Table 78iii).

The relative frequency of cattle, sheep and pig in the various wells and pit groups is shown in FIG. 126 and indicates that there is considerable variation across the trench. Pit Group 2, which is located close to Ditch 11631, is virtually dominated by the remains of cattle with sheep and pig scarce and a similar pattern was noted in Well 8328 situated in the North-Western Compound. Cattle also display high frequencies (*c.* 60–75 per cent) in Pit Groups 1, 4 and 7 which lie in the middle to north-western area of the trench. In contrast, cattle are particularly scarce (<25 per cent) in Pit Group 3 and Wells 10421 and 13965 which are located further south or east.

In order to investigate disposal patterns selected elements were grouped into carcass units and those samples containing more than 20 specimens from individual Object groups are displayed in FIG. 127. Most groups contain similar frequencies of head, major limbs and feet, although foot bones are noticeably more numerous in Pit Group 1 which is located in the northern part of the site. The highest frequency of major limbs occurs to the south in Pit Group 3 where the sample is composed almost entirely of major limbs and feet with cranial bones virtually absent. Heads are better represented in Pit Group 10, located in the eastern part of the settlement, at the expense of major limb bones.

Metrical data are given in Table 79 and where possible have been compared to measurements held on the Animal Bone Metrical Archive Project (ABMAP). Most fall within the ranges recorded at contemporary sites, although there are several exceptions. For instance, an astragalus has a greatest length 2.3 mm smaller and a greatest medial length smaller by 1.4 mm. A metacarpal has a proximal breadth 3.4 mm smaller whilst the same measurement taken on another specimen is 1.9 mm larger. Smaller measurements were also recorded for the breadth at the point of distal fusion on two specimens with the largest discrepancy 3.6 mm smaller than previously recorded. Two metatarsals are also fairly small having proximal breadths 1.2 mm and 1 mm smaller than specimens held on ABMAP. Several scapulae are quite small with one specimen having a breadth

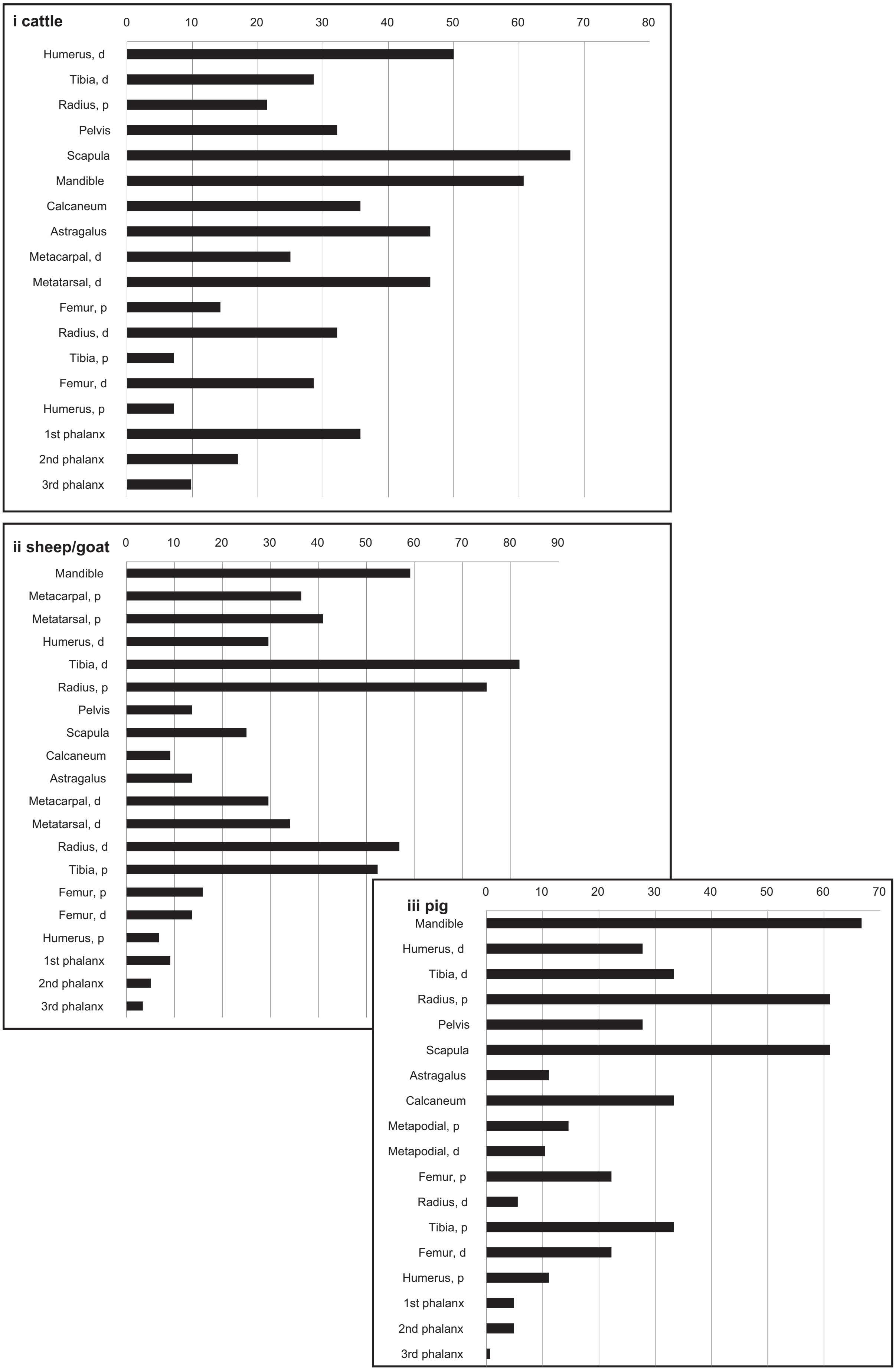

FIG. 125. Percentage survival of anatomical elements for major taxa.

of the glenoid cavity 0.5 mm smaller and another specimen a glenoid cavity 3.1 mm shorter than previously recorded.

Withers height has been calculated from the greatest length of a metacarpal using the mean value of the factors given by Matolsci (in von den Driesch and Boessneck 1974) for cows and steers; this indicates that one cow or steer stood approximately 1.08 m at the shoulder.

Sheep

According to fragment counts sheep remains are much less numerous than cattle with the hand-collected assemblage comprising 493 specimens and the sieved samples a further 150 pieces (Table 72). There is a discrepancy between the NISP and MNE (Table 73) figures with the latter indicating that sheep were more numerous than cattle (MNI 22 individuals) which can probably be explained, at least in part, as the result of preservation bias. An articulating humerus and radius were recovered from the same context (9592) in Pit 8580 (Pit Group 14) that produced the articulating cattle bones.

Elements from most parts of the body are represented, with tibiae, radii and mandibles the most numerous bones (excluding teeth) according to both fragment counts and the calculation of MNE (Tables 73 and 75). These are particularly dense elements and so their abundance is unsurprising, especially as preservation bias in favour of the densest elements is once again indicated by a relatively high frequency of loose teeth. Percentage survival of selected elements is shown in FIG. 125ii and this also indicates that tibiae and radii are present in greater numbers than would be expected in an assemblage affected solely by density-mediated taphonomic processes. In contrast, proximal metacarpals and metatarsals, distal humeri, pelves, scapulae, astragali and calcanei are all under-represented, so clearly other factors have affected body part representation.

Tooth eruption and wear data display two peaks in the ages at which sheep were slaughtered — between 12 and 24 months (34 per cent) and between three and four years (34 per cent). There is no evidence for foetal/neonatal lambs, but a small proportion died in their first year and some survived into adulthood (Table 76iii). Epiphyseal fusion data generally support this pattern (Table 77ii).

Only one specimen preserves evidence for gnawing (Table 78i). A few bones (1 per cent) display butchery marks with cuts more frequent than chops (Table 78ii). A higher proportion (10 per cent) are burnt, either calcined or charred (Table 78iii).

Comparison of the relative frequencies of the major domestic mammals indicates that sheep

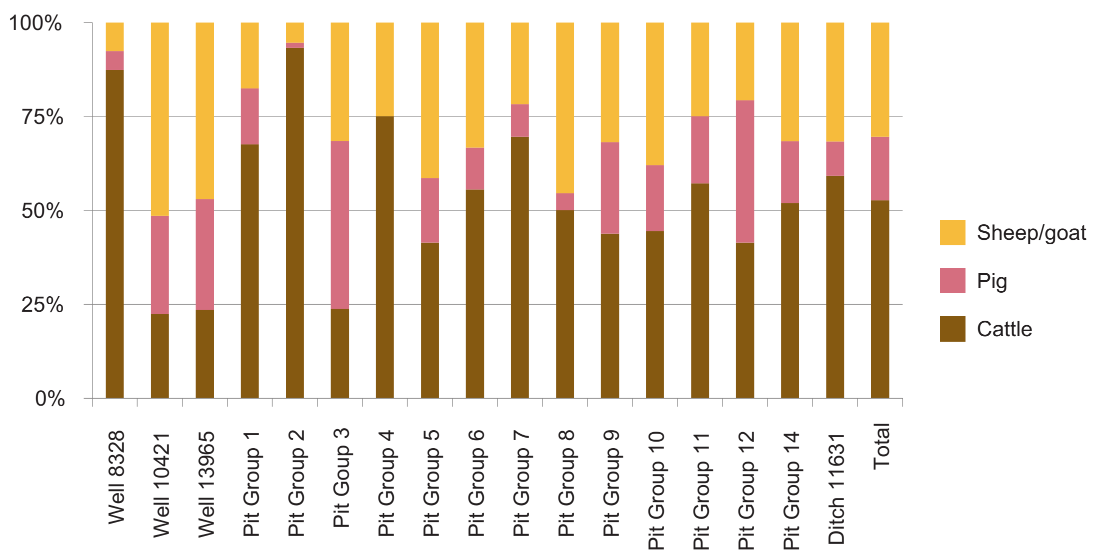

FIG. 126. Representation of major taxa according to feature or pit group (NISP).

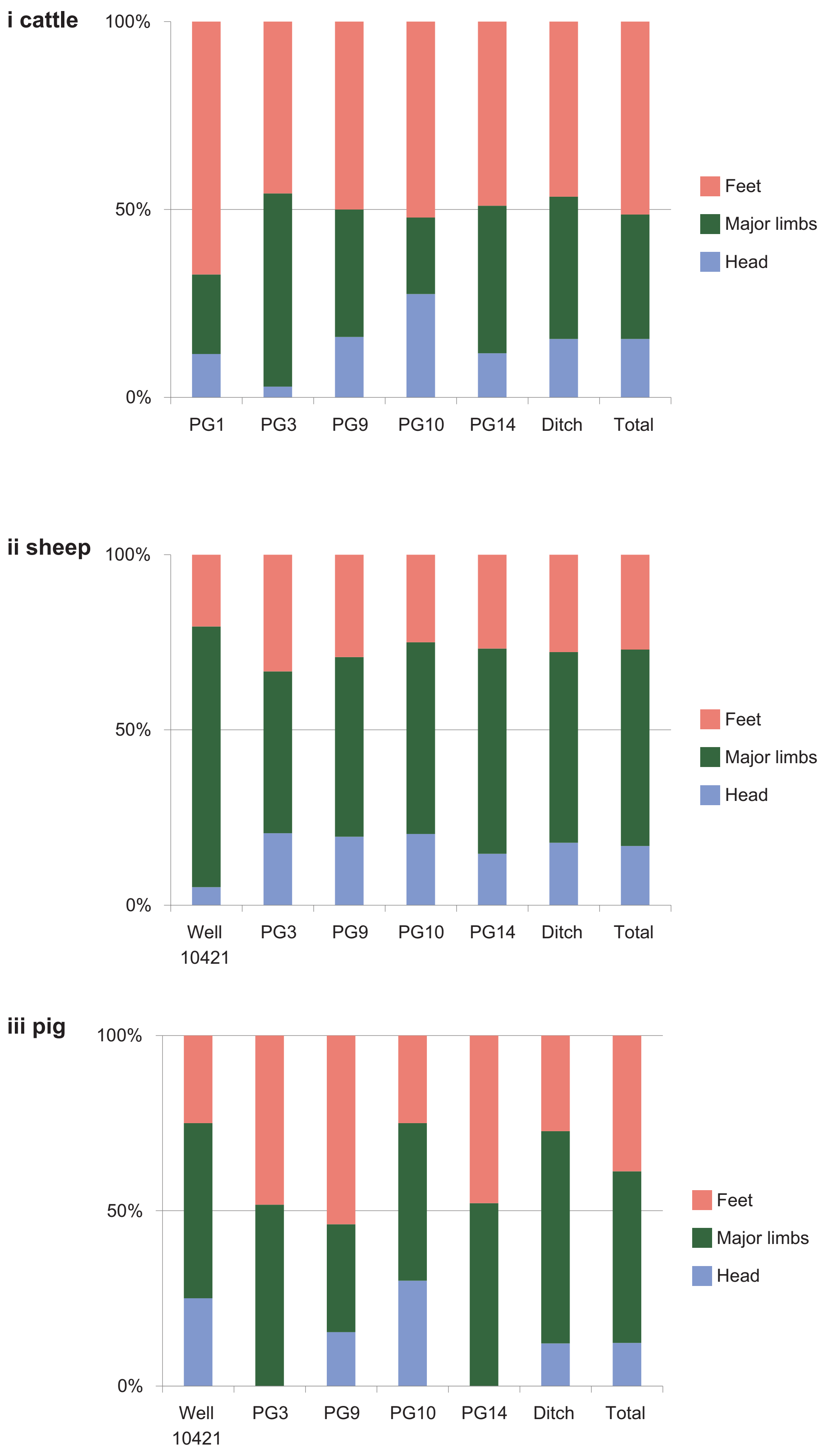

FIG. 127. Carcass unit representation (% NISP).

are particularly common in Wells 10421 and 13965 where they comprise *c.* 50 per cent according to NISP. Caprines are also noticeably common in Pit Groups 5 and 8; however, this could be a function of sample size since both are relatively small (n=22, n=29). The lowest frequencies of sheep occur in the cattle dominated pits that make up Pit Groups 1 and 2.

A consideration of the spatial distribution of carcass units indicates that most groups contain a mixture of body parts. However, there is some variation across the site with limb bones noticeably more frequent in Well 10421, whilst extremities display the highest frequency in Pit Group 3 located in the southern area close to Ditch 11631 (FIG. 127ii).

Metrical data are given in Table 79 and, where possible, have been compared to measurements held on the ABMAP. Most fall within the ranges recorded at contemporary sites, although the distal breadth of one tibia is 0.4 mm smaller than previously recorded.

Pig

The hand-collected assemblage produced 227 pig specimens and the sieved samples 126 pieces (Table 72). The NISP and MNI data both indicate that pig is the least numerous of the major domestic animals (cattle, sheep, pig) with a minimum of nine pigs represented (Table 73). Two articulating metatarsals came from Pit 17317 (16698) in Pit Group 9 and a pair of calcanei were recovered from Ditch 11631 (11592).

Most parts of the pig skeleton are represented, with mandibles more numerous than any other bone according to NISP (Table 75). The calculation of MNE suggests that radii and scapulae are equally abundant (Table 73) and percentage survival shows proximal radii and scapulae to be over-represented (FIG. 125iii). Calcanei, proximal tibiae and femora are also fairly numerous whilst most other elements are relatively scarce.

The small sample of dental data indicates that most pigs were slaughtered between 14 and 36 months (Table 76iv), whilst bone fusion suggests most pigs died before they reached two years of age (Table 77iii). Twenty-four canines provide an indication of sex and of these 14 belong to boars and 12 to sows.

Ten specimens preserve evidence for gnawing (Table 78i). Butchery marks, both cuts and chops, are visible on a small number of bones (Table 78ii). A much larger proportion (12 per cent) is burnt, mostly calcined (Table 78iii).

Consideration of the distribution of cattle, sheep and pig across the site (FIG. 126) indicates that Pit Group 3 produced an unusually high frequency (*c.* 40 per cent) of pig. Further east, Pit Group 12 also produced more than twice the average proportion. In contrast, and as with sheep, pig is particularly scarce in the cattle-dominated Pit Group 2; they are also scarce in Pit Group 8 which produced similar quantities of cattle and sheep remains.

There is some spatial variation in the frequency of carcass units (FIG. 127iii). Head bones are most frequent in Pit Group 10 and absent from Pit Groups 3 and 14. Major limbs are relatively more frequent in Ditch 11631 than they are in any of the pit groups, whilst feet are particularly frequent in Pit Group 9.

Two bones display evidence for pathology: a metapodial and a pelvis which has osteophytes on the ilium.

Metrical data are given in Table 79 and where possible have been compared to measurements held on the ABMAP. Most fall within the ranges recorded at contemporary sites, although three radii have proximal breadths smaller than previously recorded, in one case by as much as 1.6 mm.

Minor domestic animals

Twenty-two horse bones were recovered by hand and a further two pieces were retrieved from the sieved samples (Table 72). More than half the remains are loose teeth, although most parts of the body — head, major limbs and feet — are all represented (Table 75). Dental data indicate that the teeth derive from horses aged between 5 and 12 years (Table 76i). One horse bone preserves evidence for gnawing (Table 78i). A humerus recovered from Well 10421 has several transverse and oblique cut marks on the anterior distal shaft and an upper molar is charred (Table 78iii). Most of the specimens came from ditch deposits except for a lower premolar, an astragalus, tibia and 1st phalanx which came from Pit Group 4, and the butchered humerus and a metapodial found in Well 10421.

A miniature dog burial recovered from the lower fill of Pit 12746 (12751) associated with Iron Age Structure 9 was examined and reported on by Kate Clark (see pp. 274–6). This specimen is not included in the general tables but the findings are presented at the end of this report and metrical data are given in Table 79. In addition, 12 dog bones were recovered by hand collection and one came from the sieved samples (Table 72) with elements from most parts of the skeleton represented (Table 75). One bone has been gnawed and two are burnt. Pit Group 14 produced three specimens — a canine tooth, a radius and an ulna — whilst another radius and a tibia came from Pit Group 10 and single specimens were recovered from Pit Groups 1, 3, 9 and 14. Well 8328 produced a parietal and maxilla possibly belonging to a single skull, whilst Well 10421 contained a mandible and lower molar. An articulating radius and ulna display evidence for pathology in the form of osteophytes on their proximal anterior articulations and these came from Pit 8580 (9592). This deposit also produced articulating cattle and sheep remains.

Eight galliform bones were recovered by hand and an additional two specimens came from the sieved samples. The assemblage includes upper and lower fore and hind limbs and several pieces of sternum. A tarsometatarsus with a spur most probably belongs to a male and two femora contain medullary bone so probably belong to hens in lay. One specimen has been gnawed and another is calcined. Four specimens came from Pit 15142 (15140) in Pit Group 10, including a pair of humeri, one of which has transverse cut marks on the distal posterior shaft. A few odd bones came from Pit Groups 3 and 14 and Well 10421.

Wild animals

The single rabbit bone came from the ditch and is almost certainly intrusive. The only other wild animal bone recovered by hand is a carpometacarpus which belongs to a wader, probably a woodcock (*Scolopax rusticola*); it was recovered from Pit 8580 in Pit Group 14.

The sieved samples produced evidence for a few other wild animals. Pit 11670 (11669) produced a carpometacarpus belonging to a thrush. A house-mouse mandible came from Pit 11026 (11603) and a frog ilium came from Pit 9606 (9622), both in Pit Group 14. The thrush and frog are burnt, but whether this is the result of a deliberate act or an accident is uncertain. Toad (*Bufo bufo*) remains were found in Well 10421 which, as with the other amphibian and rodent remains, most probably represent pit-fall victims.

The only evidence for fish is a salmonid vertebra, the size of which is comparable to trout (*Salmo trutta*); it was recovered by sieving from Pit 17317 (16698) in Pit Group 9. Trout were probably available in local rivers; however, it is uncertain if this specimen is present at Silchester as a result of human activity or was discarded by a non-human piscivore.

DISCUSSION AND INTERPRETATION

ANIMAL HUSBANDRY PRACTICES

The late Iron Age assemblage from Insula IX is clearly dominated by the remains of the three major domestic animals, a pattern which is usual for a site of this period. Cattle are the dominant species according to fragment count, although calculation of the minimum number of elements and individuals, which takes into account the effects of fragmentation, indicates that sheep may have been more abundant. This discrepancy is probably related to the generally poor condition of the assemblage since small bones and bones belonging to relatively small animals will have been preferentially destroyed. Consequently it is almost certain that sheep and pigs were originally present in greater numbers than their remains suggest. A comparison of species representation with the Period 1 assemblage recovered from late Iron Age deposits at the forum basilica (Grant

2000) using fragment counts indicates the two assemblages are very similar. Three methods of quantification were used by Grant (2000, 246) to investigate species frequency and in this case, all produced similar results, suggesting that preservation conditions varied across the settlement and that, overall, most of the meat eaten at the settlement came from cattle.

Considerable research into Iron Age husbandry regimes in Britain has been carried out by Hambleton (1999) who subdivided the country into six geographical regions in order to investigate regional patterning. Silchester is located in the northern part of the region of Wessex and central southern England close to the border with the Thames Valley region, an area in which late Iron Age and Roman settlements are fairly common. In contrast to the pattern evident at Silchester, sheep outnumber cattle at many Wessex sites, including Danebury (Grant 1984), Winnall Down (Maltby 1985), Balksbury (Maltby n.d.) and Old Down Farm (Maltby 1981) in Hampshire. This is perhaps unsurprising since much of the region consists of chalk downland which produces relatively poor grassland and has scattered water sources so is better suited to raising sheep than cattle, since the latter require better quality grass and more water. Support for a generally high incidence of sheep is provided by the work of Hambleton (1999, 46) who notes that the general pattern for Wessex is a high proportion of sheep (40–70 per cent), moderate amounts of cattle (20–50 per cent) with pigs scarce (<25 per cent). In terms of taxa representation, the Silchester assemblage has more in common with assemblages recovered from the Thames Valley region where cattle are better represented. For instance, the rural sites of Ashville (Wilson *et al.* 1978) and Barton Court Farm (Wilson 1986) in Oxfordshire both produced higher frequencies of cattle than most Wessex sites, although sheep are still more abundant than they are at Insula IX or the forum basilica area (Grant 2000, 426) of Silchester (FIG. 128). Despite these variations in species representation, husbandry strategies are thought to have been fairly similar in both regions, with cattle providing the bulk of the meat (Hambleton 1999).

Pigs are also generally better represented at Silchester than at many other late Iron Age sites in the region, including the hillfort at Danebury. An increase in the consumption of pork is often thought to reflect continental influences, especially during the Roman period. However, high proportions of pig are also associated with high-status settlements and feasting activities; pork is often considered a luxury food as pigs provide little in the way of secondary products, other than manure and bristles, so are kept primarily for meat. In this respect it is interesting that, as Grant (2000, 443) noted, the *oppidum* at Skeleton Green, Herts. (Ashdown and Evans 1981), produced an even higher frequency of pigs than Silchester and, consequently, an abundance of pigs might reflect the comparative wealth and importance of *oppida* compared to farming settlements. At most of the Wessex settlements mentioned above, there appears to be little change in species

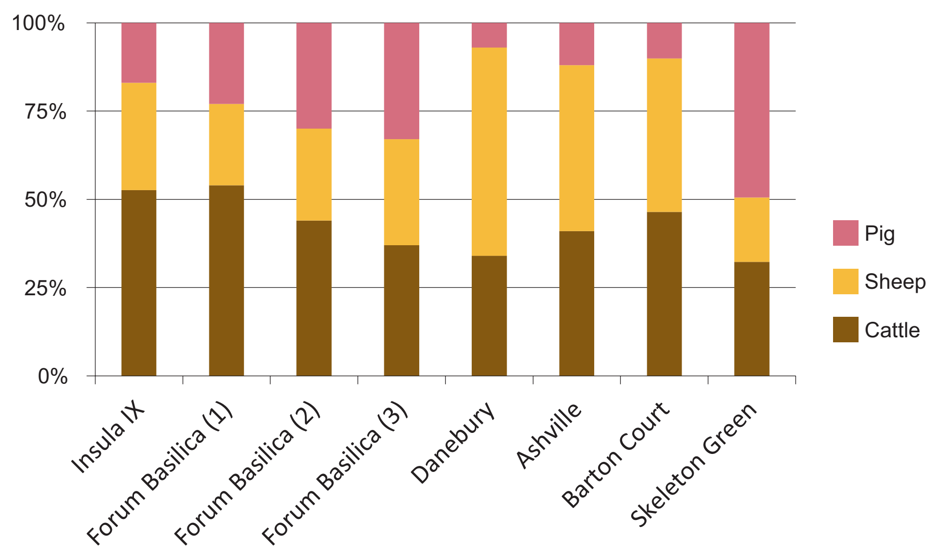

FIG. 128. Representation of major domestic species at selected sites (% NISP).

exploitation from the late Iron Age to the early Roman period (Hambleton 1999, 46) and at the time of writing this also seems to have been the case at Silchester. However, at Insula IX a higher incidence of pig was recorded in the early Roman period and was thought to reflect differential disposal (Ingrem 2012, 187), but as more recent analysis of the material from Period 1 indicates an increase in the consumption of pork, this may reflect continuity with the late Iron Age.

Mortality profiles indicate that cattle were important providers of both meat and secondary products (milk, traction, manure), a pattern that is seen at contemporary sites in central southern England (Hambleton 1999, 81). Those slaughtered between two and three years of age would have provided prime beef; older animals also provided meat but only after they had been exploited for other resources. Some of the older cattle may have been valued as providers of milk but the scarcity of young calves, which would have been slaughtered in order to maximise the amount of milk available for human consumption, suggests that dairying was not practised on a large scale at Silchester. Of course, juvenile remains are particularly porous and therefore less likely to survive than adult bones so this might also account for their scarcity. However, a similar pattern was seen in the better preserved early Roman assemblage (Ingrem 2012), suggesting that calving took place away from the settlement up until the mid-Roman period when the higher incidence of both calves and older adults is more suggestive of dairying. The possibility that dairy produce was not routinely consumed at late Iron Age Silchester should also be considered since the results of organic residue analysis carried out on the Period 0 ceramic vessels at Insula IX (Ch. 10) found no isotopic evidence for the use of milk or dairy products. This contrasts with results recorded at some other late Iron Age settlements in the region such as Danebury, where, in addition, the high level of infant mortality is more indicative of dairying (Hambleton 1999, 81). The apparent scarcity of dairy products at Silchester is difficult to explain although, as classical sources (White 1970, 277–8) indicate that cattle milk was unpopular, it might reflect a pre-conquest Roman influence on dietary preferences at the settlement. Whilst there is no evidence for dairying at Silchester itself, much of the beef came from older cattle that would have previously been exploited, if not for milk, as breeding stock and for traction and manure in order to improve arable production. A dependence on beef from mature cattle was apparent in the assemblage recovered from the area of the forum basilica (Grant 2000, 445) and is supported by Hambleton's review (1999, 81) which indicates that in Wessex cattle husbandry was geared toward more than just beef production. At Insula IX, in addition to meat from mature cattle, a good proportion of beef came from prime-aged animals and this might represent animals supplied by sites in the Upper Thames valley where there was a greater emphasis on beef production (ibid., 82).

Sheep were an integral part of Iron Age farming practices, especially in central southern England where they were often associated with, and complemented, arable production (Hambleton 1999, 87) as they could be allowed to graze on stubble and arable fields near settlements in the autumn with the added benefit of manuring them. The sheep represented in the Insula IX assemblage reflect their value as providers of both good quality meat and also secondary products. Those slaughtered in their second year would have reached a reasonable carcass weight and provided good quality mutton so would have been kept primarily to provide good quality meat. Sheep that survived into their fourth year also provided mutton, but by this age they would have already provided several fleeces as well as manure, whilst the ewes may have been milked; clearly secondary products were sufficiently important to the economy to warrant over-wintering a good proportion of the flock. The late Iron Age assemblage from the forum basilica also indicated that mutton was derived from sheep of various ages. Once again this conforms to the general pattern of sheep mortality recorded from Iron Age sites (Hambleton 1999, 70) and it is possible that some of the sheep represented at Silchester were supplied by rural farmsteads. The late Iron Age pattern also compares well with that evidenced during the early Roman period when most mutton was derived from sheep aged between one and four years of age (Ingrem 2012, 192). A low neonatal and infant mortality rate is a common characteristic of Iron Age sheep assemblages and might indicate that spring lambing also took place away from the settlement, perhaps in the surrounding fields. Alternatively, it might be explained as the result of preservation bias.

As discussed above, pigs provide little in the way of secondary products so they are kept primarily to provide meat. Animals which are surplus to breeding requirements are generally slaughtered once they have reached a good carcass weight and as a result pig assemblages are usually dominated by the remains of immature and sub-adult animals as was the case in both the late Iron Age assemblages recovered from Insula IX and the forum basilica (Grant 2000, 445) at Silchester. A few older animals came from the forum basilica but, in respect of Insula IX, the general scarcity of older animals may simply be a function of the small sample size and in any case does not necessarily preclude the possibility that pigs were bred at the settlement. A scarcity of older animals has been noted at many sites but, because they produce large litters and start breeding when one year old (Hambleton 1999, 69), it is thought that herds would still have been sustainable. Boars and sows are represented in similar numbers at Insula IX which also suggests that some pigs may have been raised there. The assemblage from early Roman deposits at Silchester displays a similar mortality profile, although in this case canine teeth indicate that most were male, a pattern typical of a consumer site, whereby pork is generally derived from imported surplus males whilst females are retained for breeding.

Horse remains are commonly found in small numbers at late Iron Age sites and similar frequencies (1 per cent) were recorded in the assemblages recovered from both Insula IX and the forum basilica (Grant 2000, 426). They would have been kept to provide transport and as pack animals, although cut marks on a humerus suggest that their meat was also eaten. This is not unusual as evidence from contemporary sites including Skeleton Green (Ashdown and Evans 1981, 215) similarly suggests that horsemeat was occasionally eaten during this period. The lack of evidence for young horses is not unexpected either since very few sites of this period have produced the remains of immature horse. The majority of horses at Danebury (Grant 1984), Winnall Down (Maltby 1985), Gussage All Saints (Harcourt 1979), Old Down Farm (Maltby 1981) and Uffington (Ingrem 2004) were mature. At Danebury there was a complete absence of neonatal or very young animals in contrast to the evidence for neonatal cattle, sheep and pigs. This led Grant (1984, 522) to propose the possibility that specialised breeding sites existed and evidence recovered from the recently excavated site of Rooksdown, Hants. (Powell and Clark, in prep.), appears to support this. At Rooksdown, the remains of horses ranging in age from foetal/neonatal through to adult were recovered and there is also evidence for females, in contrast to the majority of sites which have been dominated by males. An alternative explanation for a scarcity of young horses at Gussage All Saints was proposed by Harcourt (1979, 158), who suggested that horses were not bred during the Iron Age but periodically rounded up from wild herds. Support for this type of practice comes from the site of Bury Hill, Hants., where a male dominated population and a peak in mortality between five and seven years suggested to Hamilton (2000, 62) that semi-feral horses were rounded up, surplus stallions were culled and young horses were trained prior to export.

Dogs would have been kept for guarding, hunting, herding and as companions, although some of their remains might simply represent feral dogs that lived nearby in order to take advantage of the rich pickings offered by human settlements. Dog remains are commonly found in small numbers at late Iron Age sites and, although there is no evidence for their post-mortem exploitation in the Insula IX area of Silchester, knife cuts recorded on four bones recovered from late Iron Age deposits at the forum basilica (Grant 2000, 448) suggest that dogs were occasionally eaten at Silchester. As with horses, this is not unusual as contemporary sites have produced evidence for the post-mortem exploitation of dogs including Guiting Manor Farm (Palmer and Clark 1997), where butchery marks on a humerus are thought to have been caused by disarticulation or skinning. In addition to the physical resources offered by dogs, there is considerable evidence to suggest that during the Iron Age dogs had symbolic associations and received different treatment to the major domestic food animals. At Insula IX, the miniature dog burial (see below) from the lower fill of Pit 12746, associated with the foundation trench of the substantial hall structure, has been interpreted as either a foundation or closing deposit (p. 25). Other deposits may also result from ideological activity, particularly a piece of skull (parietal and occipital) that was recovered from Well 8328 containing whole pots. Evidence of this nature has been noted at contemporary sites including Danebury (Grant 1984, 543), where the deposition of dog skeletons in pits is believed to represent ritual activity such as propitiatory offerings.

Domestic fowl only appear in the archaeological record from the late Iron Age but small samples came from both Insula IX and the forum basilica (Grant 2000, 444). The assemblage recovered from Insula IX includes a distal humerus with a horizontal cut mark that was probably inflicted during disarticulation and provides evidence for their consumption. In addition to meat, eggs and feathers would have been valued and the presence of medullary bone in two femora indicates that some of the hens represented at Silchester were in lay. A metatarsus with a spur attests to the presence of a cock (Sadler 1991) and strongly suggests that domestic fowl were bred at Silchester.

Wild resources were rarely, if ever, exploited by the late Iron Age inhabitants of Insula IX and although it is possible that wildfowl, such as woodcock, and trout were caught locally, this is by no means certain. Wild resources were also scarce in the forum basilica assemblage, but the recovery of a few bones belonging to woodcock and one to salmonid increases the likelihood that some wild animals were caught and eaten. Hunting and fishing appear to have been of minimal importance generally during the Iron Age. A few fragments of red and roe deer have been recovered from other sites including Balksbury (Maltby 1985, 104), Old Down Farm (Maltby 1981, 117) and Danebury (Grant 1984, 525), but some are antler which could represent the collection of shed antler for working rather than the hunting of wild animals.

Most of the cattle, sheep and pig measurements fall within the ranges recorded at contemporary sites, although there are a few outliers most of which belong to particularly small cattle. Iron Age livestock were generally smaller and more slender than modern breeds and as a result would have been less productive.

ANIMAL RELATED ACTIVITIES AND DISPOSAL PRACTICES

Whole carcasses of cattle, sheep and pig were originally present at Silchester and it is almost certain that domestic animals arrived on the hoof as was common practice during the Iron Age. As discussed above, the scarcity of neonatal remains might reflect preservation bias or it may be that the *oppidum* at Silchester was provisioned with livestock from the surrounding region. Whilst Danebury may have functioned as a specialised breeding centre, the presence of complete skeletons of neonatal lambs at Old Down Farm and Balksbury provides clear evidence that lambing generally took place at rural settlements (Maltby 1981, 115; n.d., 22) and some of these may have produced surplus animals for export and trade. Although it is not known what proportion of the livestock was raised by the inhabitants themselves or was acquired through tribute or trade, the similarities that exist between the late Iron Age and early Roman assemblages suggest there was little change in the supply chain during these periods.

Anomalies in body-part representation, particularly the over-representation of cattle and pig scapulae, suggest that some meat may have been imported as joints. Scapulae are not the densest elements but they are quite meaty and there is evidence from the Roman period, in the form of hook damage, to suggest that shoulders of beef may have been preserved by smoking. Whether or not beef and pork were preserved during the late Iron Age is unknown but the abundance of scapulae could certainly reflect the importation of shoulder joints. The abundance of cattle mandibles, astragali, distal metatarsals and 1st phalanges is more difficult to explain although, as heads and feet are often removed during the early stages of butchery, it may well reflect butchery and disposal practices. Mandible and metapodia would have been valued for their marrow and, since metapodia were slightly under-represented in the area of the forum basilica (Grant 2000, 444), it is possible that some were collected and taken to specialist processing areas with the tarsals and phalanges still attached. Metapodials are also often used as a raw material with which to fashion artefacts and tools so it is possible that their abundance at Insula IX results from their being stockpiled for either marrow extraction or making artefacts.

A different pattern is visible for sheep with lower limbs — radii and tibiae — abundant and major meat-bearing bones generally scarce. This probably reflects preservation bias, whilst the scarcity of dense metapodia might again be related to their raw material utility. This was also suggested by Grant (2000, 444) to explain the scarcity of sheep metapodia in the area of the forum basilica and is supported by evidence from Danebury for the use of metapodia for fashioning artefacts. However, unlike cattle metapodia, it appears that sheep metapodia were either taken to another area of the settlement for processing or have been rendered invisible.

In addition to scapulae, distal femora and proximal tibiae belonging to pig are well represented which might signal the importation of hind legs of pork as well as shoulders. The relative abundance of proximal radii is less easy to explain unless this bone had an, as yet unknown, utility value or it relates to preservation bias.

It has long been recognised that variations in the way that animal carcasses are treated as a result of size-related methods of butchery and food preparation can affect taxa and anatomical representation across a settlement. Previous research suggests that primary butchery of cattle often took place on the outskirts of settlements with the waste disposed of in nearby ditches (Maltby 1985, 101). In contrast, smaller animals such as sheep and pigs are more likely to be spit-roasted with the waste disposed of in more centrally located pits. The enclosed environment offered by pits also results in better preservation and, consequently, small elements and bones belonging to small animals are more likely to survive than they are in ditches or layers. Although most of the Insula IX assemblage came from pits and wells, a significant proportion is derived from Ditch 11631. However, as the frequency of sheep is generally similar in both types of features, there is little reason to think the assemblage is overly biased as a result of differential deposition and the type of features excavated.

There is some evidence for the differential deposition of animal waste which is probably related to methods of butchery varying according to carcass size and industrial processing. For instance, the high frequency of cattle in Ditch 11631 and some of the pits located in the middle to north-western part of the trench, particularly those in Pit Group 2 which is close to the ditch itself, suggests this area may have been used for processing cattle. Further south and also in close proximity to the ditch a high frequency of pig was recovered from the pits in Pit Group 3. Sheep on the other hand are particularly frequent in Wells 10421 and 13965, which probably results from the fact that their more central location made them a convenient place to dispose of waste from the later stages of food preparation and consumption.

A consideration of the spatial representation of carcass units also highlights the existence of some small-scale variation. In respect of cattle, the relative scarcity of major limbs in Pit Groups 1 and 10, both located in the northern part of the site, suggests that more primary butchery waste was deposited in this area and, consequently, that cattle butchery and/or tanning took place in the vicinity. Foot bones often remain with the hide (Serjeantson 1989, 136) and since cattle feet display high frequencies in Pit 10746, Pit Group 1, this deposit may well represent tanning waste. In contrast, the relatively high frequency of cattle and pig heads in Pit Group 10 is more likely to result from primary butchery. Pig feet were relatively abundant in a third pit group, Pit Group 9, located just to the south so this area may have been used for processing pig skins. Despite this patterning, the generally mixed nature of the deposits in terms of taxa and body part representation is testimony to the varied nature of the activities taking place across the site.

During the Iron Age there is considerable evidence from contemporary sites, most notably Danebury (Grant 1984; Hill 1995), for the deliberate placing of animal remains (partial skeletons, skulls and articulations) in the bottom of pits and many are thought to represent propitiatory offerings (Grant 1984, 543). In addition to the miniature dog burial, a few articulating bones and a partial skull were recovered from the pits and wells at Insula IX, which might reflect ideological practices, although it is also possible that they simply represent more mundane butchery waste.

CONCLUSIONS

The late Iron Age assemblage recovered from the Insula IX area of the *oppidum* at Silchester displays a similar pattern to that noted in the area of the forum basilica and also indicates continuity with the early Roman period when cattle similarly provided most of the meat. The importance of secondary products, particularly traction, wool and manure, in the late Iron Age economy is attested by the proportion of beef and mutton that was derived from mature animals, although good quality meat from prime-aged animals was also available. This may reflect regional differences in husbandry practices, especially if some livestock and joints of meat were supplied by rural settlements in Wessex and the Upper Thames Valley as a result of trade or tribute. Comparative studies suggest that the high frequency of pig is unusual and may be related to the importance and wealth of the settlement. There is some small-scale evidence for the spatial segregation of activities associated with carcass processing but most deposits contain a mixture of waste resulting from a range of activities. The presence of a miniature dog burial which appears to have been carefully placed strongly suggests that certain animals possessed symbolic associations and received special treatment after death, and quite possibly also during their lives.

MINIATURE DOG BURIAL FROM PIT 12746 (12751) *By Kate Clark*

The site photographs show the animal lying on its right side with the hind legs parallel and in extension, and the forelimbs, also parallel, slightly flexed to draw the forepaws in line with the muzzle (FIG. 15). The head is forward facing and in a natural position relative to the spine. While it is not impossible that this post-mortem posture could have occurred through the casual casting of the body, it is more redolent of the careful placement of the carcass to replicate a normal, relaxed, resting posture of the dog.

The dog is adult, but not elderly. Fusion evidence (Sumner-Smith 1966) indicates an animal over 40 weeks of age, but there is minimal wear on the teeth and no indications of age-related arthropathy. No epiphyseal lines are visible, and it is likely this animal was in its second or possibly its third year. Beyond that age some tooth wear should be evident even if the animal was sustained on a soft diet.

Selected measurements are shown in Table 18, and the limb bones and metapodia give an estimated shoulder height of 24 cm, using the factors of Harcourt (1974) and Clark (1995). The only pathological lesions visible are in the mandible with the congenital absence of the third molar (a common manifestation in miniature types) and the ante-mortem loss of the second and third premolars where the alveoli have filled.

The animal does not appear to be a mutation of the type described as brachymel (Teichert 1987) and seen in modern short-limbed breeds such as basset hounds and dachshunds, which are technically achondroplastic dwarves. The limb bones are slender, straight and proportionate to those dimensions recovered from the mandible, and more comparable to modern toy breeds. Figure 129 shows the humerus, radius and tibia of the small Silchester dog with the same elements of a modern toy poodle (with estimated shoulder height of 29 cm).

FIG. 129. A comparison of the humerus, radius and tibia of the Silchester miniature dog with the same elements of a modern toy poodle.

TABLE 18. MINIATURE DOG FROM PIT 12746

i. Selected postcranial measurements

Element	R/L	Measurement	mm
Axis		Length inc. dens	21.2
		Breadth of cranial articular surface	9.2
		Breadth of caudal articular surface	14.5
Scapula	L	Length of glenoid including glenoid process	14
		Breadth of glenoid cavity	8.5
		Min. length of neck	10.1
Humerus	L	Greatest length	74.7
		Length to caput	75.2
		Proximal depth	19.2
		Distal breadth	17.1
		Min. shaft diameter	5.5
Radius	R	Greatest length	71.2
		Proximal breadth	8.3
		Distal breadth	9
		Min. shaft diameter	5.1
Femur	L	Greatest length	78.6
		Proximal breadth	18.3
		Depth of caput	10
		Distal breadth	15.9
		Min. shaft diameter	6.4
Tibia	R	Greatest length	81.6
		Proximal breadth	16.5
		Distal breadth	11.2
		Distal depth	8.1
		Min. shaft diameter	5.9
Metacarpal II	L	Greatest length	30
Metacarpal III	L	Greatest length	30
Metacarpal IV	L	Greatest length	29.2
Metatarsal III	R	Greatest length	34.5

ii. Selected cranial and mandibular measurements

von den Driesch	Measurement	mm
17	Length premolar row	27
19	Length carnassial alveolus	11.9
Mandible		
4	Condyle process to aboral border of canine	58.6
5	Angular process to aboral border of canine	53.4
6	Indent between condyle & angular process to aboral border canine	58.7
12	Length P2–P4	20.1
14	Length carnassial alveolus	13.9
17	Thickness below M1	5.9
19	Height behind M1	10.8
20	Height between P2 & P3	8.8

Very small dogs, while not uncommon in the Romano-British period, are far less common in the Iron Age record and, as far as the author is aware, the Silchester animal currently represents the smallest yet recorded. One of its long bones has been radiocarbon dated to 110 cal B.C.–cal A.D. 60 (p. 347). Dogs of 30 cm or less at the shoulder have only been identified in late Iron Age deposits and, so far, have been restricted to the sites at Danebury (Grant 1984, 524), Baldock (Clark 1995) and Skeleton Green (Ashdown and Evans 1981, 213–14), where in each case they were recovered from pits. Skeleton Green yielded the smallest Iron Age dog (at 27 cm) prior to the excavation of the Silchester animal, together with another at 31 cm and Ashdown and Evans (1981, 214) noted that these dogs bore a similarity to Yorkshire terriers or toy poodles. However, there are indications from elsewhere of 'miniaturised' dogs, notably at Coombe Down on Salisbury Plain (Powell *et al.* 2006, 186–8), where a Jack Russell-sized mandible was recovered from a middle Iron Age deposit and a smaller, Cairn terrier-sized jaw from a late Iron Age/early Romano-British context, and at Owslebury, where Maltby (1987) identified a late Iron Age dog of around 30 cm.

CHAPTER 16

INSECT REMAINS FROM THE LATE IRON AGE WELLS

By Mark Robinson

METHODS

Bulk samples were taken for analysis for biological remains from the sequences of waterlogged sediments comprising the lower fills of the two late Iron Age wells: Wells 8328 and 10421. Insect remains were found to be present in six contexts from Well 8328 and two contexts from Well 10421 (Table 19). Sub-samples from these contexts were washed over onto a 0.25 mm mesh for the primary purpose of extracting macroscopic plant remains but some insect fragments were also picked out. These flots and some additional sub-samples which had likewise been washed over onto a 0.25 mm mesh were subjected to paraffin flotation to extract insect remains. The flots were washed with hot water and detergent and sorted in water using a binocular microscope for potentially identifiable insect remains. They were identified by reference to the Hope Entomological Collections of the Oxford University Museum of Natural History. Unfortunately, there were too few remains for interpretation to be made on the basis of individual contexts. Therefore combined results and sample sizes for Coleoptera (beetles) are given in Table 20, the nomenclature following Duff (2012). The results for other insects are given in Table 21. The Coleoptera have been divided into species groups after Robinson (1991, 278–81) and the results displayed in FIG. 130.

TABLE 19. DETAILS OF THE PERIOD 0 INSECT SAMPLES

Well	Context	Sample No.	Sample volume (litres)
8328	9152	3191	13
8328	9170	2978	11.5
8328	9257	3216	4
8328	9258	3195	na
8328	9309	3217, 3219, 3235, 3293	8.06
8328	9663	3332, 3335, 3380	6.5
10421	10441	4141	7
10421	10422	4165	9.5

RESULTS

The preservation of remains was mostly satisfactory except in contexts 9152 and 9170 in Well 8328, where some had undoubtedly been lost through decay. The concentration of remains was low as tends to be the case with organic remains in well sediments at Silchester (Robinson 2011).

The most numerous insects in Well 8328 were Coleoptera from a range of habitats related to the decay of organic material. They included hydrophilid and staphylinid beetles of wet foul organic material (Species Group 7), scarabaeoid dung beetles which feed on the droppings of herbivores on pasture (Species Group 2) and lathridiid beetles which occur on accumulations of damp mouldy plant material (Species Group 4). Some of them are associated with indoor habitats including synanthropic beetles (Species Group 9a) and the woodworm beetle (Species Group 10). There were also some puparia of Diptera (flies) associated with decaying organic material. The remaining Coleoptera were mostly species such as Carabidae (ground beetles) and Chrysomelidae (leaf beetles) of open habitats ranging from grassland to rather sparsely-vegetated disturbed ground. Other insects of such habitats included Heteroptera (true bugs) and Formicidae (ants). Aquatic Coleoptera were absent but there were some juvenile remains of flies with aquatic larvae. There were no obvious differences between the insect assemblages from the various contexts other than the concentration of remains.

The most abundant insects in Well 10421 were from Coleoptera of open habitats where some droppings of domestic animals were present. They included scarabaeoid beetles which feed on dung on pasture (Species Group 2) and some of the hydrophilid and staphylinid beetles which occur in a wide range of foul organic material as well as dung (Species Group 7). There was an element associated with tall grassy herbaceous vegetation (Species Group 3) and a carabid beetle of disturbed ground (Species Group 6a). Although not classified into any of the groups, there were many carabid beetles which tend to be associated with open habitats, particularly weed-covered disturbed ground. There were also some Curculionidae (weevils) and Chrysomelidae of weeds of disturbed ground and grassland. Coleoptera which tend to be associated with settlement habitats such as mouldy thatch or hay (Species Group 8), indoor habitats (Species Group 9a) and structural timbers (Species Group 10) were absent. Aquatic insects were also absent. There were no obvious differences between the insect assemblages from contexts 10441 and 10442.

INTERPRETATION

WELL 8328

The insect fauna of the well appears to have been limited to the aquatic larvae of flies. While Chironomidae (non-biting midges) larvae occur in a range of aquatic habitats, pupae of *Psychoda alternata* (trickling filter fly) were also present. The larvae of this fly develop in water with a high level of organic pollution, for example where there is sewage contamination. Its occurrence was probably a reflection of the state of the water in the well while it was being backfilled with, amongst other material, organic refuse.

Given the macroscopic plant remains found in Well 8328, it is thought that many of the insects which occur in decaying organic material had been amongst such material dumped into the well. The members of Species Group 7, including *Cercyon haemorrhoidalis*, *Megasternum concinnum*, *Anotylus rugosus* and *Platystethus arenarius*, comprised 13.5 per cent of the terrestrial Coleoptera. They occur in a wide range of wet foul organic material including dung both in the form of individual droppings in pasture and gathered into midden heaps. Other Coleoptera of these habitats included *Onthophilus striatus*, *Hister bissexstriatus* and *Megalinus glabratus*. The larvae of *Musca domestica* (house fly), which was represented by a puparium in context 9309, occur in these habitats. There were also Coleoptera which are dependent on the more restricted habitat of the droppings of larger herbivores on the ground, the scarabaeoid dung beetles of Species Group 2 including *Geotrupes* sp., *Aphodius rufipes* and *A.* cf. *sphacelatus*. They comprised 18 per cent of the terrestrial Coleoptera. A third element to the decomposer community were Coleoptera of mouldy plant material such as old straw, damp hay and animal bedding as well as compost heaps. Some, such as members of the Cryptophagidae, *Lathridius minutus* gp. and *Omonadus floralis* or *formicarius*, occur in these habitats under a wide range of conditions; others, the general synanthropic beetles of Species Group 9a, in this case *Ptinus fur* and *Typhaea stercorea*, more usually occur in indoor habitats. Species Group 9a comprised 6.7 per cent of the terrestrial Coleoptera.

The members and associates of Species Groups 2, 7 and 9a were all sufficiently abundant to suggest their habitats were important in the vicinity of the well. Species Groups 7 and 9a tend to be abundant on settlements, reflecting concentrations of organic refuse and the occurrence of buildings housing both humans and at least some domestic animals; Species Group 2 is

TABLE 20. COLEOPTERA FROM WELLS 8328 AND 10421

	Minimum No. of Individuals		
	8328	10421	Species Group
Clivina collaris (Hbst.) or *fossor* (L.)	-	1	
Nebria brevicollis (F.)	2	2	
Trechus obtusus Er. or *quadristriatus* (Schr.)	3	4	
Bembidion lampros (Hbst.)	-	4	
B. lampros (Hbst.) or *properans* (Step.)	-	1	
Bembidion sp.	1	2	
Poecilus cupreus (L.)	-	1	
Pterostichus madidus (F.)	-	1	
Pterostichus sp.	2	1	
Calathus fuscipes (Gz.)	-	4	
Amara aenea (De Geer)	-	3	
Amara sp.	4	1	
Harpalus rufipes (De Geer)	-	1	6a
H. affinis (Schr.)	-	2	
Helophorus porculus Bed. or *rufipes* (Bosc.)	1	-	
Cercyon haemorrhoidalis (F.)	2	-	7
C. unipunctatus (L.)	2	-	7
C. analis (Pk.)	1	-	7
Cercyon sp.	1	2	7
Megasternum concinnum (Marsh.)	3	2	7
Sphaeridium bipustulatum F. or *marginatum* F.	1	-	
S. lunatum F. or *scarabaeoides* (L.)	-	1	
Kissister minimus (Leporte)	1	1	
Onthophilus striatus (Forst.)	1	-	
Margarinotus S. *Paralister* sp.	1	-	
Hister bissexstriatus L.	2	1	
Lesteva longoelytrata (Gz.)	-	1	
Tachyporus sp.	-	2	
Aleocharinae indet.	4	1	
Anotylus rugosus (F.)	1	-	7
A. sculpturatus gp.	1	1	7
Oxytelus sculptus Grav.	1	-	
Platystethus cornutus gp.	3	-	
P. arenarius (Fouc.)	1	-	7
Carpelimus bilineatus Step.	1	-	
Stenus sp.	1	1	
Lathrobium sp.	-	1	
Philonthus sp.	2	3	
Ocypus olens (Müll.)	-	1	
Megalinus glabratus (Grav.)	2	2	

TABLE 20 (cont.). COLEOPTERA FROM WELLS 8328 AND 10421

	Minimum No. of Individuals		
	8328	10421	Species Group
Xantholinus linearis (Ol.) or *longiventris* Heer	-	1	
Geotrupes sp.	2	2	2
Aphodius rufipes (L.)	1	-	2
A. cf. *foetidus* (Hbst.)	1	-	2
A. granarius (L.)	2	-	2
A. cf. *sphacelatus* (Pz.)	3	4	2
A. contaminatus (Hbst.)	-	1	2
Aphodius sp.	6	3	2
Oxyomus sylvestris (Scop.)	-	1	
Onthophagus sp.	1	1	2
Simplocaria maculosa Er. or *semistriata* (F.)	1	-	
Ptinus fur (L.)	4	-	9a
Anobium punctatum (De G.)	2	-	10
Omosita colon (L.)	2	-	
Cryptophagidae indet. (not *Atomaria*)	2	1	
Atomaria sp.	1	1	
Lathridius minutus gp.	2	-	8
Enicmus transversus (Ol.)	1	-	8
Corticariinae indet.	1	-	8
Typhaea stercorea (L.)	2	-	9a
Anthicus antherinus (L.)	2	-	
Omonadus floralis (L.) or *formicarius* (Gz.)	1	1	
Gastrophysa polygoni (L.)	1	-	
Phyllotreta nigripes (F.)	-	2	
P. vittula (Redt.)	-	2	
Longitarsus sp.	1	3	
Chaetocnema concinna (Marsh.)	1	-	
Apion s.l. indet.	1	-	3
Ceutorhynchus erysimi (F.)	-	1	
Ceutorhynchinae indet.	1	-	
Barynotus sp.	-	2	
Sitona hispidulus (F.)	-	2	3
Sitona cf. *suturalis* Step.	1	-	3
Sitona sp.	-	1	3
Scolytus intricatus (Ratz.)	1	-	4
Total	**89**	**77**	

favoured by high concentrations of domestic animals on pasture, conditions which also favour Species Group 7. However, such conditions would also result in relatively high proportions of Coleoptera associated with other grassland habitats including the elaterid and chafer beetles

TABLE 21. OTHER INSECTS FROM WELLS 8328 AND 10421

		Minimum No. of Individuals or Presence	
		8328	10421
Forficula auricularia L.		1	3
Heterogaster urticae (F.)		1	-
Scolopostethus sp.		1	-
Aphodius gp.		-	1
Lasius niger gp.	-queen	-	1
L. niger gp.	-worker	1	2
Psychoda cf. alternata Say	-pupa	4	-
Chironomidae indet.	-larva	+	-
Musca domestica L.	-puparium	1	-
Diptera indet.	-puparium	9	3

+ = present

of Species Group 11. It is suggested that a major source of the organic refuse which had been dumped into the well was dung and litter which had been gathered together from an enclosure for domestic animals in which there was a stable, byre or some other sort of shelter.

While there was not a full grassland fauna, there were certainly insects from open grassy and weedy habitats. These included the predatory beetles *Nebria brevicollis*, *Trechus obtusus* or *quadrimaculatus* and *Stenus* sp. The phytophagous beetles included *Helophorus porculus* or *rufipes*, which feeds on various members of the Brassiceae (wild turnip, etc.), *Gastrophysa polygoni* and *Chaetocnema concinna*, which both feed on *Rumex* spp. (docks) and *Polygonum* spp. (knotgrass, etc.) and *Sitona* cf. *suturalis* which feeds on *Vicia* and *Lathyrus* spp. (vetches and vetchlings). There was also an example of the bug *Heterogaster urticae* which feeds on *Urtica dioica* (stinging nettle). Although it is likely that there was much bare ground in the vicinity of the well, these beetles would have found suitable habitats in small clumps of vegetation and parts of the site that were less heavily trampled.

The occurrence of *Anobium punctatum* (woodworm beetle, Species Group 10) reflected the presence of timber structures but they were not particularly abundant for a settlement, at 2.2 per cent of the terrestrial Coleoptera. There was an example of the bark beetle *Scolytus intricatus* in context 9309 which usually occurs on the moribund branches of oak but it is as likely to have been from wood brought to the site as fuel as to have emerged from a tree on the site. Two examples of the small carrion beetle *Omosita colon* were found in context 9663. It feeds on old bones and dry carcasses but there were too few carrion beetles to imply a presence of any more than the corpse of a small mammal or bird.

WELL 10421

There was no evidence that the well had a fauna of aquatic insects and, unlike Well 8328, there was not a distinctive component of insects which had been amongst decaying organic material which had been dumped into the well. Most, if not all, of the insect remains were from individuals which had fallen into the well from the surrounding environment.

The scarabaeoid dung beetles of Species Group 2, particularly members of the genus *Aphodius*, comprised 14 per cent of the terrestrial Coleoptera, suggesting the nearby presence of domestic animals. Species Group 7, beetles which occur more generally in decaying organic material, comprised 6.5 per cent of the terrestrial Coleoptera. They were no more abundant than might be expected, given the presence of dung beetles of Species Group 2, although it is likely that some of them were occurring in habitats other than dung. As in Well 8328, there were other

Coleoptera of decaying organic material, including *Hister bissexstriatus* and *Megalinus glabratus*. However, very few of them apart from an individual of *Omonadus floralis* or *formicarius*, both beetles of compost heaps and haystack bottoms, need habitats other than those associated with the droppings of domestic animals or dead plant debris at the base of tussocks of vegetation.

Some of the carabid beetles such as *Poecilus cupreus* and *Calathus fuscipes* readily occur in grassland but, as was also the case for Well 8328, the two samples did not contain a full grassland fauna. Species Group 11 was again absent. Others of the carabid beetles such as *Harpalus rufipes* (a member of Species Group 6a) prefer disturbed ground with a covering of weeds while *Amara aenea* readily ventures onto bare ground. The more host-specific of the phytophagous Coleoptera were mostly species which feed on plants of disturbed ground, for example *Phyllotreta nigripes*, *P. vittula* and *Ceutorhynchus erysimi* feed on various Brassicaceae (wild turnip, shepherd's purse, etc.). However, the clover and vetch-feeding weevils of the genera *Apion* s.l. and *Sitona* spp. (Species Group 3) comprised 4 per cent of the terrestrial Coleoptera. While they are particularly characteristic of hay meadows, they are also favoured by areas of tall grassy vegetation on neglected ground.

The simplest interpretation of the results is that the well was set amidst disturbed or heavily trampled ground with some areas quite bare of vegetation and others covered in weeds which in some places graded into tall grassy vegetation. There does not seem to have been extensive pasture in the vicinity of the well but there was presumably an enclosure for animals nearby, which was perhaps very heavily grazed, thus reducing the habitats for grassland insects. Settlement-related habitats, including accumulations of organic refuse and timber structures, were apparently absent.

DISCUSSION

The late Iron Age insect assemblages from Wells 8328 and 10421 showed both strong similarities and strong differences. They both suggested a local environment of weedy disturbed ground and a nearby concentration of grazing animals. However, only Well 8328 gave evidence for

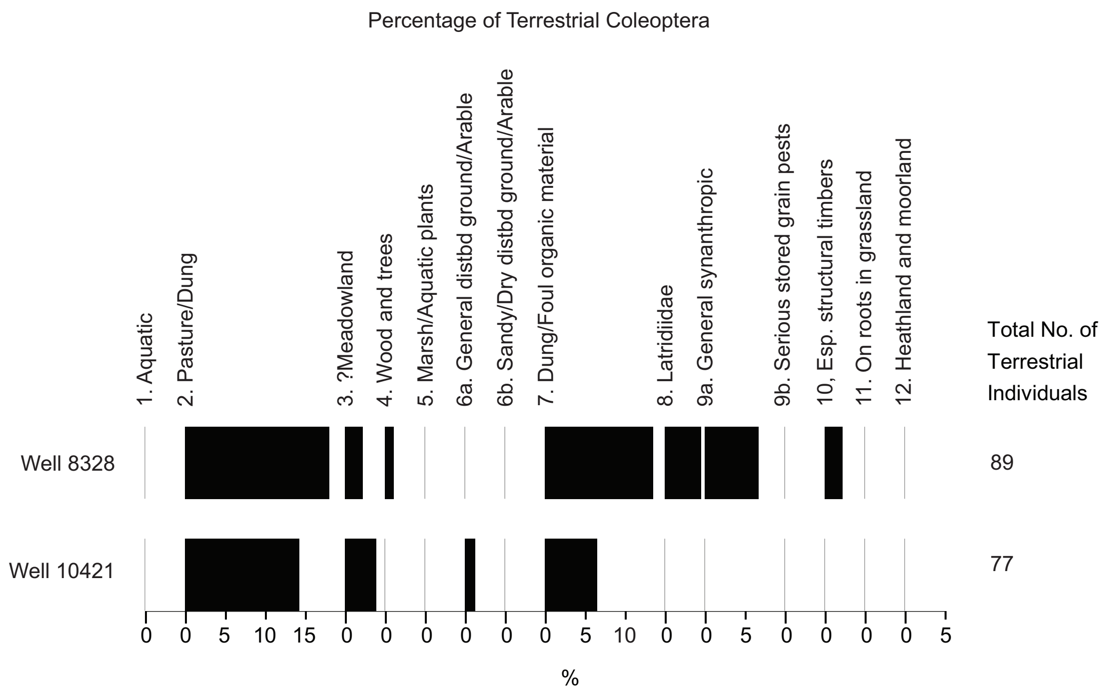

FIG. 130. Species groups of Coleoptera from Wells 8328 and 10421. Species groups expressed as a percentage of the total terrestrial Coleoptera (i.e. aquatics excluded). Not all the terrestrial Coleoptera have been classified into groups.

structural timbers, indoor habitats and concentrations of organic refuse. There are two plausible explanations. One possibility is that the organic fills of Well 10421 were earlier than the fills of Well 8328. Well 10421 could have dated to a time after the enclosure of the area of the *oppidum* when there was much activity within the *oppidum* but before the part of the site which later became Insula IX was built up. In contrast, Well 8328 could have fallen into disuse after there were settlement structures close by which generated the material that was dumped into it. The other possibility is that the information from the wells reflected very local conditions; Well 8328 was immediately adjacent to a structure such as a byre whereas Well 10421 was not.

The results for insects from Well 8328 suggested relatively similar conditions to those shown by the mid-Roman waterlogged deposits from Insula IX. Both gave evidence for accumulations of animal bedding and the presence of animal dung (Robinson 2011). The Well 8328 samples gave rather more evidence for accumulations of foul organic material and less evidence for timber structures than the mid-Roman samples, but this was probably due to local environmental variation rather the overall differences in the town environment. However, one important point about the late Iron Age insect fauna is that all the species identified are regarded as native to Britain. The grain pests which are currently believed to have been introduced by the Romans at, or shortly after, the conquest and which subsequently became widespread in the towns of Roman Britain (although not Silchester) were absent (Smith and Kenward 2011). In this and other respects, the late Iron Age insect fauna was not distinctively urban and is entirely appropriate for a rural settlement.

CHAPTER 17

THE CHARRED AND WATERLOGGED PLANT REMAINS

By Lisa A. Lodwick

INTRODUCTION

Archaeobotanical evidence has the potential to evaluate the agricultural basis of *oppida* and the plant food diet of the inhabitants, yet, due to the lack of systematic bulk sampling at earlier excavations of sites, such as Camulodunum and Verulamium, the systematic study of charred and waterlogged plant macrofossils from a British *oppidum* has long remained an outstanding research priority (Burnham *et al.* 2001; Van der Veen *et al.* 2007, 206). Furthermore, many *oppida* are located below Roman, medieval and modern settlements, meaning excavations are often limited in size, and the archaeobotanical datasets have strong potential for residuality and contamination. Recent studies of central and western European *oppida* have brought the question of the subsistence basis of these settlements to the foreground (Danielisová and Hajnalová 2014). The agricultural basis of *oppida* in Britain has also been discussed, from the soil type on which they are located (Collis 1984, 174; Haselgrove 1976, 40) to the relationship with agricultural innovations posited to have occurred in the late first millennium B.C. (Campbell and Hamilton 2000; Jones 1981), and to models linking southern Britain and the Continent through the exchange of cereals (Haselgrove 1982). Hence the archaeobotanical assemblage presented here from Insula IX represents a key dataset for the analysis of diet, agriculture, site activities and settlement vegetation at a late Iron Age *oppidum*.

Silchester has long been a focus for archaeobotanical analysis. In a pioneering study, Reid and Lyell analysed waterlogged plant remains from the northern, southern and eastern areas of the town, excavated between 1901 and 1909, producing evidence for food imports and vegetation (Lodwick 2017b). Small-scale analysis of charred and waterlogged plant macrofossils has been undertaken at the forum basilica site (Jones 2000) and a marsh-like deposit outside the south-east gate (Monk 1984). Analysis of mid- and late Roman charred, mineralised and waterlogged plant remains from Insula IX produced evidence for food imports and settlement vegetation, but little evidence for agricultural activity (Robinson *et al.* 2006; Robinson 2011). This report presents the identification and analysis of charred and waterlogged plant macrofossils from features dated to the late Iron Age Period 0 occupation within Insula IX.

METHODS

Plant macrofossils were recovered through a programme of bulk sampling established in 1997 (Robinson *et al.* 2006; Robinson 2011), with an increase in bulk sample size established from 2010 with the initiation of the author's research. Sample volumes ranged from 2 to 49 L from dry features. Samples were taken from a range of feature types across the excavation area, including all substantial features (pits, ditches, occupation layers) and a representative number of other features (post-holes, gullies, accumulations). Large bulk samples (1 to 29 L) were taken from waterlogged sediments due to the low density of waterlogged plant remains recovered from later wells (Robinson 2011, 281). Bulk samples were processed on site in a modified 'Siraf' flotation tank, using a 0.25 mm flot mesh for waterlogged samples and a 0.5 mm flot mesh for charred samples. Heavy residues were sieved to 2 mm and sorted by eye, with all charcoal and plant remains extracted. Waterlogged flots were stored in water and charred flots were dried.

All waterlogged flots were assessed, and waterlogged plant remains were found to be present in two of the late Iron Age wells: Well 10421, located in the centre of the excavation and Well 8328, located underneath the later east–west street (FIG. 29). All charred flots were assessed. The majority contained less than ten charred plant remains. Samples were analysed from all possible pit groups, wells and Ditch 11631, with more samples studied from feature groups with abundant plant remains. Plant remains were sorted and identified under a binocular microscope at x10–x40 magnification. Sub-sampling of the 0.25–0.5 mm fraction of waterlogged samples was undertaken due to a hyper-abundance of *Juncus* spp. seeds. Plant remains were identified using the seed reference collection housed in the Oxford University Museum of Natural History. Nomenclature follows Stace (1997), with additions from *Flora Europaea* (Tutin and Akeroyd 1993) and with cereal names following traditional terminology (Zohary *et al.* 2012, 29). Detailed identification criteria can be found in Catalogue 2 in Lodwick (2015). The following MNI criteria were applied for charred plant remains; the embryo end for cereal grains, the tops of rachis internodes for rachis fragments, the base of glume bases for spikelets and culm nodes for straw. Charred nutshell was quantified as number of fragments. For waterlogged plant remains, MNI criteria were selected specific to each taxa.

Waterlogged plant remains have been analysed through a combination of univariate (sums, frequencies, sums per habitat group) and contextual analyses based on well deposits. Broad habitat codes have been applied to each taxa drawing from British and local floras (Brewis *et al.* 1996; Crawley 2005; Stace 1997). The British National Vegetation Classification (NVC) was used to place taxa in phytosociological groups, referred to by codes such as MG5 (mesotrophic grassland 5) (Rodwell 1993). Rigorous quantitative data analysis has been undertaken of charred plant remains in order to gain insights into cereal-processing and crop cultivation practices. All cf. and definite identifications were merged and standardisation of crop, cultivated and wild taxa was undertaken in order to produce useful categories for analysis (Table 22). Seeds identified to family or genus level (e.g. Polygonaceae indet. or *Bromus/Avena* sp.) were reallocated between the relevant taxa on a sample basis. All samples from the same contexts have been summed due to the generally low number of items present, and are referred to by the lower sample number. Summary statistics (density, frequency and sum) have been calculated for individual taxa by feature group and phase.

The potential for wild taxa to derive from arable weed was evaluated based on their flowering time, ecology and behaviour in correspondence analysis, and all taxa which were plausible arable weeds were treated as such. Correspondence analysis has been used to explore variation within the charred dataset. The statistics are calculated on the proportion of taxa present within samples, and the variation within the dataset is displayed along four axes, with the first (x axis) displaying the most significant variation. The most common taxa and similar samples plot in the centre of the plot, and the most dissimilar plot at opposite ends of the axes. Taxa present in under 5 per cent of samples were excluded, and samples were only entered which contained >30 items. Correspondence analysis was performed using CANOCO version 4.5 and the results were plotted using CANODRAW version 4.1 (Ter Braak and Ŝmilauer 2002).

Crop-processing analysis was undertaken by assigning each sample to a dominant crop type based on the proportions of barley and spelt wheat. The maximum number of spelt/emmer wheat or barley grain or chaff items was used. Samples consisting of a mix of spelt/emmer wheat and barley could not be derived from one crop-processing stage. Ratios of barley grains : barley rachis and spelt grains : spelt glume bases were calculated (Table 23) and used to separate fine-sieve products containing mainly clean grain (FSP), from fine-sieve by-products containing spelt glume bases removed after de-husking (FSBP). To complement the results of ratio calculations, discriminant analysis, a form of canonical ordination analysis (Jones 1991), has been used. Weeds seeds were classified by characteristics relevant to their behaviour during crop-processing: aerodynamic qualities (light vs heavy), headedness (headed vs free) and size (small vs big) (Jones 1984, 55). Measurements of the second largest dimension of a seed were taken from several sources. After considering the taxa present in uncontaminated FSP and FSBP samples, a size

TABLE 22. REALLOCATION OF CHARRED TAXA AND CANOCO CODES

Name	CANOCO code	Contents
Crop		
Cereal indet. culm	CINDC	Cereal indet. culm
Hordeum sp. grain	BARLEYG	All *Hordeum* grain
Hordeum sp. rachis	BARLEYR	All *Hordeum* rachis
Triticum spelta grain	SPELTG	*T. spelta*, *T. dicoccum*, *T. spelta/dicoccum*, *T.* sp.
Triticum spelta glume base	SPELTGB	*T. spelta*, *T. dicoccum*, *T. spelta/dicoccum*
Cultivated		
Apium graveolens	-	*Apium* sp.
Linum usitatissimum	LINUUSI	*Linum usitatissimum*
Pisum/Vicia	PISUVIC	*Pisum sativum*, *Pisum/Vicia*
Collected		
Corylus avellana (nutshell)	CORYAVE	*Corylus avellana*
Rubus sect. *Glandulosus*	-	*Rubus* sect. *Glandulosus*, *Rubus* sp.
Sambucus nigra	-	*Sambucus nigra*
Wild		
Atriplex sp.	ATRISP	*Atriplex* sp.
Avena sp.	AVENSP	*Avena* sp.
Brassica sp.	BRASSP	*Brassica* sp.
Bromus secalinus	BROMSEC	*Bromus* sp., *Bromus secalinus*
Carex sp.	CARESP	*Carex* sp.
Cerastium fontanum	-	*Cerastium* sp., *Cerastium fontanum*
Chenopodium album	CHENALB	*Chenopodium album, C. ficifolium, Chenopodium* sp.
Eleocharis palustris	ELEOPAL	*Eleocharis palustris*
Odontites vernus	-	*Odontites vernus, Euphrasia/Odontites*
Fallopia convolvulus	-	*Fallopia convolvulus*
Galium aparine	-	*Galium aparine*
Juncus indet.	-	*Juncus articulatus, Juncus* indet.
Linum catharticum	-	*Linum catharticum*
Malva sylvestris	MALVSYL	*Malva sylvestris, Malvaceae* indet.
Medicago lupulina	-	*Medicago* sp.
Medicago/Trifolium/Melilotus sp.	MEDITRI	*Melilotus* sp., *Trifolium/Lotus* sp., *Medicago/Trifolium* sp.
Montia fontana	-	*Montia fontana* Ssp. *chondrosperma*
Persicaria lapathifolia/maculosa	PERSLAM	*Persicaria lapathifolia, P. maculosa, P.* sp.
Poaceae indet.	POACIND	Poaceae indet. (large and small)
Polygonum aviculare agg.	POLYAVI	
Potentilla erecta	-	*Potentilla* sp., *Potentilla erecta*
Prunella vulgaris	-	*Prunella vulgaris*
Ranunculus subg. *acris/repens/bulbosus*	RANUARB	*Ranunculus repens, R.* sp., *R. a.r.b., R.* subg. *R.*
Rumex acetosella agg.	RUMEACT	*Rumex acetosella* agg.
Rumex sp.	RUMESP	*Rumex* sp.
Solanum nigrum	SOLANIG	*Solanum* sp., *Solanum nigrum*
Spergula arvensis	-	*Spergula arvensis*
Stellaria graminea	-	*Stellaria graminea*
Stellaria media gp.	STELMED	*Stellaria media* gp.
Tripleurospermum inodorum	TRIPINO	*Tripleurospermum inodorum*
Urtica dioica	URTIDIO	*Urtica* sp., *Urtica dioica*
Vicia/Lathyrus sp.	VICILAT	*Lathyrus nissolia, Vicia/Lathyrus*

boundary of 2 mm was set between 'small' and 'big' weed seeds (Lodwick 2015, Catalogue 3). All seeds present in a sample were included in the discriminant analysis. The discriminant scores were obtained by running a discriminant analysis in IBM SPSS Statistics Version 21 using the Amorgos ethnographic data as control groups (winnowing by-product, coarse-sieve by-product, fine-sieve by-product, fine-sieve product) (Jones 1984). Samples were entered that contained at least ten seeds that had been categorised into one of Jones' groups, and these were then classified using the discriminant scores. P values of ≥ 0.9 were classified as high probability results (Bogaard 2011, 155). The ratio and discriminant analysis results have been combined to assign a single crop-processing stage to each sample. Cereal cultivation practices have been investigated through autecology, by assessing the tolerance of weed taxa present alongside cereals in individual samples to different environmental conditions. Autecological data were collected from local floras and ecological publications of British Ellenberg numbers (Brewis *et al.* 1996; Crawley 2005; Fitter and Peat 1994; Hill *et al.* 2004; Stace 1997). Full raw data are available in online resource (University of Reading 2018) and summary tables are incorporated into Appendix 6.

TABLE 23. SUMMARY OF CRITERIA FOR CROP-PROCESSING ANALYSIS

Ratio	Values	Origin
Barley grains/Barley rachis	>3	Fine sieve product
	<3	Early stage by-product
Spelt grains/Spelt glume bases	>1.5	Fine sieve product
	0.8-1.5	Spikelets
	<0.8	Fine sieve by-product

RESULTS

WATERLOGGED PLANT REMAINS

Wells 8328 and 10421

Waterlogged plant remains were studied from five contexts in Well 8328 and four contexts in Well 10421 (Table 80).

A more diverse range of taxa was identified from Well 8328 (Table 80). The lowest fill (9663) was dominated by annuals of disturbed ground, mainly *Capsella bursa-pastoris* (n=61) and *Polygonum aviculare* (n=152) (FIG. 131). Smaller proportions of grassland (*Prunella vulgaris*, *Rhinanthus* sp.), wet ground (*Alisma plantago-aquatica*, *Montia fontana* ssp. *chondrosperma*) and woodland taxa (*Rubus* Sect. *Glandulosus*) were present. Heathland plants were represented by seeds of *Calluna vulgaris* (n=7), Ericaceae indet. capsules, *Ulex europaeus* spines and *Pteridium aquilinium* fronds. The cultivated plants identified were eight *Linum usitatissimum* (flax) capsules, one *Apium graveolens* seed and two *Triticum spelta* and one *Triticum spelta/dicoccum* glume bases, and some probable arable weeds (*Agrostemma githago*). In addition, a leaf was found adhering to a complete small necked ceramic jar (SF 5445). The leaf was identified by Mark Robinson as *Acer campestre* L. (field maple), a tree found in woodland, scrub and hedgerows (Stace 1997). Samples from the overlying fill 9309 consisted almost entirely of laminated vegetative material and cereal bran, accompanied by abundant seeds. There was an increased proportion of cultivated taxa, largely consisting of *L. usitatissimum* seeds (n=61) and capsule fragments (n=38), and also *T. spelta* (17) and *T. spelta/dicoccum* (7) glume bases. Further imported plant foods were present; three *Coriandrum sativum* (coriander) seeds and six *Anethum graveolens* (dill) seeds, and four hazelnut shell fragments were present. One *Malus* sp. (apple) pip was identified. There was an increase in the proportion of taxa of disturbed ground (*Sagina* sp. and *Urtica dioica*), grassland (*Filipendula ulmaria*, *Prunella vulgaris*, *Ranunculus repens*, *Rhinanthus minor*) and wet ground taxa (*Eleocharis palustris*, *Ranunculus flammula*), alongside a diverse range

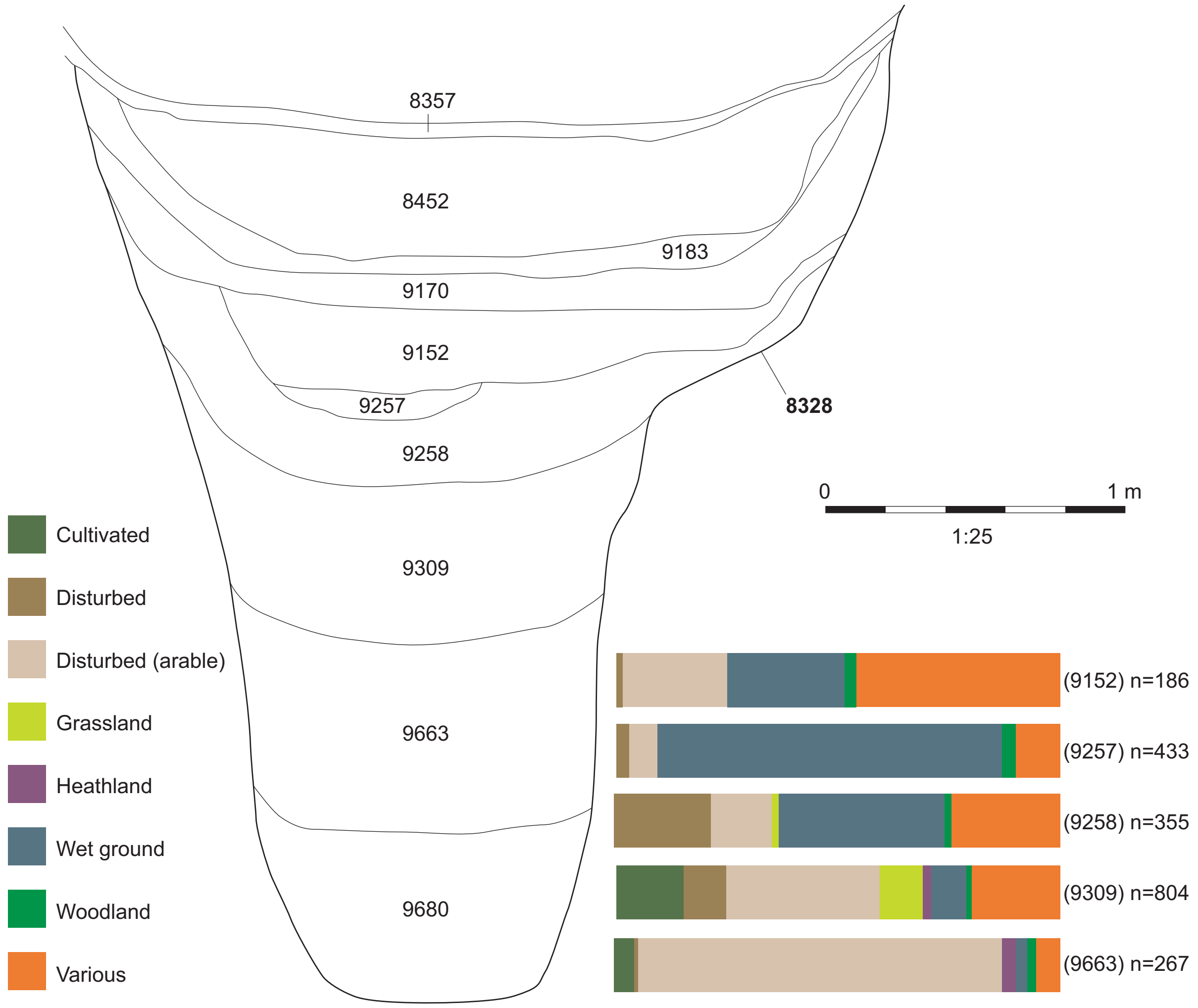

FIG. 131. Proportion of seeds classified by habitat group in Well 8328.

of plants of disturbed nitrogen-rich ground (*Aphanes australis*, *Chenopodium album*, *Polygonum aviculare*, *Stellaria media*, *Urtica urens*) and more permanent disturbed ground (*Ballota nigra*, *Malva sylvestris*, *Urtica dioica*). A wide range of vegetative plant items was present, including abundant *Pteridium aquilinium* frond fragments (n=815), *Calluna vulgaris* (heather) shoots and seed capsules, *Trifolium* sp. (clover) calyx and flower, *Ulex europaeus* (gorse) spines and a fragment of *Ilex aquifolium* (holly) leaf. Spot sample 3217 was examined from context 9309 in order to investigate the potential of intact pieces of dung. Pollen samples were taken from dung cakes (Brown, p. 327), but the material examined by the author consisted of compacted cereal bran, Poaceae spp. seeds, some grassland taxa (*Prunella vulgaris*, *Ranunculus repens*) and other wild taxa (*Eleocharis palustris*, *Rumex* sp., *Stellaria media*), representing laminated material with a dung component rather than intact dung *per se*.

The upper well fills produced few vegetative plant remains, and a smaller range of less well preserved taxa. Context 9258 was dominated by *Eleocharis palustris* (34 per cent) and *Urtica dioica* (20 per cent). Similarly, context 9257 was dominated by the wet ground taxa *Eleocharis palustris* and *Mentha aquatica* (56 per cent). The uppermost context to contain waterlogged plant remains, 9152, largely consisted of poorly preserved *Solanum* sp. seeds.

The two basal fills of Well 10421 (10442 and 10441) were dominated by a similar range of disturbed (arable) taxa (FIG. 132). The most abundant taxa were *Capsella bursa-pastoris*, *Chenopodium album*, *Polygonum aviculare*, *Stellaria media* and *Urtica urens*. Smaller proportions of disturbed ground (*Atropa belladonna*, *Ballota nigra*, *Urtica dioica*) and grassland taxa (*Hypochaeris*

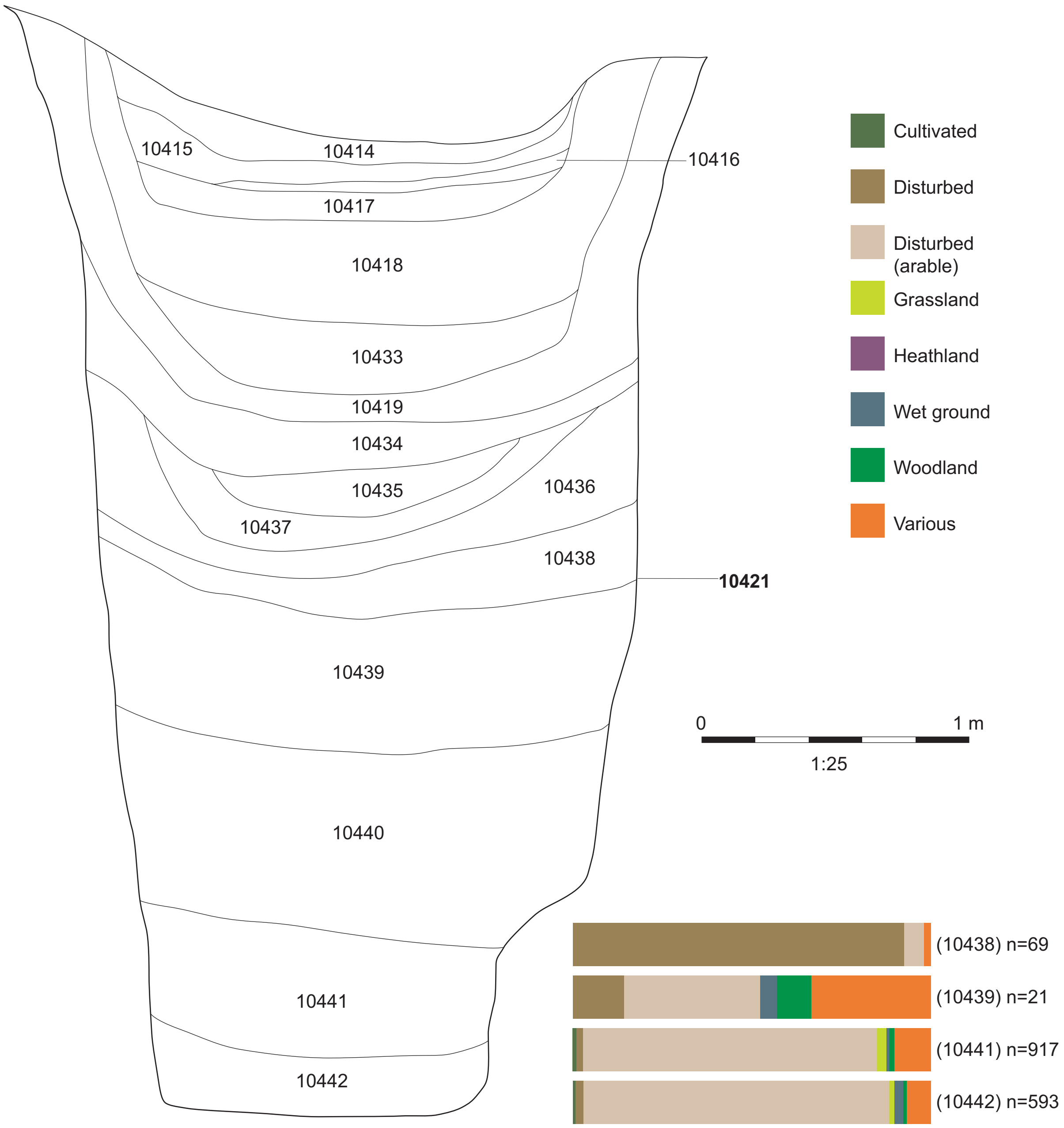

FIG. 132. Proportion of seeds classified by habitat group in Well 10421.

sp. and *Ranunculus repens*) were present, as well as wet ground plants (*Eleocharis palustris*, *Isolepis setaceae*). A single *Ulex europaeus* frond was identified from context 10441. Several cultivated plants were present. In context 10442, two endocarp fragments of *Olea europaea* (olive) were identified with one seed of *Apium graveolens* (celery). Eight seeds of *Apium graveolens* were present in context 10441, as well as one seed of *C. sativum* (FIG. 133). *Corylus avellana* (hazelnut) shell fragments were present in both fills. Contexts 10439 and 10438 both contained a low density of seeds, with large numbers of *Juncus* ssp. and Poaceae indet., and *Sagina* sp. in context 10438, and lower quantities of plants of disturbed ground (various *Papaver*), wet ground and woodland (*Carex* sp., *Rubus* Sect. *Glandulosus*). Sample 4029 (10436) contained a few poorly preserved plant remains (*Triticum spelta/dicoccum* glume bases, *Bromus* sp., *Carex* sp.). Overall, there was a low presence of grassland and heathland taxa.

FIG. 133. Images of plant remains. (a) Waterlogged cultivated and wild plant foods. Top row L-R: *Olea europaea*, *Anethum graveolens*, *Coriandrum sativum*, *Apium graveolens*. Bottom row L-R: *Malus* sp., *Rubus* sect. *Glandulosus*, *Sambucus nigra*. (b) Waterlogged stable flooring material. Top row L-R: *Sphagnum* sp., *Ulex europaeus* frond, *Pteridium aquilinium* frond, *Linum usitatissimum* seed, *Linum usitatissimum* capsule, *Agrostemma githago* fragment. Bottom row L–R: *Linum catharticum*, *Trifolium* calyx, *Prunella vulgaris*, *Filipendula ulmaria*, *Rhinanthus minor*. Scale bar = 2 mm.

CHARRED PLANT REMAINS

Cereal and cultivated taxa

Charred plant remains were studied from a total of 73 samples from 58 individual contexts (Table 24). The majority of samples derived from pits, wells and ditches, with three contexts studied from features related to structures. Eleven contexts were studied from the upper fills of Ditch 11631, but as evidenced from the small finds, ceramics and soil micromorphology the upper fills reflect the gradual accumulation of material and are likely to contain later Period 0 as well as some intrusive Period 1 material. The feature groups not covered are due to an absence of samples from those contexts or the absence of charred plant remains present in available samples. Densities of charred plant remains ranged from 0.1 to 84.2 items per litre, with the majority of samples containing below 10 items per L. No chronological pattern was observed in the average density of samples per feature group (Table 24). The gravelly soil and wet (and sometimes frozen) soil conditions during the later years of excavation may have affected charred plant remains through physical erosion. After the excavation area had flooded and frozen over the winter in 2011/2012, no samples with densities higher than 20 items/L were recovered (FIG. 134). The density of cereal grains (0–10.3 items/L) and cereal chaff (0–5.1 items/L) again show no change over time, indicating that cereal processing or handling was not taking place at a large scale within late Iron Age Insula IX, as the relative density within a region relates to the scale of cereal processing and consumption taking place (Van der Veen and Jones 2006). Furthermore, cereal grain preservation ranged from 'epidermis incomplete' to 'clinkered' (Hubbard and Al Azm 1990). The generally low densities of charred plant remains in samples from Insula IX suggest that they derived from regular daily activities, rather than large-scale consumption or production events. A combination of generally low densities of charred plant remains with often small sample sizes means that the number of items per sample is often low, and well below the

TABLE 24. SUMMARY OF SAMPLES ANALYSED FOR CHARRED PLANT REMAINS

Feature Group	Average density (all items/L)	No. of samples: Total	Crop-processing analysis	Weed ecology analysis
Ditch 11631	4.9	10	8	4
Pit Group 1	2.0	5	-	-
Pit Group 2	4.7	4	3	1
Pit Group 3	2.1	4	1	1
Pit Group 4	39.4	5	3	1
Pit Group 6	9.8	1	-	-
Pit Group 7	0.1	1	-	-
Pit Group 8	22.5	3	1	-
Pit Group 9	0.1	3	-	-
Pit Group 10	4.7	5	3	3
Pit Group 11	0.5	1	-	-
Pit Group 12	0.4	2	-	-
Pit Group 14	6.6	2	1	1
Well 8328	15.4	2	1	1
Well 10421	9.2	3	2	1
Buildings and Trackway	9.8	3	1 – Structure 10	1 – Structure 10

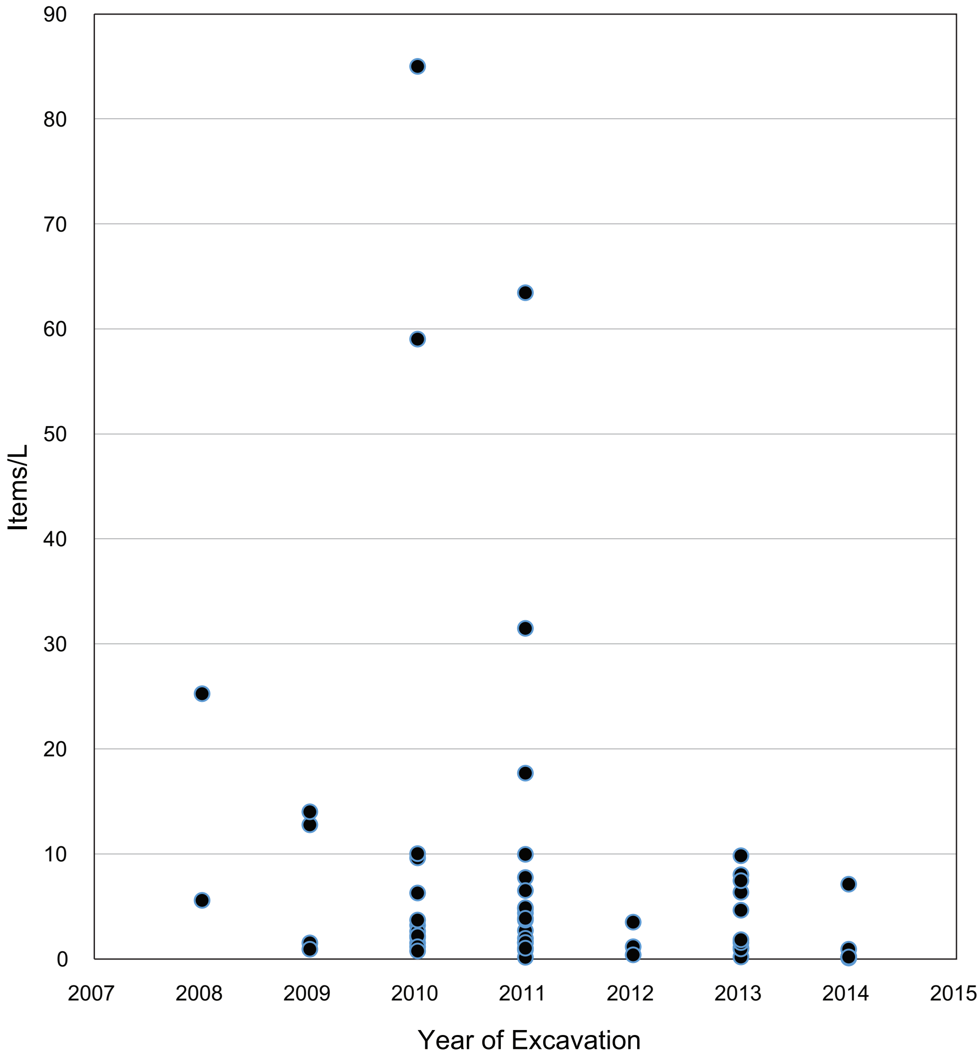

FIG. 134. Scatter graphs showing the density of charred plant remains per sample, classified by year of excavation.

desired numbers of *c*. 400 items. Hence, in the case of small samples, the conclusions need to be treated tentatively. However, given the spatial extent covered, and the large number of samples from the period overall, conclusions drawn from the repetitive presence of taxa are more secure.

The most frequent and abundant charred plant remains are the cultivated cereals *Triticum spelta* (spelt wheat) and *Hordeum vulgare* (six-row hulled barley). Spelt wheat grains were present in 34 per cent of samples, a total sum of 67 (n=67), and spelt wheat glume bases were present in 57 per cent of samples (n=329). Short-grained spelt was present in two samples. Sample 5622 from Pit 11721 in Pit Group 4 produced one short-grained spelt wheat grain alongside higher numbers of barley and spelt wheat. A cf. grain was recovered from Pit 11720 (sample 5427) in Pit Group 4 alongside small quantities of barley and spelt/emmer grain and chaff. Clearly short-grained spelt wheat was not cultivated as a separate crop at late Iron Age Silchester, but probably reflects genetic variation within the spelt crop, as concluded from Iron Age and third–fourth-century A.D. sites in the Danebury environs (Campbell 2000, 51; 2008, 66). *Triticum dicoccum* (emmer wheat) grains were present in 12 per cent of samples (n=10), and glume bases were also present in 12 per cent of samples (n=11). Glume wheat grains which could not definitely be assigned as spelt or emmer (*Triticum spelta/dicoccum*) were present in 45 per cent of samples (n=110), and glume bases in 55 per cent of samples (n=275). FIG. 135 displays the proportion

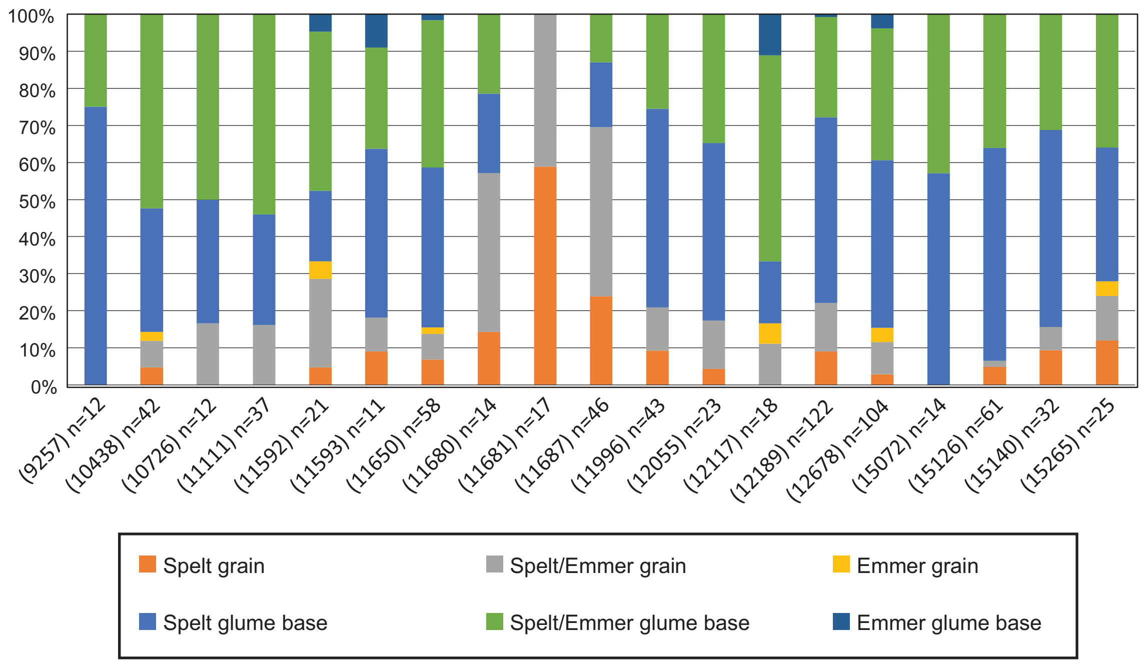

FIG. 135. Bar chart showing the proportion of spelt, emmer and spelt/emmer grain and glume bases in samples.

of spelt, emmer and spelt/emmer grain and glume bases within samples containing at least ten of these items, showing that emmer wheat always occurs in much smaller proportions than spelt wheat. Thus, spelt wheat was the only glume wheat crop being cultivated by the inhabitants of Insula IX, and emmer wheat represents a contaminant. Thus all *T. spelta/dicoccum*, *T. dicoccum* and *T.* sp. is treated as spelt wheat. Free-threshing wheat was identified from two samples, both as *Triticum* sp. cf. free-threshing cereal. One grain was present in sample 7068 in Post-hole 12781 from Structure 10, alongside a total of 16 glume wheat grains and five *Triticum* sp., with no free-threshing *Triticum* sp. rachis present. Likewise, in sample 2978 from Well 8328 (9170) one cf. free-threshing wheat grain was present alongside six barley grains, and one spelt/emmer wheat grain. Free-threshing wheat was not being consumed at late Iron Age Insula IX.

Barley was more frequent and abundant than glume wheat material, barley grain being present in 72 per cent of samples (n=294), and barley rachis in 29 per cent of samples (n=75). A range of twisted and straight grains were present showing that the barley was six-rowed. Many grains were identified as hulled, and none as naked. Some lax-eared barley rachis was present.

No other cereal crops were identified. The only *Avena* sp. floret base present in Pit 11721 (sample 5622) from Pit Group 4 was identified as *fatua/ludoviciana* (wild type). Small quantities of cultivated pulses were present in 16 per cent of samples (n=10). Of these, four samples contained cf. *Pisum sativum* (garden pea), the identification of which was based on shape and internal texture. *Pisum/Vicia* was identified in six samples. As pulses are likely to be under-represented in charred assemblages due to their fragility (Green 1982, 42), it is not possible to estimate their importance as a food crop. Seeds of the oil crop, flax, were present in 17 per cent of samples (n=15), across all phases. *Papaver somniferum* (opium poppy) may also have been used as an oil crop. One seed was present in sample 8788 from Ditch 11631 (12055) and, given the presence of crop-processing waste in the ditch, it most likely represents an arable weed. One *Apium graveolens* was present in Pit 11721 (sample 5542) from Pit Group 4 and one *Apium* sp. in Pit 16075 (sample 10382) from Pit Group 11. *A. graveolens* is a salt marsh plant which grows wild only in damp brackish places close to the sea (Stace 1997, 511). Considering the inland location of Silchester and the presence of *A. graveolens* in the waterlogged assemblage, it is more likely that the seeds represent cultivated plant food.

Wild taxa

Other charred plant remains present represent collected resources. *Corylus avellana* (hazel) nutshell fragments were present in 47 per cent of samples (n=114). These may be under-represented as the nutshell fragments were mainly recovered from residues sorted on-site by students. *Rubus* sect. *Glandulosus* (blackberry) was a rare occurrence, present in 7 per cent of samples (n=4). *Sambucus nigra* (elder) was present in 9 per cent of samples (n=25). Hazelnut, blackberry and elderberry are probably evidence of wild plant food consumption. Other collected resources represented are Ericaceae indet. capsules, present in 21 per cent of samples (n=1052), but mainly present in sample 10441 in Pit 15142 from Pit Group 10 and sample 5991 in Pit 11694 from Pit Group 8. These are likely to be from *Calluna vulgaris* (heather) given its presence in the waterlogged assemblage. Other vegetative items were present in the charred dataset. Leaf abscission pads were present in three samples, with seven present in sample 3216 from Well 8328. Indet. buds were present in 27 samples, with individual bud scales present in six samples. Several vesicular lumps were present. Tentative identifications of bread fragments were made to pieces which included cereal bran and consisted of vesicular material. Stem fragments were also present.

The majority of the wild taxa represent herbaceous plants of ruderal and arable land, most likely representing arable weeds. The most frequent and abundant taxa are *Eleocharis palustris* (60 per cent, n=200), *Rumex* sp. (59 per cent, n=224), *Bromus secalinus* (55 per cent, n=474), *Chenopodium album* (41 per cent, n=141), *Vicia/Lathyrus* (40 per cent, n=114), *Polygonum aviculare* (40 per cent, n=68), *Medicago/Trifolium/Melilotus* (40 per cent, n=99) and *Rumex acetosella* (38 per cent, n=73). Several rare wild taxa were also present. *Onopordum acanthium* (cotton thistle), a tall biennial found in waste and rough ground, was found only in Ditch 11631 (sample 8788). The only other Iron Age record is from Farmoor, Oxon., in the Upper Thames Valley (Robinson 1979; Preston *et al.* 2004), and several seeds have been identified from two Roman waterholes at Heathrow Terminal 5 in the Middle Thames Valley with possible uses suggested including oil, down, medicinal or as food (Carruthers 2006). *Reseda lutea* (wild mignonette) occurs only in sample 5991 in Pit 11694 from Pit Group 8, a biennial/perennial weed of arable and waste ground, especially found on calcareous soils (Stace 1997, 282), and considered an Iron Age or Roman introduction (Preston *et al.* 2004). Other rare occurrences were wet ground plants. One seed of *Persicaria hydropiper* (water-pepper), an annual plant of damp places and shallow water, was present in Ditch 11631 (sample 7232). *Isolepis setaceae* (bristle club-rush), a plant of wet ground in ditches, fens, marshes, heaths etc., was present in Well 8328 (sample 2978). One Iridaceae indet. seed, a member of the Iris family, was present in sample 7140 in Pit 12179 from Pit Group 3. However, overall, the high frequency of spelt wheat and barley grain and chaff strongly implies that much of the charred plant remains are derived from crop-processing by-products.

Feature group descriptions

The composition of individual samples is now discussed by feature group (Table 81), in order to identify spatial patterns within the dataset. The components of all samples containing more than 20 identified items have been grouped into the following categories: spelt wheat, spelt glume base, barley grain, barley rachis, cultivated (flax, pea/bean), collected (Ericaceae, hazelnut, *Rubus*, *Sambucus*), and displayed as pie charts and plotted over plans (FIGS 136–137).

Eleven contexts were analysed from Ditch 11631, with a similar composition of plant remains along the length of the ditch (FIG. 136). Wild taxa made up the highest proportion in all contexts, followed by spelt glume bases, and spelt and barley grains. Higher proportions of barley grain were present in the central and southern sections of the ditch (contexts 11649, 11977, 11111, 11592, 11613, 12847) with more spelt glume bases in the central and northern sections (contexts 12189, 11650, 12055). *Hordeum* sp. grains were present in all samples, spelt glume bases in 91 per cent, spelt grains in 82 per cent, barley rachis fragments in 55 per cent and cereal culm nodes in 11 per cent of samples. Flax seeds were present in two samples from 11592 and 11650 and pea/bean in three samples from 11650, 12055 and 12189. Hazelnut shell was present in 55 per cent of samples and Ericaceae indet. seed capsules in 27 per cent. Arable weeds were frequent

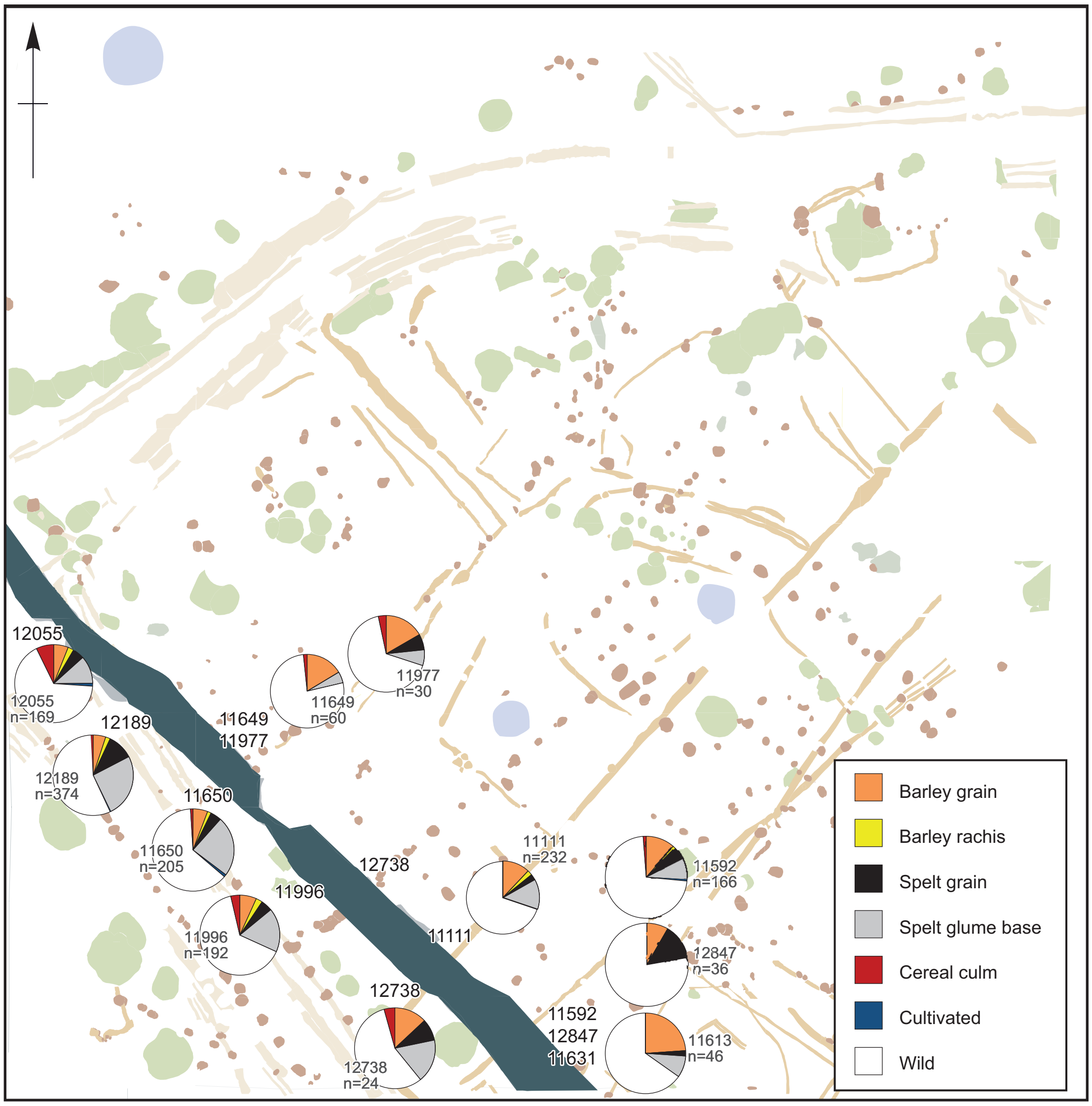

FIG. 136. Distribution of components of samples from Ditch 11631 containing charred plant remains.

and made up a large proportion of most samples. The most common were *Bromus secalinus*, *Eleocharis palustris* and *Rumex* sp. (100 per cent), *Carex* sp. (91 per cent), *Chenopodium album* and *Polygonum aviculare* (82 per cent), *Avena* sp. (73 per cent), *Vicia/Lathyrus* (64 per cent), *Stellaria media* (55 per cent). Ditch 11631 was also the source of several of the rare wild taxa, such as *Cerastium fontanum*, *Lychnis flos-cuculi*, *Scleranthus annus* and *Spergula arvensis*.

A relatively high density of charred plant remains was recovered from contexts 10438 and 10439 in Well 10421, respectively 14.2 and 15.5 items/L. Fill 10438 contained grain and chaff of spelt wheat and barley, and a typical range of weed seeds. Smaller quantities of spelt and barley cereal grain were recovered from 10436, alongside hazelnut shell fragments and a few weed seeds. Sample 4085 contained barley grain and rachis, spelt glume bases, a few Poaceae indet. seeds and a hazelnut shell fragment. Considering the period as a whole, samples 4068 and 4085 contained the highest proportions of barley rachis. From Well 8328, a higher density of charred plant remains was present in fill 9257, containing barley grain and rachis, spelt glume bases and weed seeds, with a similar range of materials also in sample 2978 from fill 9170.

Again, low densities of charred plant remains (average two items/L) were recovered from five samples from Pit Group 1, which flanked Trackway 2 in the North-West Compound. Whilst only traces of barley grain, spelt wheat grain and glume bases were present, there were larger

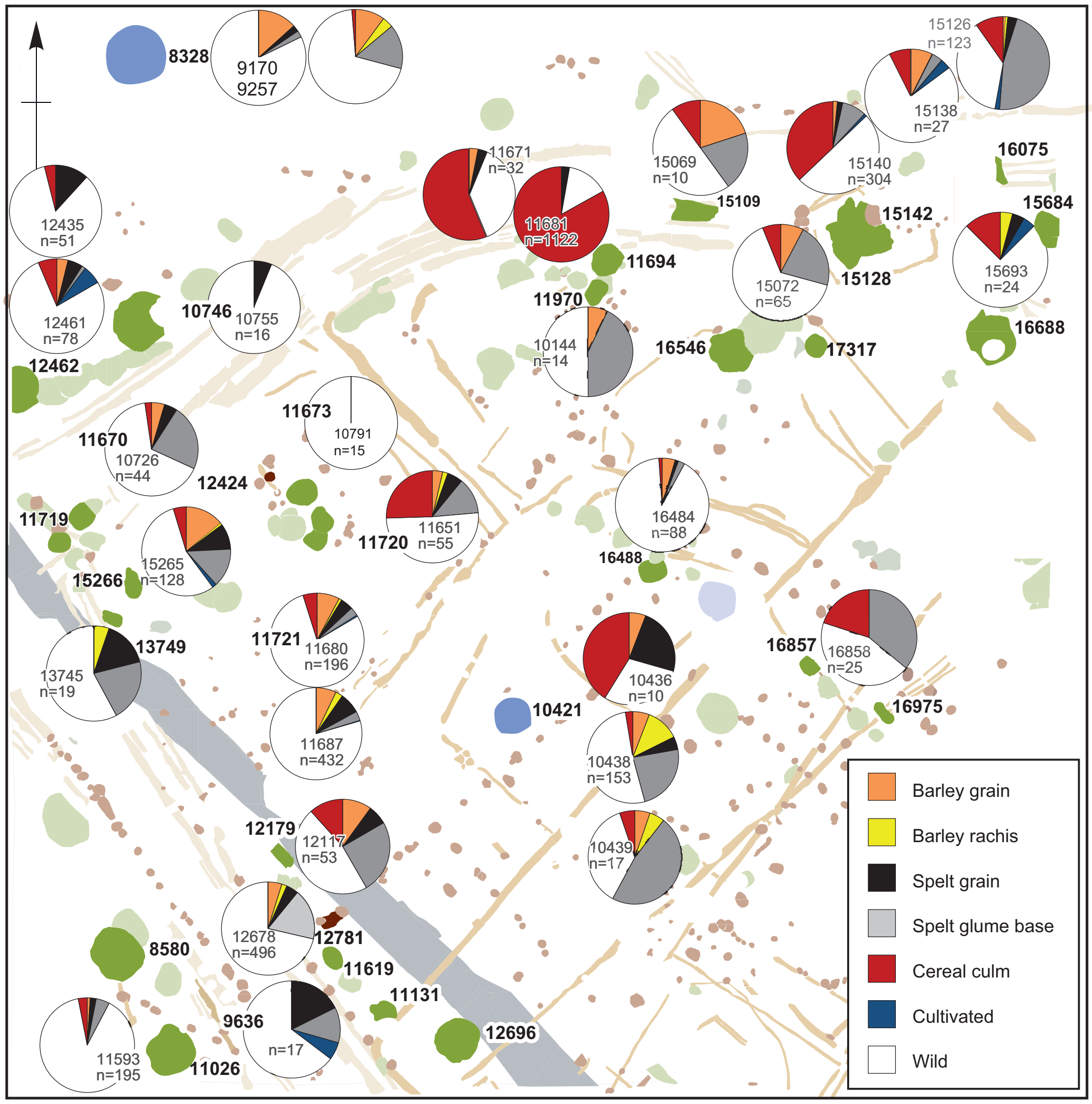

FIG. 137. Distribution of components of samples from pits and wells containing charred plant remains.

quantities of wild taxa (FIG. 137), including the typical range of arable weeds, notably *Bromus secalinus* (80 per cent) and *Carex* sp. (60 per cent). Several rare grassland taxa, *Rhinanthus minor*, *Linum catharticum* and *Potentilla erecta*, were present in this pit group. At the western limit of the excavation, two samples were studied from the large Pit 12462. No mineralised plant remains were present in the residue of sample 6767 (12461), but the presence of bone splinters indicated the likely presence of faecal material. The charred plant remains from sample 6767 included flax, wild resources, possible grassland taxa, some barley and spelt grains, and sample 6633 (12435) included spelt grains, hazelnut shells, Poaceae indet. and weeds. Two samples from the large Pit 10746 contained a typical range of arable weed seeds, with some barley grains in sample 4976 (10730). Similarly, sample 9041 (15069) from Pit 15109 at the southern edge of the trackway contained a few arable taxa and two barley grains.

Samples from Pit Group 2 each derived from a different pit (11670, 11719, 13749 and 15266), but all contained both spelt wheat and barley crop remains, and small quantities of weed seeds, with *Chenopodium album*, *Rumex* sp. and Poaceae indet. in 75 per cent of the samples. Wild taxa made up the highest proportion of all of the samples, followed by spelt glume bases, spelt and barley grains, as well as barley rachis in Pit 13749 (13745).

Pit Group 3 (FIG. 137) produced low densities and small quantities of charred plant remains.

One of the few samples associated with a building was sample 6530 from Pit 12696 in the southern central end of Structure 9, and this contained only one *Pisum sativum*/*Vicia faba* and a few weed seeds. Sample 7140 was interpreted as *in-situ* burning within the upper fill of Pit 12179. It contained spelt and barley grains, spelt glume bases, hazelnut shell fragments and a few weed seeds. Similarly, Pit 11131 (sample 5425) and Pit 11619 (sample 5723) contained only traces of cereals and weed seeds. Sample 9655 from Pit 14658 produced two cf. Pisum sativum grains which were radiocarbon dated (Barnett, p. 347).

Pit Group 4, in the centre of Enclosure 3, produced a high average density of charred plant remains at 39.4 items/L, due to the composition of samples 5542 (11680) and 5622 (11687) from small Pit 11721. Sample 5622 contained 30 barley grains, 31 spelt grains, 11 barley rachis, 14 spelt glume bases and one pea/bean, but most of the sample consisted of wild taxa — 208 Poaceae indet. seeds, 64 *Avena* sp., 45 *Bromus secalinus* and 10 *Rumex* sp. Overlying context 11680 sample 5542 had a very similar overall composition (FIG. 137), but with the presence of additional wild taxa, including *Malva sylvestris*, *Brassica* sp., and the collected resources hazelnut shell and *Rubus* sect. *Glandulosus*. Samples from two other pits produced lower quantities of charred plant remains. Sample 5427 (11651) had a similar composition to those from Pit 11721, but at lower densities, containing barley grain and rachis, spelt grain and glume bases, and higher proportions of collected taxa — hazelnut shell fragments, as well as *Juncus* indet.

One sample, 11033, was studied from Pit 16488 in Pit Group 6. It contained small numbers of barley grains and spelt glume bases, and higher quantities of wild taxa including Poaceae indet., *Persicaria lapathifolia*/*maculosa*, *Vicia*/*Lathyrus*, *Medicago*/*Trifolium*/*Melilotus* and *Plantago lanceolata*. Similarly, only one sample, 6752, was studied from Pit 12447 in Pit Group 7. A particularly low density of charred plant remains was present (0.1 items/L), with only one hazelnut shell fragment and one Poaceae indet. identified.

For Pit Group 8, two samples were studied from Pit 11694. Sample 5991 (11681) contained very high numbers of Ericaceae seed capsules (n=902), *Sambucus nigra* (n=19) and high numbers of grassland taxa, *Ranunculus a .r .b.* (n=16) and *Medicago*/*Trifolium*/*Melilotus* (n=14). There were small proportions of cereal remains, consisting of 17 spelt wheat grains, ten *Triticum* sp. and one culm node. Sample 5543 from the overlying context 11671 contained a similar proportion of taxa, with 18 Ericaceae indet. seed capsules, four *Ranunculus a. r. b*, *Carex* sp., *Eleocharis palustris* and one *Hordeum* sp. grain (FIG. 135). There is no plant macrofossil evidence for the use of Pit 11694 for cereal storage. Sample 6667 from Pit 11970 contained different proportions of plant remains, albeit with a low number of total items. Six spelt glume bases, one *Hordeum* sp. grain and a few weed seeds were present.

Pit Group 9, in the eastern enclosures, produced very low quantities of charred plant remains (average density 0.1 items/L). Single barley grains were present in each sample, alongside a hazelnut shell fragment in sample 11892 from Pit 16546 and an Ericaceae seed capsule and *Sambucus nigra* in sample 12100 from Pit 17317.

From Pit Group 10, the average density of charred plant remains recovered was relatively high at 4.7 items/L. Considering the pit group overall, there was a high frequency of flax seeds and Ericaceae indet. seed capsules, both present in four out of five samples, and higher frequencies of *Ranunculus a. r. b* (60 per cent) and *Malva sylvestris* (80 per cent) than normal. Three samples were studied from Pit 15142 in the centre of Structure 15. 373 items were identified from sample 10441 (15140), which contained barley and spelt grain, spelt glume bases, pea/bean, flax, hazelnut shell and Ericaceae indet. seed capsules alongside a wide range of wild taxa, the most abundant of which were *Vicia*/*Lathyrus* (n=12), *Rumex* sp. (n=12), *Chenopodium album* (n=10), *Eleocharis palustris* (n=13), *Carex* sp. (n=15) and Poaceae indet. (n=42). Samples 10270 (15126) and 10557 (15138) contained fewer plant remains, but with similar proportions and with the majority of the taxa present in 10441. Sample 9183 from Pit 15128 contained barley grain and spelt glume bases, the collected resources *Sambucus nigra* and Ericaceae indet. seed capsules alongside higher quantities of wild taxa, including the rare grassland plants *Prunella vulgaris* and *Rhinanthus minor*. Sample 11012 (15693) from Pit 15684 contained barley rachis, Ericaceae indet. capsules, a flax seed and weed seeds.

Two samples were studied from Pit Group 11, underlying the later north–south Roman street.

A low density of charred plant remains was present (average 0.5 items/L). Sample 12124 from Pit 16688 (16691) produced only one hazelnut shell fragment. A single cf. *Apium* sp. seed was recovered from sample 10382 from Pit 16075, alongside one barley grain and four spelt glume bases.

Pit Group 12 had the lowest average density of charred plant remains of 0.4 items/L. Sample 12163 from Pit 16975 contained only three spelt glume bases, one *Vicia/Lathyrus* and one Poaceae indet, whilst sample 11894 from Pit 16857 (16867) contained only two cereal indet. grains. Another sample from this pit, 11869 from layer 16858, contained some Ericaceae indet. seed capsules and small quantities of weed seeds.

Two pits were studied from Pit Group 14 flanking Trackway 1 in the South-West Compound. Just one spelt grain, one flax seed and a few weed seeds were identified from sample 3737 in Pit 8580 (9110). To the south-east, two samples were studied from the upper fills of Pit 11026. Of these, sample 5546 (11593) contained small quantities of barley grain, spelt grain and glume bases and hazelnut shell fragments, but many wild taxa, the most abundant of which were Poaceae indet. (n=65), *Juncus* indet. (n=65), *Rumex* sp. (n=21), *Bromus secalinus* (n=9), and smaller quantities of *Atriplex* sp., *Avena* sp., *Bromus secalinus*, *Cerastium fontanum*, *Polygonum aviculare*, *Rumex acetosella*, *Stellaria graminea* and *Stellaria media*. Sample 5595 from overlying fill 11603 contained only one barley grain, one hazelnut shell fragment and no wild taxa.

A single sample, 4749, from Gully 9636 of Trackway 1 had a typical composition of a few spelt grains and glume bases, one pea/bean and Poaceae indet. seeds.

Sample 6051 from Post-hole 12424 in Structure 13 produced one flax seed, one *Medicago/Trifolium/Melilotus* and one Poaceae indet. Many more charred plant remains were recovered from Post-hole 12781 (sample 7068) in Structure 10. The high density of charred plant remains (32.1 items/L) included 24 barley grains, 16 spelt grains, 9 barley rachis, 88 spelt grains and numerous arable weeds, including *Bromus secalinus* (119), *Vicia/Lathyrus* (29) and *Avena* sp. (22).

Overall, there is clear variation within the charred plant remains present within feature groups, with Ditch 11631 and Pit Groups 4 and 8 representing foci for the deposition of charred plant remains. There are some interesting occurences, such as the high frequency of flax in Pit Group 10, but no overall spatial pattern is observed, as flax is also present in Pit Group 14 (south-west), Pit Group 1 (north-west), Structure 13 (centre-west), Pit Group 2 (centre-west) and Ditch 11631.

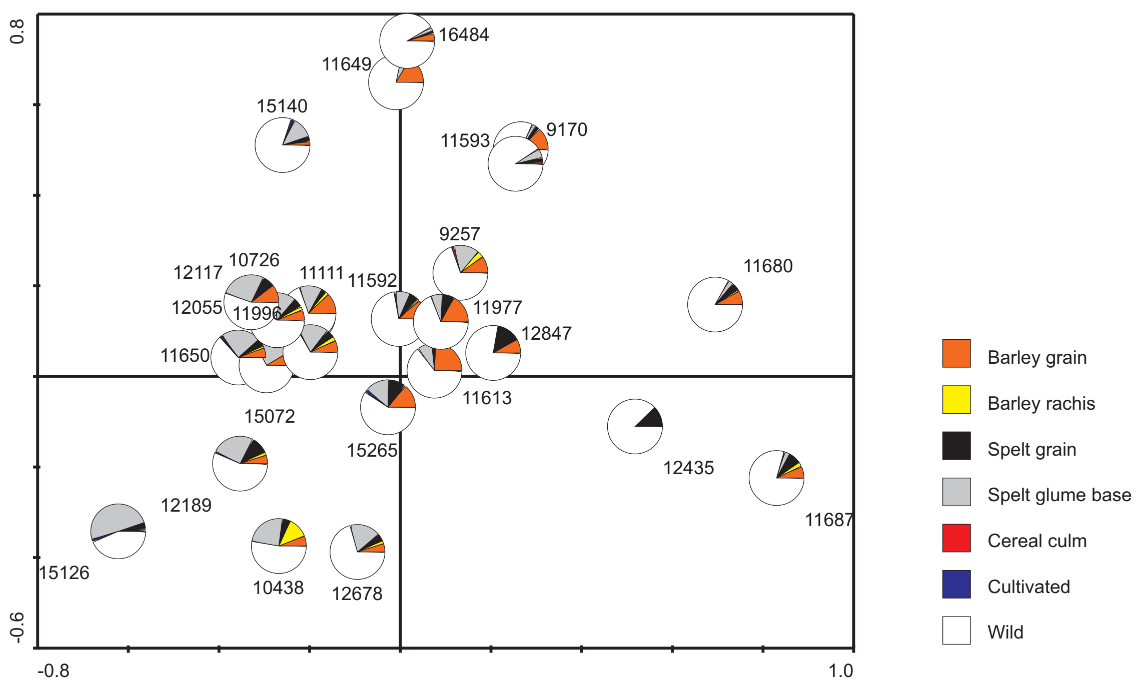

FIG. 138. CA plot of crop, collected and wild contents of charred samples, sample pies classified by crop type. 25 samples, 29 taxa.

Correspondence analysis

In order to further explore the spatial and chronological patterns correspondence analysis has been applied. The initial analysis of all samples and taxa (plot not shown) confirmed the observations of the above analysis. Samples from Pit 11694 (11671, 11681) plotted as outliers due to the presence of Ericaceae indet. capsules, *Sambucus nigra* and *Ranunuculus a. r. b.*, and to a lesser extent fill 15140 of Pit 15142 also plotted as an outlier due to the presence of Ericaceae indet. Context 12461 plotted as an outlier due to the presence of flax seeds and *Sambucus nigra*. FIG. 138 shows all samples, their composition classified by crop, cultivated and wild categories.

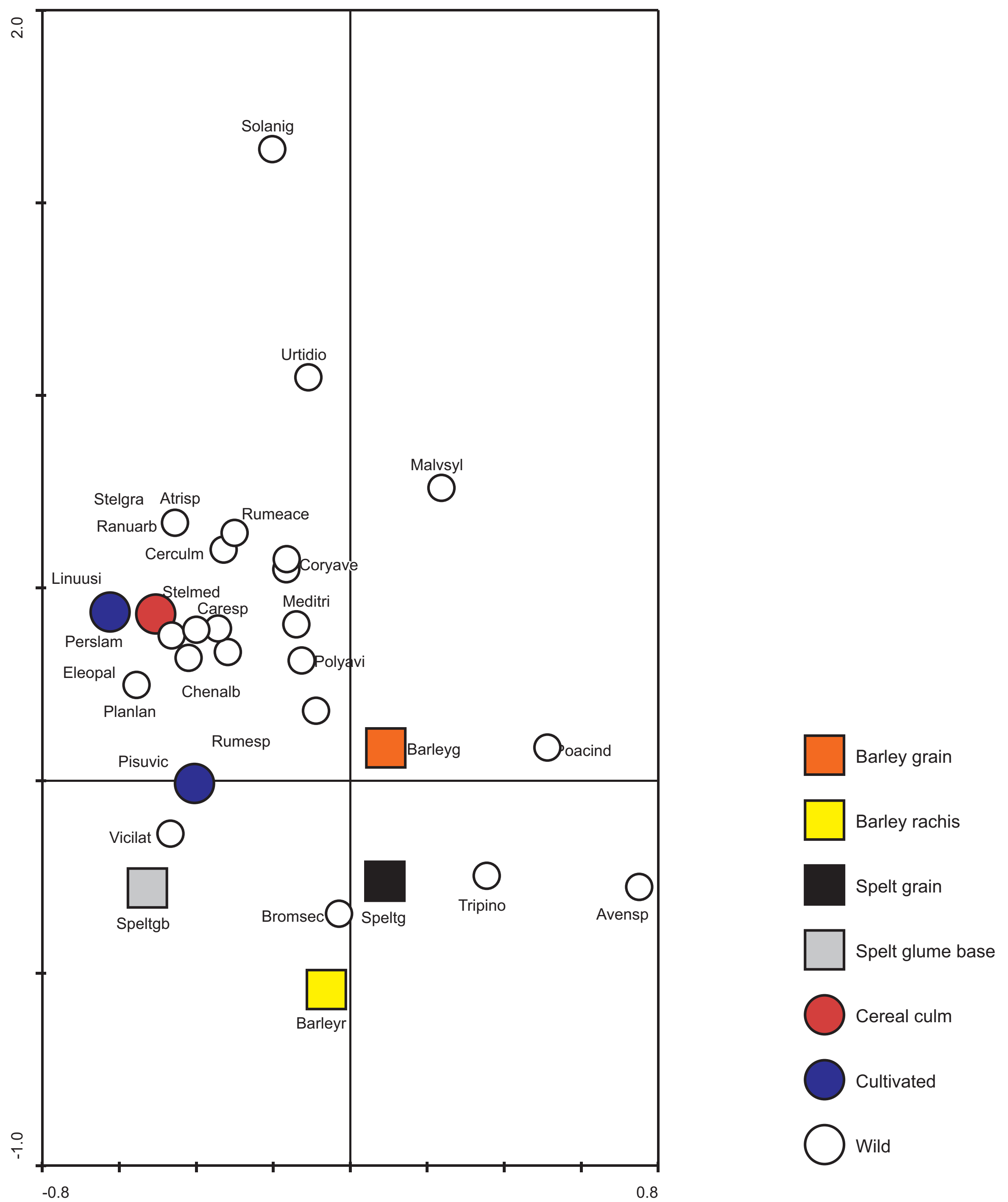

FIG. 139. CA plot of crop, collected and wild contents of charred samples, taxa classified by crop type. 25 samples, 29 taxa.

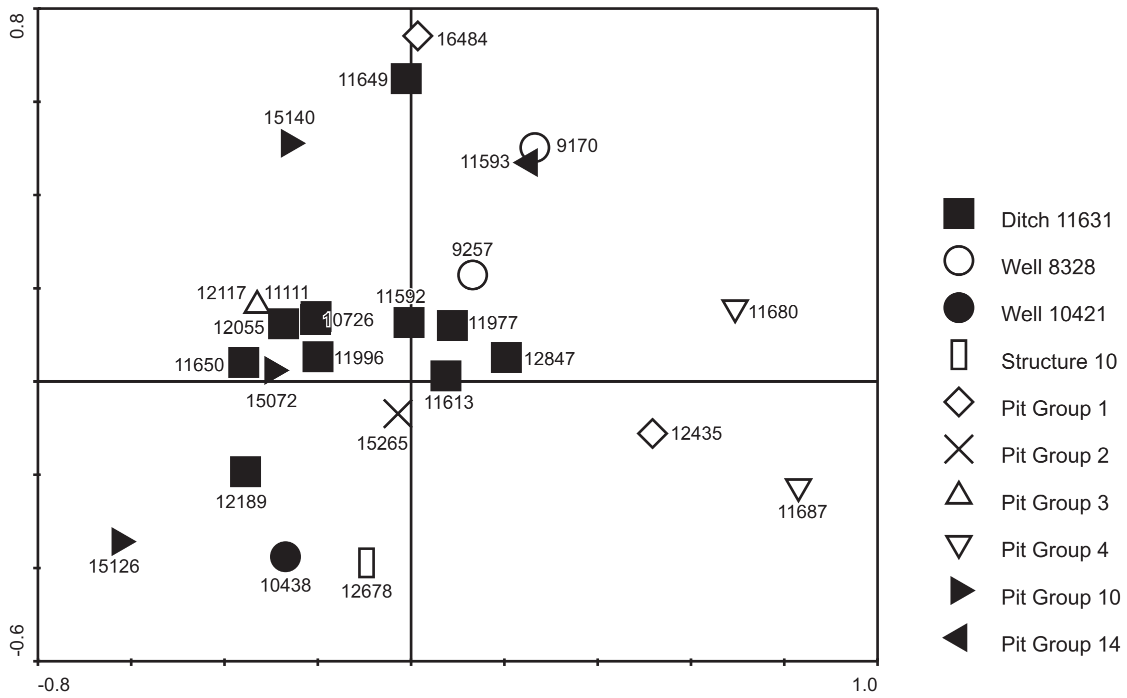

FIG. 140. CA plot of crop, collected and wild contents of charred samples, samples classified by feature type. 25 samples, 29 taxa.

On the positive x axis, samples with a high proportion of wild taxa (11680, 12435, 11687) are located on the middle of the x axis (samples had higher proportions of barley grain); on the negative x axis samples contained a higher proportion of spelt glume bases. On the positive y axis, samples also had a high proportion of wild taxa, and on the negative y axis, higher proportions of barley rachis. The corresponding taxa plot (FIG. 139) shows that the taxa located on the positive x axis are *Avena* sp., Poaceae indet., *Tripleurospermum inodorum* and spelt and barley grains. On the negative x axis are many small weeds seeds, and also spelt glume bases, cereal culm, flax and pea/bean. *Solanum nigrum* and *Urtica dioica* are located on the positive y axis, and barley rachis, *Bromus secalinus* are plotted on the negative y axis.

FIG. 140 plots the samples by feature type and shows that samples from Ditch 11631 are very similar in compostion, consisting of spelt glume bases, barley grain and wild taxa. The composition of samples from Pit Group 4 and Well 8328 is also similar. The CA plots show that many of the wild taxa are closely associated with spelt glume bases (*Vicia/Lathyrus*, *Plantago lanceolata*, *Chenopodium album* and *Rumex* sp.), and hence almost certainly arable weeds. The arable status of other wild taxa is less certain, for instance *Malva sylvestris*, *Solanum nigrum* and *Urtica dioica*, which plot with samples 11649 and 16484. Cultivated (flax, pea/bean) and collected taxa (hazelnut shell) are located on the negative x positive y axis, amongst small weed seeds found alongside spelt glume bases, indicating that they were deposited alongside crop-processing waste.

SOURCES OF PLANT REMAINS

WATERLOGGED PLANT REMAINS

Sequence of well deposits

In order to determine the likely sources for the waterlogged plant macrofossils identified from the two late Iron Age wells, it is necessary to consider their context within the well shafts. Context 10442 in Well 10421 is the primary fill, meaning that the plant remains are evidence of the daily activities taking place in the area around the well shaft (Greig 1988a) and/or initial erosion and stabilisation of the well profile. Overlying context 10441 represents a dump of non-organic material, mainly clay. The presence of placed pots within 10442 has been interpreted as a deliberate act (p. 44). Considering the low density of waterlogged plant remains present in this context, it seems unlikely that any of these represent purposeful ritualised deposition. The new plant foods identified from this well most likely represent waste from nearby dining. Further refuse material was dumped into the well forming contexts 10439 and 10438.

In contrast, the waterlogged plant remains recovered from Well 8328 derive from a series of dumps of richly organic material, and thus are more likely to reflect dumps of assemblages of material deriving from single activities. Contexts 9663 and 9309 are similar in terms of their artefactual and archaeobotanical composition. Again, a structured deposit, of three complete pots, was placed in the primary fill 9680, and burnt fragments of quernstone, a small complete pierced pot and an intact pot were found within 9309. A further deposit of midden-type material (9258) was placed into the well, followed by a small deposit of probable sewage (9257).

Identification of indicator groups

The artefactual and archaeobotanical contents of wells typically derive from a mixture of anthropogenic and natural sources, including domestic and agricultural refuse, hindering the identification of discrete sources of plant macrofossils (Greig 1988a). The presence of dumped material within Well 8328 means that the set of plant remains can be considered together. A diverse range of taxa, combined with vegetative fragments of grassland plants such as *Trifolium* calyx and flower, a *Viola* subg. *Melanium* capsule and indet. stem fragments can be interpreted as cut grassland material. The distinct range of taxa present (*Filipendula ulmaria*, *Prunella vulgaris*, *Rhinanthus minor*) has previously been identified as similar to the British NVC groups (Rodwell 1993) mesotrophic grassland 4 (MG4) *Alopecurus pratensis-Sanguisorba officinalis* and mesotrophic grassland 5 (MG5) *Centaureo-Cynosuretum cristati* (Greig 1984; 1988b; Robinson 2007). Other waterlogged plant remains from this context may also have derived from hay meadow vegetation, such as *Juncus* indet. and Poaceae indet. Hay meadow vegetation occurs today when alluvial grassland is closed off to animal grazing in the spring, cut for hay in June, and then grazed from early August onwards. Cereal bran is likely to have derived from animal faecal material, and several plants which grow in wet bankside conditions (*Apium nodiflorum*, *Ranunculus* subg. *Batrachium*) may have also been ingested through grazing. The abundance of wet ground plants in general could have derived from a range of sources from thatching to flooring, to dung, to arable weeds. The absence of any clear evidence for roofing material in the well fills makes the first option unlikely.

A range of heathland plants, *Pteridium aquilinium* (bracken), *Ulex europaeus* (gorse) and *Calluna vulgaris* (heather), is unlikely to have been growing within the settlement area and probably represents gathered material which could have been used for a range of uses including fodder, bedding and fuel (Mabey 1977; Rymer 1976; 1979). However, their co-occurrence with hay and dung strongly suggests that they were used as bedding and/or fodder for animals stabled close by. This combined group of material matches the indicator group termed 'stable flooring material', consisting of coarse-textured material accumulated in a byre or stable (Kenward and Hall 1997; Hall and Kenward 1998). The abundance of seeds of nitrophilous weeds of disturbed ground (*Chenopodium album*, *Urtica urens*) is likely to be linked to the presence of stable manure, and is probably derived from plants growing on middens of the material. When combined with the artefacts present from these contexts — nails, vivianite and animal bones — it allows the identification of the whole indicator package of stable manure. The palaeoentomological remains from Well 8328 (Robinson, p. 278) indicate the presence of grassland vegetation and mouldy plant material, but house fauna and grassland feeding weevils typical of stable flooring material are under-represented (Kenward and Hall 1997). The coarse texture of the plant remains indicates that the material originated from horses, rather than cattle or caprines (Wilson 1979).

The indicator group for flax processing for linen fibres includes aquatic plants, scutching waste (fibres) and flax specific weeds (Hall and Kenward 2003). Little evidence of the first two is present, but *Spergula arvensis*, a typical weed of flax fields (Campbell and Robinson 2009), is present alongside flax in samples from context 9309 in Well 8328. Either way, flax retting would have taken place off-site in rivers or retting pits, and cannot be proven from on-site evidence. The presence of flax seeds and capsules alongside stable manure deposits shows that one use of by-products was as fodder, whilst this corresponds with their presence in Pit Group 10 alongside *Prunella vulgaris*, *Rhinanthus minor* and Ericaceae indet. capsules. Charred flax seeds were present in Structure 13 and Pit 15142 in the centre of Structure 15, suggesting it may be related to internal domestic activities.

Background activities and settlement vegetation

Other significant results are the earliest records within Britain of celery, coriander and olive (Lodwick 2014). Given their previous absence from Britain, they must represent waste from nearby food preparation and/or consumption. A single apple pip from sample 3217 in Well 8328 could be either native wild crab apple (*Malus sylvestris*) or introduced cultivated apple (Van der Veen 2008, 104). Hazelnut shell, elderberry, blackberry and sloe are also likely to have derived from the consumption of wild plant foods. Other wild taxa represented which may have been consumed are *Daucus carota*, *Mentha* sp. and *Papaver somniferum*. The range of wild and cultivated plant foods includes those with medicinal properties, yet typically these involve leaves, stems and flowers which are rarely recovered from waterlogged sediments. Considering the presence of taxa with conspicuous medicinal properties, such as *Atropa belladonna*, *Hyoscyamus niger* and *Papaver somniferum* (Grieve 1992), none is present in sufficient quantities from which a human use of these plants could be concluded. Where these are present, it is always alongside other plants of nitrogen-rich disturbed ground, and it is more likely that these plants represent aspects of the settlement vegetation within the *oppidum*.

Whilst many seeds are likely to come from settlement vegetation, assessing its character is difficult in anthropogenic sediments. Following Hall (1988) the co-occurrence of constant species in NVC groups has been assessed (Rodwell 2000). In no NVC group were all constants present. In the following groups, two out of three constants were present: OV1 (arable crops and impoverished soils), OV9 (disturbed, well-drained ground), OV18 (trampled ground), OV21c (heavily trampled ground) and M35 (temporarily wet areas). The most common of these in Wells 8328 and 10421 was OV9, identified by the co-occurrence of *Polygonum aviculare* and *Stellaria media* (Table 25). When the abundances of taxa are considered, the most abundant taxa in the primary fill of Well 10421 do indicate disturbance and trampling (*Capsella bursa-pastoris*, *Polygonum aviculare*, *Stellaria media* and *Urtica urens*). A further type of vegetation, not present in the NVC classification, is the 'urban flora' observed in various Roman and medieval archaeobotanical studies, containing *Atropa belladonna*, *Hyoscyamus niger* and *Solanum nigrum* (Hall 1988). These species are all present in Period 0, indicating the presence of a nitrogen-

TABLE 25. SUMMARY OF NVC GROUPS IDENTIFIED IN THE WATERLOGGED ASSEMBLAGE

NVC Group	Description	Constants (4 or 5)	No. of samples
OV1	Arable crops, impoverished soils	*Aphanes australis*, *Rumex acetosella*, *Viola* sp.	2
OV9	Disturbed, well-drained ground	*Polygonum aviculare*, *Stellaria media*, *Tripleurospermum inodorum*	9
OV18	Trampled ground	*Capsella bursa-pastoris*, *Matricaria recututa*, *Polygonum aviculare*	3
OV21c	Heavily trampled ground	*Plantago major*, *Polygonum aviculare*, *Ranunculus repens*, *Trifolium* sp.	2
M35	Temporary wet areas	*Montia fontana*, *Ranunculus* S. *Batrachium*, *Ranunculus flammula*	3

rich environment within the late Iron Age settlement, probably associated with the presence of animals, and the establishment of a more permanent disturbed ground community, grading into scrub (*Sambucus nigra* and *Urtica dioica*). The presence of *Montia fontana*, *Ranunculus flammula* and *Ranunculus* subg. *Batrachium* in the lower fills of Well 8328 may indicate the presence of damp areas around the well shaft.

CHARRED PLANT REMAINS

Crop-processing analysis

In comparison to the waterlogged plant remains, the assemblage of charred plant remains contains much more cereal material. Considering the high frequency of spelt glume bases and presence of typical arable taxa, it is most likely that the plant remains derived from crop-processing by-products. All samples reflect secondary deposits, with no *in-situ* primary deposits. It is considered here that if the composition of a sample is consistent with one crop-processing stage, it can be utilised in crop-processing and weed ecology analysis (Bogaard 2011, 151; Hillman 1984).

The calculation of dominant crop type in samples containing over ten identified crop items resulted in 16 spelt samples, three barley samples and five mixed samples. Ratio and discriminant analysis (DA) were applied to each sample in order to assign it to a single crop-processing stage (Table 26). This resulted in 11 spelt fine-sieve by-products (FSBPs). On three occasions ratio analysis classified a sample as a FSBP, and DA produced the result of FSP. This category has been described as 'pre-sieved FSBP'. These most likely derive from fine-sieve by-products from the dehusking of spikelets which had previously been sieved to remove most small weeds (Stevens 2003, 69–71). Samples classified as barley fine-sieve products, dominated by barley grain (5976 and 11644 from Ditch 11631, 5542 from Pit 11721), produced a DA result of FSBP. Barley grain and small free and heavy weed seeds do not occur together in any ethnographically observed crop-processing products or by-products (Hillman 1984; Jones 1984); hence the samples must represent the combination of plant remains from multiple sources. In fact, the majority of samples classified as spelt FSBP also contain barley grain. Perhaps the by-products of spelt wheat-processing were used to heat barley grains. This analysis has suggested that in most cases, the physical properties of wild taxa are consistent with being arable weeds. A taxon whose arable status has been previously debated, *Eleocharis palustris*, a perennial herb found alongside ponds, marshes, ditches and riversides, plots with taxa which are very likely to have been arable weeds (FIGS 136, 137) (Jones 1988a). Classification of the CA plot containing crops, collected items and wild taxa shows that the crop-processing stages defined through ratios and DA do correlate with the variation within the assemblage. The majority of samples located on the positive x axis (FIG. 141) were classified as mixed crop-processing products and by-products, or had too few crop items to be classified. Samples which were classified as spelt FSBP are mainly located on the negative x axis, with those classified as pre-sieved located on the negative y axis, associated with *Bromus secalinus* (FIG. 141).

Given the limited number of samples classified to a crop-processing stage, only limited patterns can be highlighted (Table 26). The highest number of samples to be classified as spelt FSBP originated from Ditch 11631. Other samples from this feature also contain low ratios of spelt grain to glume base, but higher proportions of barley grain, reflecting the same range of material. Other pit groups produced one or two spelt FSBP, with other samples unclassified due to the low number of items. A CA plot of just the crop content of samples confirms the findings of ratio analysis by showing that sample composition is reasonably similar. The main variation is between samples with higher proportions of spelt glume bases on the positive x axis, and samples with higher proportions of barley grain on the negative x axis (FIG. 142). This analysis has established that the final stages of crop-processing were occurring within the *oppidum*.

Other sources of charred plant remains

Whilst there is a strong input from the fine-sieving by-products of spelt wheat, other categories

TABLE 26. SUMMARY OF RESULTS OF CROP-PROCESSING ANALYSIS OF CHARRED PLANT REMAINS

Feature	Sample	Context	Crop Type	Spelt grain: Spelt glume base	Barley grain: Barley rachis	Ratio Outcome	DA 1st group	P value	DA 2nd group	Combined outcome
Ditch 11631	5956	11650	Spelt*	0.2	4	Spelt* FSBP	FSBP	0.99	4	Spelt* FSBP
Ditch 11631	5976	11649	Barley*	0.1	10	Barley* FSP	FSBP	1.00	4	mixed
Ditch 11631	6147	11996	Spelt*	0.3	2.6	Spelt* FSBP	FSBP	1.00	4	Spelt* FSBP
Ditch 11631	7232	11111	mixed	0.2	5.6	-	FSBP	0.98	4	-
Ditch 11631	7556	11592	mixed	0.6	9.5	-	FSBP	0.99	4	-
Ditch 11631	7713	12189	Spelt*	0.4	2.7	Spelt* FSBP	FSBP	0.98	4	Spelt* FSBP
Ditch 11631	8788	12055	Spelt**	0.4	2.5	Spelt** FSBP	FSBP	0.99	4	Spelt** FSBP
Ditch 11631	9061	11977	-	1	5	-	FSBP	0.99	4	-
Ditch 11631	11644	11613	Barley*	0.25	11	Barley* FSP	FSBP	0.74	4	mixed
Structure 10	7068	12678	Spelt*	0.2	2.7	Spelt* FSBP	FSP	1.00	3	Spelt* FSBP svd
Well 8328	3216	9257	Spelt**	0	2.7	Spelt** FSBP	FSBP	1.00	4	Spelt** FSBP
Well 10421	4068	10438	Spelt**	0.2	0.5	Spelt** FSBP	FSBP	0.97	4	Spelt** FSBP
Well 10421	4085	10439	Spelt	-	-	-	-	-	-	-
Pit 11670, Pit Group 2	5171	10726	Spelt*	0.2	-	Spelt* FSBP	FSBP	1.00	4	Spelt* FSBP
Pit 11719, Pit Group 2	5745	11718	mixed	0.5	-	-	-	-	-	-
Pit 15266, Pit Group 2	10329	15265	mixed	0.7	18	-	FSP	0.87	3	-
Pit 12179, Pit Group 3	7140	12117	Spelt*	0.3	-	Spelt* FSBP	FSBP	1.00	1	Spelt* FSBP
Pit 11720, Pit Group 4	5427	11651	Spelt*	0.4	2	Spelt* FSBP	FSP	0.74	3	Spelt* FSBP svd
Pit 11721, Pit Group 4	5542	11680	Barley**	1.5	8	Barley** FSP	FSBP	0.99	4	mixed
Pit 11721, Pit Group 4	5622	11687	mixed	2.3	2.8	-	FSP	0.99	3	-
Pit 11694, Pit Group 8	5991	11681	Spelt	29	-	Spelt FSP	FSBP	0.92	4	mixed
Pit 15128, Pit Group 10	9183	15072	Spelt*	0	-	Spelt* FSBP	FSBP	0.90	4	Spelt* FSBP
Pit 15142, Pit Group 10	10270	15126	Spelt	0.1	-	Spelt FSBP	FSP	0.74	3	Spelt FSBP svd
Pit 15142, Pit Group 10	10441	15140	Spelt*	0.2	-	Spelt* FSBP	FSBP	1.00	4	Spelt* FSBP
Pit 11026, Pit Group 14	5546	11593	Spelt*	0.4	-	Spelt* FSBP	FSBP	0.98	1	Spelt* FSBP

* = low levels of contamination (70–90% dominant crop type), ** = high levels of contamination (60–70% dominant crop type), svd = pre-sieved.
Samples with fewer than 10 crop items are not included

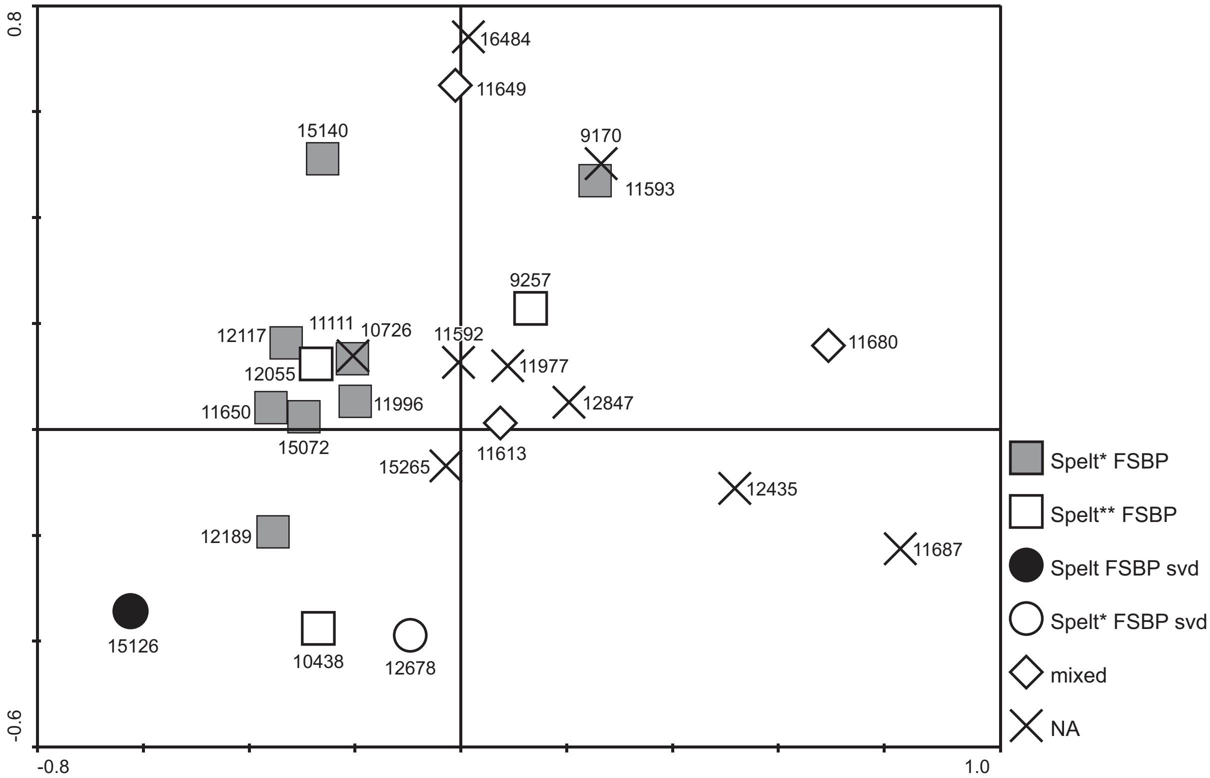

FIG. 141. CA plot of crop, collected and wild contents of charred samples, samples classified by crop-processing stage. 25 samples, 29 taxa.

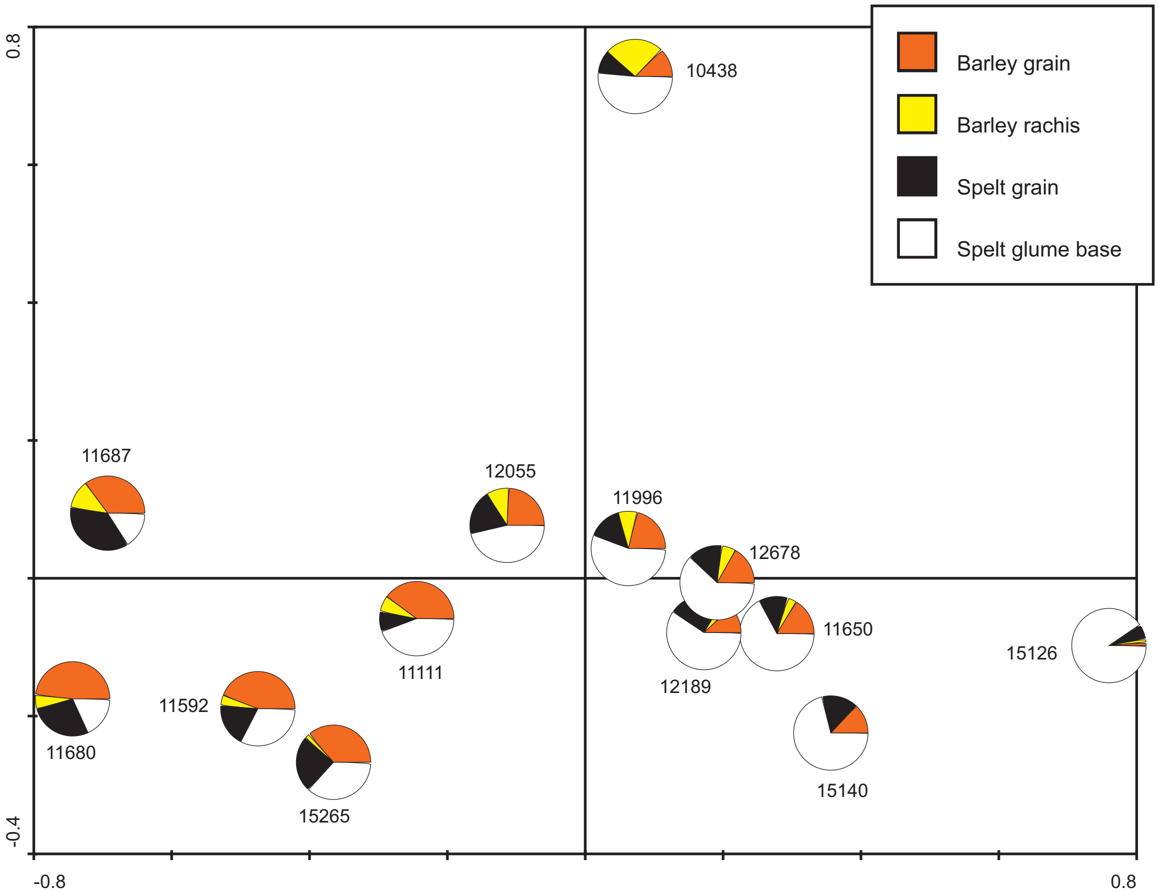

FIG. 142. CA plot of crop contents of charred samples, sample pies classified by crop type. 13 samples, 5 taxa.

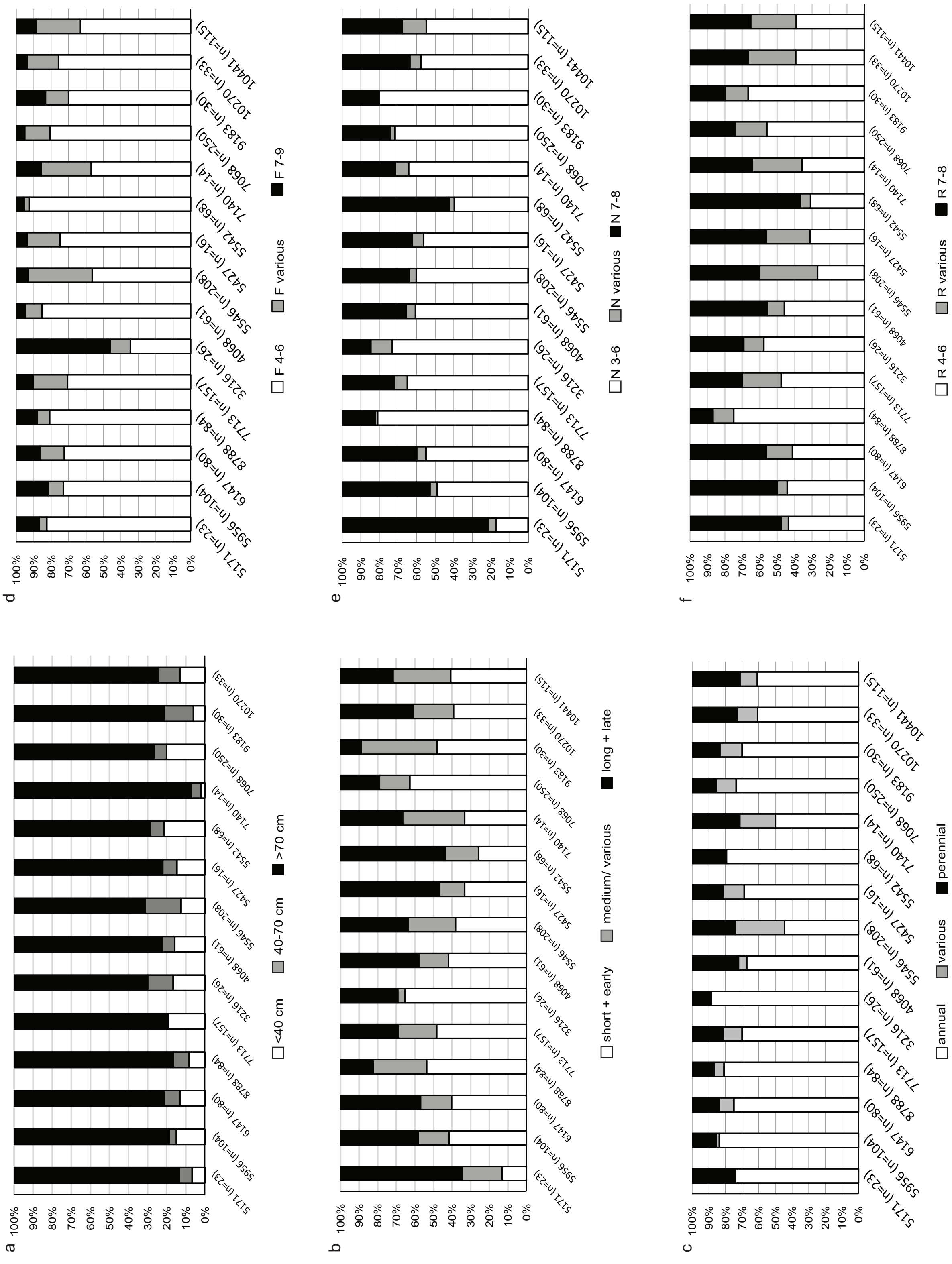

FIG. 143. Weed content of spelt FSBP samples, classified by: (a) harvest height; (b) flowering onset and duration; (c) life form; (d) F values; (e) N values; (f) R values.

of plant remains were being charred. Heather was being used as animal bedding or fodder, as indicated by the contents of Well 8328. In sample 5991 of Pit 11694 from Pit Group 8, the presence of Ericaceae indet. capsules alongside *Sambucus nigra* and *Ranunculus a. r. b.* may derive from the disposal of fodder through burning. Alternatively, *Sambucus nigra*, *Rubus* sect. *Glandulosus* and the numerous buds may derive from scrub vegetation collected for tinder. More widely, the presence of stems in several samples suggests the inclusion of cut grassland vegetation, most likely fodder, disposed of in fires. The frequent occurrence of hazelnut shell must represent the disposal of waste from food consumption, as do the rare *Apium graveolens* seeds. The most likely option is that samples represent the disposal of various categories of waste, the most dominant of which is crop-processing by-products from spelt wheat.

Cultivation practices

In the cases of samples classified as spelt FSBP, it can be accepted that the spelt cereal remains and the weed seeds have a shared origin in the same arable field. Due to the small number of spelt FSBP samples, variations in the levels of contamination and pre-sieved status accounted for the variation in a correspondence analysis plot of the weed content of spelt FSBP samples, rather than any spatial or chronological pattern. Hence, in order to investigate the cultivation practices, the range of arable taxa was reduced to those present in at least ten samples, and the range of spelt FSBP samples was reduced to those containing at least ten of these weeds, resulting in ten samples. The main weed taxa present were *Avena* sp., *Bromus secalinus*, *Carex* sp., *Chenopodium album*, *Eleocharis palustris*, *Plantago lanceolata*, *Polygonum aviculare*, *Rumex acetosella*, *Rumex* sp., *Stellaria media* and *Vicia/Lathyrus*. Many grass seeds were also present which could not be identified. Each weed taxon was categorised by autecological values and taxa were grouped into ranges of these values in order to identify trends. First, taxa were categorised by height. FIG. 143a shows that the highest proportion of taxa in all samples are >70 cm, however there is a consistent presence of taxa <40 cm such as *Plantago lanceolata* and *Polygonum aviculare*. This indicates that harvesting was taking place low on the stalk, with straw being collected as well as the cereal ears. However, the low frequency and abundance of cereal culm nodes within the charred assemblage indicated that straw was separated from spelt wheat prior to dehusking. As the harvest height was low, assemblages can be considered to be reflective of all weed seeds growing in a field.

The onset and duration of flowering in arable weeds can be used to indicate the season of crop sowing (Bogaard *et al.* 2001). All spelt FSBP samples contained taxa in the early and short, medium, and long and late groups. The presence of some short and early taxa implies that an autumn sowing time was more likely (FIG. 143b). The life form of arable weeds can indicate the levels of disturbance with which an arable field was cultivated (Van der Veen 1992, 137). In all Period 0 samples, there are higher percentages of annual and regenerative perennial taxa alongside smaller proportions of perennials, indicating that cultivation was at an intermediate-to-high level of disturbance (FIG. 143c).

British Ellenberg values can be used as a tool to assess soil conditions in arable fields. As an indicator of soil moisture, most samples have higher proportions of F4-6 taxa (*Avena* sp., *Bromus secalinus*) which prefer soils with intermediate moisture levels, with lower proportions of F7-9 taxa (wet soils) such as *Eleocharis palustris* and *Montia fontana* ssp. (FIG. 143d). A higher proportion of F7-9 taxa in sample 3216 is due to an abundance of *Eleocharis palustris* in that sample. In considering N values (FIG. 143e), samples contain higher proportions of N3-6 taxa of intermediate soil fertility, and lower proportions of N7-8 taxa of richly fertile soil. Similarly, an assessment of R values shows that samples contain a mix of taxa of weakly acidic to basic soils (R7-8) and moderately acidic soil (R4-6) (FIG. 143f). The combination of N and R values suggests that soil fertility was maintained but not maximised.

Finally, the geological preference of weed taxa can be used to assess the origin of cereal crops, an important factor to assess since some have considered *oppida* to be largely non-agricultural and reliant on cereals imported from other regions (Cunliffe 2012; Sharples 2010, 173). The majority of weed taxa present in spelt FSBP samples do not have any preference for, or aversion to, clay or calcareous soil types. *Rumex acetosella*, present in 12 out of 15 spelt FSBP samples, is not found on calcareous or clay soils (Stace 1997, 190). It is a perennial herb of cultivated ground, acidic grassland and heathland, restricted to ant-hills and superficial acidic deposits in chalk grassland (Brewis *et al.* 1996, 122). Similarly, *Spergula arvensis*, an annual herb of acidic sandy cultivated ground and present in three out of 15 samples, does not grow on pure chalk soil or damp clay soils (Brewis *et al.* 1996, 227; Crawley 2005, 800). Unfortunately, no other taxa provide information on geological origin, but considering the frequency with which *R. acetosella* occurs, it seems most likely that cultivation of spelt wheat took place on local sandy acidic soils. Overall, autumn-sown spelt wheat was grown on damp–dry soils. Cultivation practices appear consistent with subsistence-level agriculture, with no marked changes in soil fertility.

DISCUSSION

The substantial assemblage of plant macrofossils from Period 0 will now be discussed in terms of agriculture, site activities, settlement vegetation and diet.

CROPS, CULTIVATION AND PROCESSING

Archaeobotanical analysis has shown that arable farming was practised by at least some of the inhabitants of Calleva, but cereal production was not aimed at maximising production. The two cereals cultivated, six-row hulled barley and spelt wheat, were the staple crops of the British Iron Age in central-southern Britain (Campbell and Straker 2003). The arable weed seeds present alongside spelt wheat crop-processing waste indicate the spelt was cultivated at intermediate levels of soil fertility, disturbance and dampness, most likely on slightly acidic soils in the local area around Silchester. The soils of the Silchester gravel plateau are free-draining but very stony and acidic, soils of the head deposits around the edges are wet and stony, and the clay soils in the areas between the Silchester plateau and the Loddon are hard in the summer and impermeable in the winter (Jarvis 1968; Jarvis *et al.* 1979). To the south and east of the gravel plateau, more favourable soils are located such as the finer textured soils of the Titchfield series, and ceramic scatters have indicated an area of manuring limited to an area of 500 m around the walls (Corney 1984b; Ford and Hopkins 2011).

The spatial distribution of crop-processing waste across the excavated area in the late Iron Age indicates that a range of households was involved in cereal processing. Samples studied from within domestic buildings, Structure 10 and Pit 15142 in the centre of Structure 15, indicate the dehusking of spelt wheat spikelets was taking place inside, and the waste disposed of in fires. Crop-processing waste was also disposed of in Ditch 11631. There were particularly high densities of charred plant remains in Pit Groups 4 and 8 in the north of the Central Compound and low densities from Pit Group 1 at the edge of the north-western trackway, indicating that crop-processing activities were focused away from the streets. The low occurrence of cereal culm and barley rachis indicates that the early stages of crop-processing were not taking place within this part of the settlement, and probably occurred in the fields.

In regard to agricultural innovations suggested as taking place in the late first millennium B.C., the excavation has provided no evidence for the diversification of the crop spectra (Jones 1981). There is no evidence of spring sowing as identified in the Danebury environs (Campbell 2000). There are no indications of an increase in the scale of production, no evidence for shifts in cultivation practices and no high density deposits of cereals which would have indicated large-scale handling of cereal grain or by-products (Van der Veen and Jones 2006). Hence it is very unlikely on this evidence that Calleva was engaged in surplus arable production in order to supply cereals to the Continent (Haselgrove 1982). In contrast, the presence of some spelt crop-processing by-products shows that the settlement's inhabitants were not reliant on other more fertile regions for their staple food supply, as suggested by some (Cunliffe 2012; Sharples 2010, 173). Calleva was, however, engaged in the cultivation of flax, a crop which had largely fallen out of use in the Iron Age (Lambrick and Robinson 2009, 254). Whether it was cultivated for food, fodder and/or linen cannot be determined, yet it is a demanding crop, requiring fertile and moist soils due to its small root run (Valamoti 2011). Peas were also cultivated, as they had been through the Iron Age (Campbell and Straker 2003), but no conclusions can be drawn on their use due to their rare occurrence.

MANAGEMENT OF GRASSLAND RESOURCES AND FODDER

The identification of hay from Well 8328 indicates that hay meadows were being managed in the area around Silchester, and traces of these taxa were also present in the charred assemblage (*Filipendula ulmaria*, *Rhinanthus minor*). The presence of stable-flooring material indicates that animals, probably horses, were kept within or nearby the excavated area, which would have provided easier access to secondary products as well as security in times of unrest. The increased management of grassland areas would have enabled the expansion of arable land onto areas previously used for pasture (cf. Williamson 2003, 169), in the case of Silchester onto damp fields as evidenced by the presence of taxa such as *Eleocharis palustris* and *Montia fontana*, and hence an increase in the amount of cereals produced without changes in cultivation practices. Local areas are still being managed in this way today. The SSSI of Ron Ward's Meadow is situated 4 km to the south-west of Silchester in an area of neutral hay meadow (Natural England 2012). Alluvial soils in the Kennet and Loddon valleys may also have provided land for hay meadow management. Previously there was no evidence for hay meadow management having occurred in the Iron Age or earlier (Lambrick and Robinson 2009) and it was thought to have begun in the early Roman period (Booth *et al.* 2007, 280); for instance, plant remains have been interpreted as hay from the legionary barracks at Culver Street, Colchester *c.* A.D. 60/61 (Murphy 1992). Experimental cultivation has shown that for hay meadows to become established by the management of weed and wasteland takes 20+ years (McDonald 2007), implying that the presence of hay in Well 8328 definitely shows that hay meadow management was taking place pre-conquest. This suggests that the inhabitants of Calleva developed new grassland management techniques as a reaction to the new nucleated form of settlement.

ON- AND OFF-SITE SETTLEMENT VEGETATION

Within the excavated area, the settlement vegetation would have consisted of a range of plants of damp ground, trampled ground, nitrogen-rich disturbed ground, more permanent waste ground communities and perhaps small areas of scrub. The plant macrofossil evidence has also provided insights into the diverse range of vegetation in the area around Silchester. *Corylus*, *Betula*, *Malus* and *Prunus spinosa* were all present in local woodland, as supported by charcoal analysis (see Barnett, p. 320). Areas of heathland were present, containing *Calluna vulgaris*, *Pteridium aquilinium*, *Sphagnum* and *Ulex europaeaus*. These were most likely located on the gravel plateaus to the north and west of Silchester. Areas of wet pasture, grazed by animals which were also penned within the settlement, were likely present along the Silchester Brook or River Loddon, probably adjacent to hay meadows. Another key component in the surrounding landscape was arable fields.

The macrofossil evidence does not provide any indications of how the surrounding landscape changed through the course of the late Iron Age. On the basis of its name, Calleva is hypothesised to have been built in a wooded landscape (Boon 1974, 19, 36; Rivet and Jackson 1970, 70), although previous activity on the gravel plateau is demonstrated by the presence of probable early or middle Bronze Age barrows on Mortimer Common (Bradley and Fraser 2010, 24; Grinsell 1936, 57–8; 1939, 15–16). The earliest on-site data derive from Well F762 at the forum basilica site, where a pollen sample from basal context 2099 (*c.* 15 B.C.) contained 47 per cent arboreal pollen, which decreased to 6 per cent in the late first-century B.C. fills of Well F718/719 (Wooders and Keith Lucas 2000). The range of vegetation indicated by the pollen, charcoal and waterlogged plant remains included alder carr, arable, pasture and heathland. Pollen samples from the buried podzolised soil beneath the amphitheatre seating bank, *c.* A.D. 30–50, indicate a range of grassland types and low arboreal content (4–20 per cent) (van Scheepen 1989, 153–6). Contemporary with this decrease in arboreal pollen, the waterlogged assemblage from Wells 8328 and 10421 indicates the presence of heathland, woodland and hay meadows. Charcoal analysis of contemporary deposits from this excavation indicates establishment of heathland and scrub locally but also the continued presence of a wide range of open woodland taxa, indicating a mosaic of vegetation types (Barnett, p. 323). Areas of earthworks are more extensive to the north-west of Calleva, and if heathland development had begun prior to the late Iron Age expansion, as in similar regions in southern Britain (Groves *et al.* 2012), the upland area would have been more suitable for grazing than arable cultivation. The trend towards more pasture and arable land use in the landscape by *c.* A.D. 200 is confirmed by very low tree and shrub percentages and very high percentages of non-cereal Poaceae pollen from buried marshland soil at the south-east gate (Keith-Lucas 1984). The only off-site sequence to confirm this pattern of increasing woodland clearance and landscape management is from the buried ground surface beneath Grim's Bank situated 3 km to the north-west of Silchester (Astill 1980). The samples are indicative of pasture and rough grazing, and are considered to be of late Iron Age date (Wooders and Keith-Lucas 2000, 533).

IMPORTED FOODS AND OTHER FOOD STUFFS

Archaeobotanical evidence for the plant food diet shows that new flavours were imported from the Mediterranean. Olives were an important aspect of the Classical diet, appearing in written sources such as Pliny's *Natural History* and Apicius (*NH* 4.15.1–34; Grocock and Grainger 2006), and also present in archaeobotanical records from the Italian peninsula and north-west Europe (Livarda 2008; Murphy *et al.* 2013). In Roman Britain, olives are mainly recovered from urban and military sites (Van der Veen *et al.* 2008, 18), and the only settlement to produce olive in the first century A.D. is London (Lodwick 2014). Celery, coriander and dill were commonly used in Roman cooking (Dalby 2003, 77, 104, 117) and are some of the most frequently found new plant foods in Roman Britain, occurring initially at military and urban sites, and later also at rural settlements (Van der Veen *et al.* 2008). The selective adoption of these new plant foods by the inhabitants of late Iron Age Silchester may be due to several factors. Herbs can be easily added to staple cereal foods (Van der Veen 2008, 102), and there is some evidence that *Brassica nigra* (black mustard) was already being used as a flavouring during the Iron Age (Lodwick 2014). These flavourings were also being adopted at late Iron Age settlements in north-western Europe: for instance celery was recorded in *c.* 250–10 B.C. at Damary, Aisne Valley (Bakels 1999), celery and dill at Bibracte dating to 150–30 B.C. (Wiethold 1996) and coriander at a La Tène D well at Fosse des Pandours, Alsace (Kreuz and Wiethold 2010); hence it appears that the selective adoption of aspects of a Roman Mediterranean diet was a wider late Iron Age phenomenon (Lodwick 2014). At Silchester, the consumption of these new foods was part of wider luxury dining practices, as evidenced through oysters, mussels, domestic fowl, imported table wares and amphorae containing fish sauce, wine and olive oil (Fulford and Timby 2000, 549, 562). In addition to food imports, flax seeds may have been used as flavourings or pressed for their oil, paralleling the evidence for olive oil import and the consumption of more oily foods.

The presence of imported plant foods and introduced weed seeds provides evidence for the trade links of the late Iron Age *oppidum*. No evidence was recovered for either an absence of crop-processing, which would suggest import of cereals, or their large-scale handling, which would suggest export from Silchester. In contrast, *Agrostemma githago* (corncockle) was identified from Well 8328, as well as from the forum basilica excavations. It has previously been seen as evidence for the importation of cereals from the Continent (Fulford 2004, 313). However, in light of finds from settlements on the Hampshire Downs, at middle Iron Age Bury Hill and late Iron Age Suddern Farm this is less certain (Campbell 2000, 56). Definite evidence for import trade comes from the presence of new plant foods. Olives would have originated from an area of olive production in the Mediterranean (Dalby 2003, 237–40), and are likely to have been transported in Haltern 70 amphorae (p. 163), which originated from southern Spain (Fitzpatrick 2003). Fruits of celery, coriander and dill can be stored and transported as dried seeds. Potential transport vessels for flavourings are Central Gaulish coarse micaceous ware jars (p. 159), which were produced in the Morvan, central France (Cool 2006, 166; Tyers 1996, 142), but amphorae, wooden crates or sacks are all possible transport vessels.

COMPARISON WITH ARCHAEOBOTANICAL EVIDENCE FROM BRITISH *OPPIDA*

A comparison of the Period 0 assemblage with that from the forum basilica shows that Well 10421 is most similar to Period 1 (*c.* 25–15 B.C.) Well F718/719. In these two wells there was a small range of plants of disturbed and damp ground, hazelnut shell and wild fruit stones. In contrast to Well 8328, there was no evidence from Well F718/719 for diverse heathland plants, flax, hay meadow taxa or stable-flooring material (Jones 2000). This discrepancy may reflect spatial variation in the distribution of activities within the *oppidum*, or chronological variation, with Well 8328 being later. The charred assemblage from the forum basilica consisted of small samples, but those from Period 2 (*c.* 15 B.C.–A.D. 40/50) produced spelt and emmer wheat and hulled six-row barley, as well as bread wheat, but as the latter identification was based on cereal grain, it cannot be considered reliable. A similar range of arable taxa was present, including *Agrostemma githago*, *Avena* sp., *Bromus* sp., *Chenopodium album*, *Eleocharis palustris* and *Rumex* sp.

Beyond Silchester, all published archaeobotanical data from other *oppida* are reviewed below (Table 27). Evidence for crop choice is limited by small charred datasets from Chichester (Pelling 2005), Oram's Arbour, Winchester (Biddle 2004; Carruthers 2011; Green 2004) and Skeleton Green, Herts. (Monk 1981), which contained traces of barley and/or spelt wheat. At Abingdon Vineyard, Oxon. (Stevens 1996), Dragonby, North Lincs. (Van der Veen 1996), and Stanwick, N Yorks. (Van der Veen 2016), six row-hulled barley and spelt wheat were being consumed. No evidence for the use of new staple crops was found at any sites. Despite large-scale sampling, no cultivated pulses were recovered from Abingdon Vineyard, and only a single *Vicia faba* var. *minor* was identified from Dragonby. Flax was not recovered from any other *oppida*. The only evidence for imported plant foods is fig from Hengistbury Head site 3 in Dorset, a coastal marsh adjacent to the trading settlement (Cunliffe 1987, 339). The only other bioarchaeological remains of imported foods in late Iron Age Britain are bones of *Scomber colias* (Spanish mackerel) from Skeleton Green, Braughing (Wheeler 1981), although, of course, the presence of a range of transport amphorae and storage jars at *oppida* indicates that wine, olive oil and processed plant foods were widely imported (Fitzpatrick and Timby 2002). The consumption of wild plant foods is evidenced by charred hazelnut shell and elderberry at Stanwick and Abingdon Vineyard, charred sloe at Stanwick and waterlogged hawthorn at Dragonby. Considering the low frequency of wild plant foods in the Iron Age in general (Van der Veen 2008, 100), this may tentatively suggest the increased consumption of wild plant foods in the late Iron Age.

Charred plant remains from a few sites show that crop-processing was undertaken. At Abingdon

TABLE 27. ARCHAEOBOTANICAL ASSEMBLAGES FROM BRITISH *OPPIDA*

Site	Site type (following Pitts 2010)	Reference
Abingdon Vineyard	Enclosed *oppidum*	Stevens 1996
Braughing, Skeleton Green	Nucleated settlement	Monk 1981
Camulodunum, Stanway site D	Territorial *oppidum* (burial)	Fryer 2007; Murphy and Fryer 2007
Dragonby, Lincs.	Nucleated settlement	Van der Veen 1996
Fishbourne, Chichester	Territorial *oppidum*	Pelling 2005
Hengistbury Head	Port-of-trade	Nye and Jones 1987
Oram's Arbour, Northgate House	Enclosed *oppidum*	Carruthers 2011
Oram's Arbour, Staple Gardens	Enclosed *oppidum*	Biddle 2004
Oram's Arbour, Sussex Street	Enclosed *oppidum*	Green 2004
Silchester, Forum Basilica	Territorial *oppidum*	Jones 2000
Stanwick, site 9	Territorial *oppidum*	Van der Veen 2016
Verulamium, Folly Lane	Territorial *oppidum*	Murphy and Fryer 1999

Vineyard, a dominance of small weed seeds in both the mid-Iron Age and late Iron Age/Roman samples was interpreted as showing the household storage of unsieved spikelets (Stevens 2003). Re-analysis of Abingdon samples based on proportions of all crop items and physical weed types demonstrates that most samples were derived from fine-sieved by-products of spelt spikelets (Lodwick 2015, 144). The application of ratio and discriminant analysis at Stanwick has identified a range of crop-processing by-products, dominated by spelt fine-sieving by-products (Van der Veen 2016). At Stanway, a low-density scatter of cereal grain, chaff and arable weeds alongside charred roots and buds indicated that some crop-processing was occurring locally (Fryer 2007; Murphy and Fryer 2007). At no site was there any evidence for the further processing of grain or the bulk storage of grain. One deposit at Skeleton Green contained 103 grains of *Triticum* sp. but was close to quernstone fragments and probably derived from household activity (Monk 1981). At Stanwick, there were a few grain-rich samples from post pits. Stanwick provides the only detailed study of weed ecology at an *oppidum*, using autecological values as done here. Due to the presence of perennial weeds and taxa which grow in conditions of low soil fertility, it was inferred that the cultivation regime involved little soil disturbance and did not maintain soil fertility (Van der Veen 2016). Less rigorous analysis at Abingdon Vineyard showed an increase in perennials during the late Iron Age, interpreted as low disturbance cultivation of light soils (Stevens 1996, 230, 234).

Archaeobotanical evidence for other site activities and the palaeoenvironment of the surrounding landscape is hindered by a lack of waterlogged assemblages from other *oppida*. A single late Iron Age sample from Dragonby did not produce any evidence for collected grassland or heathland resources. The occurrence of grassland and heathland material in charred samples from Period 0 was mirrored at Stanwick, where *Calluna vulgaris* leaf shoots and flowers and *Erica* sp. flowers, interpreted as evidence for bedding or thatch, were quite common. In terms of settlement vegetation, waterlogged plant remains from Dragonby included a range of taxa similar to those reported here, including plants of nitrogen-rich waste ground (*Hyoscyamus niger*, *Sambucus nigra*, *Solanum nigrum*), as well as plants tolerant of frequent disturbance (*Aphanes arvensis*, *Polygonum aviculare*) (Van der Veen 1996, 199–207).

Evidence for the off-site environment at other *oppida* is similarly limited. A poorly-dated pollen profile from Crosby Warren, 1 km south-east of Dragonby, had increased arable and pastoral indicators, interpreted as an episode of woodland clearance linked to settlement expansion at Dragonby (Van der Veen 1996, 211). Elsewhere evidence is restricted to the decade surrounding the Roman conquest. Palynological data from turves used to construct the Stanway burial mound at Camulodunum, *c.* A.D. 35–50, originated from an area of herb-rich grassland, with some arable land nearby and very few trees (Wiltshire 2007). Analysis of charcoal from mortuary enclosures at Stanway showed the presence of some *Corylus*, *Fraxinus* and *Quercus* in the local area (Bojko and Crummy 2007). An open landscape was also evidenced by palynological analysis of turves in the backfill of the funerary shaft at Folly Lane, Verulamium, whilst charcoal and charred plant remains from the burial pit and shaft indicated the presence of pasture and meadows, with some areas of heathy grassland, hedges or scrub, along with the minor presence of oak and hazel woodland (Murphy and Fryer 1999). Over the River Ver at St Michael's, palynological analysis of waterlogged sediments buried by an early Roman building suggested a more open landscape, dominated by grassland and arable land (Dimbleby 1978). In summary, palaeoenvironmental analysis indicates that after several decades of occupation, the landscape around Camulodunum and Verulamium was also open and managed.

CONCLUSION

The charred and waterlogged plant macrofossils reported here have provided key evidence for imported plant foods, crop choice, processing and cultivation, and the management of heathland and grassland resources for animals. Whilst no innovation or surplus production was evidenced in arable farming, new practices in hay meadow management, flax cultivation and the consumption of new plant foods were demonstrated by the waterlogged assemblage. These findings have key implications for understanding the lifestyles of the inhabitants of late Iron Age Silchester, the trade linkages between the *oppidum* and beyond, and the relationship between urbanisation and agricultural developments (Lodwick 2017a).

Whether the disparities between late Iron Age Insula IX and the forum basilica are due to spatial or chronological variation can only be answered by the further excavation and sampling of settlements in and around Calleva Atrebatum. However, the results here demonstrate the continued utility of bulk sampling for plant macrofossil remains in the investigation of a late Iron Age urban settlement.

CHAPTER 18

THE WOOD CHARCOAL AND WATERLOGGED WOOD

By Catherine Barnett with a contribution by Robyn Veal

INTRODUCTION

Wood charcoal has proved relatively plentiful and well preserved for Period 0, occurring in a wide range of contexts and in quantities suitable for further investigation. Analysis has therefore been undertaken in a targeted way, with particular assemblages selected from the numerous processed and assessed bulk samples available for late Iron Age features. The samples were chosen on the basis of type of feature and activity potentially represented, the volume or richness of each charcoal assemblage and, in some cases, the availability of comparative plant macrofossil or other environmental data from the same contexts. In most cases the assemblages were removed from their point of burning and had been dumped in pits and wells; it is not, therefore, always clear what activities they were associated with but the possible sources, processes and taphonomies are considered.

A total of 35 samples from 32 contexts have been analysed for charcoal, including a series of five discrete dumps in Well 10421, layers representing the final infilling of Ditch 11631 and samples from the primary and secondary fills of pits and tree-throws within Pit Groups 1, 2, 3, 4, 6, 8, 10 and 14. Overall, a total of 1,896 fragments of wood charcoal were examined for the Period 0 contexts including 221 pieces previously identified by Veal (2013) for Well 8328; the results of her analysis are also included in this report.

In addition, waterlogged wood fragments collected by hand during excavations and/or recovered by flotation from bulk samples were analysed for the few waterlogged contexts represented, dominated by fills of Well 10421. The results of the two analyses are considered together below.

Usefully, all contexts examined here for charcoal have complementary plant macrofossil data (Lodwick, Ch. 17). Assessment of pollen samples for Well 10421 has demonstrated poor preservation but full analysis has been carried out for Well 8328 (Brown, Ch. 19).

METHODS

Following flotation of bulk samples of variable size (2–49 L), all wood charcoal >2 mm was separated from processed flots and the residue scanned or extracted as appropriate. Several samples proved rich and a representative sample of each was identified, normally 100 fragments. Smaller samples were identified in their entirety. On occasion, repeat bulk samples were taken from the same context during excavation without any clear spatial differences. Where applicable, these samples have been analysed and kept separately but the data combined to form a statistically viable count.

Fragments were prepared for identification according to the standard methodology of Leney and Casteel (1975; see also Gale and Cutler 2000). Each was fractured with a razor blade so that three planes could be seen: transverse section (TS), radial longitudinal section (RL) and tangential longitudinal section (TL). The pieces were mounted using modelling clay on a glass microscope slide, blown to remove charcoal dust and examined under bi-focal epi-illuminated microscopy at magnifications of x50, x100 and x400 using an Olympus BHM microscope. The waterlogged wood pieces were thin sectioned along the same three planes, mounted in water and examined using transmitted light microscopy at magnifications of up to x400 using a Leica DME 13595XXX microscope.

Identification was undertaken according to the anatomical characteristics described by Richter *et al.* (2004), Schweingruber (1990) and Butterfield and Meylan (1980). Identification was to the lowest taxonomic level possible, usually that of genus, but sometimes species, where there is only one known native variety or the features are highly diagnostic, and nomenclature is according to Stace (2010). While normally divisible, where insufficient characters were present, alder/hazel have been recorded as such. Each individual taxon was quantified and the results tabulated (Tables 28 and 82), with juvenile twigwood and roundwood separated from mature where discernible. Quantification was simply by fragment number and species ubiquity (i.e. number of contexts in which each species appears). No attempt was made to calculate charcoal volume or relate these to original sample volume; indeed attempts to do so can provide misleading results (Keepax 1988; Austin *et al.* 2008) and presence/absence was used as the principal means of description. Interpretation of individual species preference and habitat was made with reference to modern plant ecology (Ellenberg 1988; Peterken 1993; Stace 2010).

RESULTS

A minimum of 20 tree and shrub types were identified for the Period 0 contexts as a whole (Table 28). The identifications by context are given in Table 82 for charcoal and Table 83 for wood. The assemblages are considered below first by individual feature type then as a single entity for Period 0. It should be noted that while there is some finer phasing for the late Iron Age features, this often adds little in terms of actual chronological detail to what is already very close dating at *c.* 10 B.C.–*c.* A.D. 43 and, since many of the assemblages have been moved and redeposited in secondary contexts, may not be helpful in interpreting the charcoal on an individual context level and, therefore, has not been used as a basis for division. The common names are used for reporting, with Latin binomial given in brackets for the first appearance.

DITCH 11631

Three samples were examined from Ditch 11631. The contexts concerned, and all other charcoal-rich layers within the feature, were either the last or penultimate in the stratigraphic sequence, in all cases final secondary dumps rather than a post-use tertiary fill, and presumably relate to deliberate backfilling near the end of the life of the ditch. While their analysis cannot shed light on activities coinciding with its original construction and use, these deposits have the potential to provide a useful snapshot of fuel use and landscape associated with an early phase of Period 0.

Context 12847 was described as a small discrete dump, associated with a piece of pierced pottery (SF 6624), and underlay context 11650 (also analysed, below). The charcoal stands out as unusual for the site as it contains a large number of tiny, one-to-two-year twigwood fragments. Such pieces are notoriously difficult to identify since mature characteristics used in analysis often have not yet formed; however, a few compare favourably with Maloideae. This is supported in the same assemblage by the identification of seven larger pieces of 3–6 mm diameter Maloideae roundwood cut at five years. The larger pieces compare well with hawthorn type (*Crataegus* sp.) on the basis of width and external morphology. Together these form 50 per cent of the assemblage of 92 identifiable fragments. In addition, the sample contained 36 per cent oak, at least half of which was young roundwood, and also small quantities of alder, birch, hazel, ash and cherry type (*Prunus* sp., e.g. bird cherry or blackthorn). The high proportion of scrub and brushwood in this context is interpreted as possible burnt animal fodder and/or bedding.

The overlying context 11650 proved to have a somewhat different charcoal assemblage, with none of the small twigwood material found elsewhere in Ditch 11631. Instead, it contained 69 per cent oak, only 6 per cent of which was clearly roundwood (6 mm diameter cut at three years). There was 14 per cent each of birch and (larger) Maloideae, with lesser quantities of ash, cherry type, elm, holly (*Ilex aquifolium*) and single fragments of cf. elder (*Sambucus nigra*) and

TABLE 28. TREE AND SHRUB TAXA REPRESENTED

Family	Sub-family	Species/Taxon	Common name
TAXACEAE		*Taxus baccata*	Yew (waterlogged wood only)**
ULMACEAE		*Ulmus* sp.	Elm
FAGACEAE		*Fagus sylvatica*	Beech
		Quercus sp. *(robur/petrea)*	Oak
		*Quercus/Castanea**	Oak/sweet chestnut
BETULACEAE		*Alnus glutinosa*	Common alder
		Alnus /Corylus type	Alder/hazel
		Betula pendula/ pubescens	Silver/downy birch
		Corylus avellana	Hazel
SALICACEAE		*Salix/Populus* sp.	Willow/aspen (the 2 are anatomically indistinguishable)
ERICACEAE		*Erica/Calluna*	Heathers, lings**
ROSACEAE	Maloideae (formerly Pomoideae)	(Maloideae)	Pomaceous fruits, e.g. apple, pear, whitebeam, hawthorn
		Crataegus type	Hawthorn
		Sorbus type	Whitebeams, e.g. rowan, service-tree
	Amygdaloideae (formerly Prunoideae)	*Prunus* sp.	Cherry type, e.g. bird cherry, blackthorn
		Prunus spinosa	Blackthorn
FABACEAE		(Fabaceae) e.g. *Cytisus/Ulex*	Gorse/broom
CORNACEAE		*Cornus sanguinea/mas*	Dogwood
CELASTRACEAE		*Euonymous europeus*	Spindle tree
AQUIFOLIACEAE		*Ilex aquifolium*	Holly**
ACERACEAE		*Acer campestre*	Field maple
OLEACEAE		*Fraxinus excelsior*	Ash
CAPRIFOLICEAE		*Sambucus nigra*	Elder

*This grouping has been used for small twigwood fragments of a ring porous type with large vessels and uniseriate rays where no large aggregate rays were present or had not yet developed and therefore it cannot be said with certainty that *Castanea* (an introduced species) was not present. **Evergreen types, all others are deciduous

cf. heather (*Erica/Calluna)*, i.e. a minimum of nine taxa were identified for this relatively small sample of just 58 fragments.

Context 11111 (also located towards the south-western end of Ditch 11631) proved to be more heavily dominated by oak, which formed 85 per cent of the 100 identified pieces, half of which was roundwood cut at three to five years (dominated by cut at three years). This was accompanied by small numbers of juvenile birch, hazel, holly, willow/poplar and Maloideae fragments. The differences over a short stretch of the feature highlight the need to examine multiple samples in order to gain a better understanding of the individual taphonomic paths and thus the importance of considering the contemporary site assemblage as a whole.

WELLS 10421 AND 8328

Well 10421

Charcoal >2 mm was examined from a series of five discrete charcoal dumps recovered from secondary contexts in Well 10421. These varied in suitability for meaningful analysis from only nine useable fragments from context 10441, the first in the series of these secondary fills, to much richer samples from contexts 10436, 10438 and the uppermost one, 10439, for which counts of 70–100 were achieved. A total of 300 fragments have been identified for Well 10421. Four of the five contexts contained similar assemblages, heavily dominated by oak at 67–91 per cent with alder (*Alnus glutinosa*) at *c.* 5–8 per cent, while the earliest context (10441) contained slightly more ash (*Fraxinus excelsior*) than oak, and was the only sample from the well to contain this taxon. Birch (*Betula pendula/ pubescens*), hazel (*Corylus avellana*) and one or more members of the Maloideae each occurred in small quantities in three assemblages. Three fragments of elm (*Ulmus* sp.) were found in context 10434. The charcoal was generally in good condition, although heavily fragmented, but it was noted that many pieces from context 10436 were either vitrified and flaky or highly reflective, the latter indicating exposure to high temperatures (McParland *et al.* 2009), potentially those required for smithing, as discussed further below.

Waterlogged wood with variable preservation was also recovered from Well 10421, either as hand-picked small finds or taken from the flots of a series of bulk samples. Two pieces of hazel and one of willow/poplar were identified from the primary fill 10442 (Table 82), a piece of birch and three pieces of alder or hazel from the overlying fill 10441, both of late Iron Age date (see Barnett, Ch. 21). These are not associated with a well lining, as attested by the presence of juvenile and twig wood pieces from both contexts. Instead, disposal of waste/offcut material is indicated or, less likely (particularly given the range and presence of wetland types), direct deposition from overhanging trees. One further piece of alder wood recovered from context 10441 (SF 5723) was described as a possible shaped peg. It had dried and warped since lifting and no clear evidence of working could be seen; it was, however, partially charred at one end. A single piece of uncharred wood was recovered from context 10439 slightly higher in the sequence of Well 10421. This proved to be a small but well preserved sliver (possible offcut?) of yew (*Taxus baccata*), the only appearance of this native coniferous species in this analysis.

Well 8328

Charcoal >4 mm recovered from a series of nine secondary contexts within Well 8328 was identified and reported by Veal (2013), with a total assemblage of 221 fragments examined. To summarise, the five earlier assemblages proved similar; none were especially rich, with a maximum count of 50 achieved for context 9152 and minimum of 14 for context 9257. Condition was moderate, with a high number of unidentifiable pieces encountered. All were dominated by oak (*Quercus* sp.) at *c.* 50–86 per cent of individual samples, 72 per cent overall. Five other types were found, with alder and willow/poplar near ubiquitous and forming 15 per cent and 8 per cent of the total assemblage. Birch, ash and field maple (*Acer campestre*) were also present in small quantities. The four assemblages higher in the well sequence proved sparse, with single fragments of oak in contexts 8486 and 8428. Contexts 9183 and 8452, with counts of 15 and 25 respectively, were dominated by oak with lesser alder, willow/poplar, ash and a fragment of whitebeam (Maloideae cf. *Sorbus*). Much of the well charcoal was highly burnt (reflective) and wood of fast growth rate (*c.* 5 mm/annum) and large diameter (>50 mm and some >150–300 mm) was well-represented. In addition, iron staining of the charcoal was noted, a common finding in Well 10421 also, but, perhaps uniquely, presence of vivianite (iron phosphate) occurred here, potentially indicating the presence of a high phosphate load such as that found in stable waste (Veal 2013).

A single piece of waterlogged wood was recovered from Well 8328 secondary fill context 9152; it was described as a possible worked stave and identified as oak in 2010 before being discarded.

TREE-THROW AND PITS

One tree-throw fill and fourteen pit fills from eight of the pit groups were examined. The features have been grouped on the basis of their chronology and physical proximity. All pits are dated to the late Iron Age either through their contained ceramics or by radiocarbon dating. The tree-throw, however, contained evidence of much earlier (later Neolithic) activity and has, therefore, been considered separately. Individual features in this group were selected for analysis on the basis of their well-stratified, plentiful charcoal and because questions remained regarding their function or relationships.

Tree-throw 11630

The basal fill 15685 of Tree-throw 11630 was charcoal-rich and associated with scorched earth, indicating *in-situ* burning rather than dumping. The possibility of tree clearance and burning therefore arises and is given support by the finding that 100 per cent of the sample was oak. However, where discernible, all pieces were mature, displaying 'flat' rings with little of the curvature associated with small diameter juvenile wood. It is, therefore, equally possible that large oak timbers were removed from elsewhere and burnt in this reused tree-throw hollow, and might represent deliberate charcoal making. A piece of the oak sapwood has been dated to the later Neolithic at 2570–2340 cal B.C. (3943+/-29, SUERC-65375); this feature represents the earliest activity known at the site.

Pit Group 1

Context 12461, the primary fill of Pit 12462 to the north-west of Trackway 2 was selected as it may be a cess deposit and also contained metal objects and pottery. Sample 6767 proved small, with only ten identifiable fragments of Maloideae, cherry type and oak. The charcoal assemblage from a second adjacent sample (7616) from the same context, however, was far larger, with a count of 100. It comprised 85 per cent oak with a small number each of alder, birch, hazel, cf. spindle, heather/ling, ash, and cf. field maple

Pit Group 2

Pit 15266 forms one of a series of pits fronting the main trackways, in an area queried as one associated with metal-working (Allen, p. 242) and craft activity. The large assemblage from context 15265 was heavily dominated by oak (89 per cent), of which 23 pieces were roundwood of 3–6 years or more in age. The sample also contained birch (8 per cent) and single fragments of alder, cherry type and blackthorn (*Prunus spinosa*). That the wood was burnt whole is indicated by the greater than normal presence of bark. The evidence for access to, and use of, probably coppiced oak in the fuel mix is somewhat supportive of an industrial or craft process.

Pit Group 3

Individual fills of three pits (11131, 12179 and 12696) were examined for Pit Group 3. These pits are thought to represent early activity, lying as they do under the footprint of Structure 9. Indeed radiocarbon dating of four contexts does indicate activity from the start of the late Iron Age at 120 cal B.C.–50 cal A.D. (2034+/-29, SUERC-65381) for context 14653 (not analysed) and 100 cal B.C.–60 cal A.D. (2017 +/-29, SUERC-65376) for context 12714 (see Barnett, Ch. 21). All samples proved rich, with counts of 100 fragments achieved for two and a count of 30 for secondary context 11117. Oak again dominated the assemblages at 57–74 per cent, in this case with little evidence for the use of roundwood, but occasional presence of oak twigs. However, all three contexts contained a variety of other taxa. In addition to hazel, ash and willow/poplar, the charcoal from basal fill 12714 of Pit 12696 included 18 per cent Maloideae indet.

The charcoal from context 12117, an organic fill of Pit 12179, had been altered more than other contexts, with 12 per cent of the assemblage unidentifiable due to vitrification, and many others pieces affected. Vitrification, in which the charcoal anatomy is disrupted during burning and takes on a glassy appearance is poorly understood. Traditionally it has been interpreted as exposure of wood to >800° C burn temperature (Prior and Alvin 1983) and, therefore, used as an indicator of certain activities such as smithing. This, however, has been refuted by McParland *et al.* (2010) following experimental burning. The process remains unclear but occurrence may be caused by the interplay of several factors such as temperature plus presence of accelerants, e.g. fats plus use of damp wood. Hazel and alder were common at 12 per cent and 4 per cent + 10 per cent indet. alder/hazel, and there were smaller numbers of birch and willow/poplar. Context 12847 comprised 20 per cent birch and single fragments of hazel, Maloideae and heather/ling (*Erica*/*Calluna* sp.) in addition to the oak.

Pit Group 4

Pit 11721 forms part of a pit cluster suggested to have been used for storage. As the primary (11687) and secondary (11680) fills proved similar, they may derive from the same source with little or no chronological split. Both contained mainly oak, most if not all of which was small roundwood ≤5 years. Four pieces were complete, cut at four years and with a diameter of 16 mm. Hazel was also present in both samples, as was Maloideae, identified further to hawthorn type. Alder and holly also occurred in 11687.

Pit Group 6

A single context, 16484, secondary fill of Pit 16488, was analysed from this group. The assemblage was a relatively restricted one, with 78 per cent oak, including 46 roundwood pieces, eight of which were cut at five years, had a diameter of 18 mm and appeared straight and rod-like. There was also 12 per cent hazel and 4 per cent each of birch and ash.

Pit Group 10

Three contexts were analysed from Pit Group 10: two fills of Pit 15142 (15138 and 15140) and primary fill 15693 of Pit 15684. These are believed to represent rapidly deposited dumps of domestic waste, the layers being rich in pottery, animal bone and daub. While the fills are of Period 0 date, Pit 15142 also contained metal objects including an iron hobnail and the back-plate from an armour strap-fitting high in the sequence. The three samples proved diverse in species: 15138 and 15693 contained a minimum of eight taxa each among only 34 and 32 fragments suitable for identification respectively, while the larger assemblage from context 15140 (which stratigraphically overlay 15138, count 100) contained a minimum of 11 types. Context 15693 was dominated by birch (47 per cent, half of which was small roundwood or twigwood) but also contained oak, alder, hazel, willow/poplar and three fragments which compared favourably with heather/ling. Three pieces of young twigwood have been recorded as cf. oak/sweet chestnut (*Castanea sativa*). The latter is a species thought to have been introduced to England by the Romans (Rackham 1990, 54–6), but oak is far more likely given its considerable presence and the lack of sweet chestnut among mature pieces at the site, as well as the pre-conquest date ascribed to the assemblage. It is believed the large multiseriate rays that divide oak from the other taxon had simply not yet developed substantially in these immature pieces.

Context 15140 comprised 54 per cent oak, including some roundwood (7 years, 20 mm diameter), 12 per cent hazel, including three pieces of roundwood 3–7-years-old when cut, 10 per cent birch and 5 per cent ash, with lesser willow/poplar and Maloideae. It also contained four taxa rarely found in other samples analysed here, namely spindle tree (*Euonymous europeus*), beech (*Fagus sylvatica*), dogwood (*Cornus sanguinea*/*mas*) and a member of the Fabaceae (e.g. *Cytisus*/*Ulex*). Two large fragments of parenchymatous tissue (e.g. a tuber) were also found with the charcoal. The assemblage as a whole differed from most in containing a number of soft friable pieces and also several fissured pieces, while others showed iron deposition along vessels and rays.

Pit Group 14

Pit 11026, which lay to the south-west of Trackway 1, contained a series of discrete rubbish dumps interleaved with slumps. The two fills analysed, contexts 11602 and 11603, differed from each other slightly. The former was almost entirely oak (96 per cent, 100 fragments), with single fragments of hazel, holly, Maloideae and cherry type, while 11603 was 75 per cent oak, with 6 per cent birch and less hazel and Maloideae.

THE TOTAL ASSEMBLAGE

Given the tight chronology for the Period 0 features, with a maximum timespan of 65 years, it is appropriate to describe and consider the assemblage as a whole, while acknowledging that the collection, use and deposition of individual assemblages is unlikely to have been truly contemporaneous.

Oak formed a very substantial proportion of the burnt wood (FIG. 144), comprising 76 per cent of the total identifiable assemblage of 1,805 fragments, and was present to a greater or lesser degree in every context and sample (FIG. 145). As noted, a large number of small, young, roundwood oak fragments, normally cut at 3–5 years were represented in particular contexts, totalling a minimum of 10 per cent of the overall site assemblage. Most pieces, even rod-like fragments, were too fragmented to gauge whether these were really a same-age assemblage, as would be expected from a managed source (Edlin 1949, 70–1), but together their presence is compelling.

However, a further 20 taxa have also been identified (Table 28), some of which may represent two or more species. This is a high diversity given the short timespan represented. All types form low percentages of the overall assemblage in comparison to oak, but hazel and birch contribute a significant proportion at 5 per cent each, while Maloideae, including hawthorn, forms 6 per cent of the assemblage and alder 2 per cent. Hazel, alder and birch are all represented in 17 of the 32 contexts examined and Maloideae indet. in 15. All other taxa contribute 1 per cent or less of the total assemblage, with some, such as dogwood, beech and elder, represented by only single fragments. This highlights the importance of having a large sample size in order to pick up the less common types. However, willow (12 contexts), ash (9) and cherry type (6) are present in more contexts than the other lesser taxa and may be considered as making a more significant contribution to the assemblage. The possible habitats represented, their exploitation and route from tree to charcoal dump (i.e. the charcoal taphonomy) are considered below.

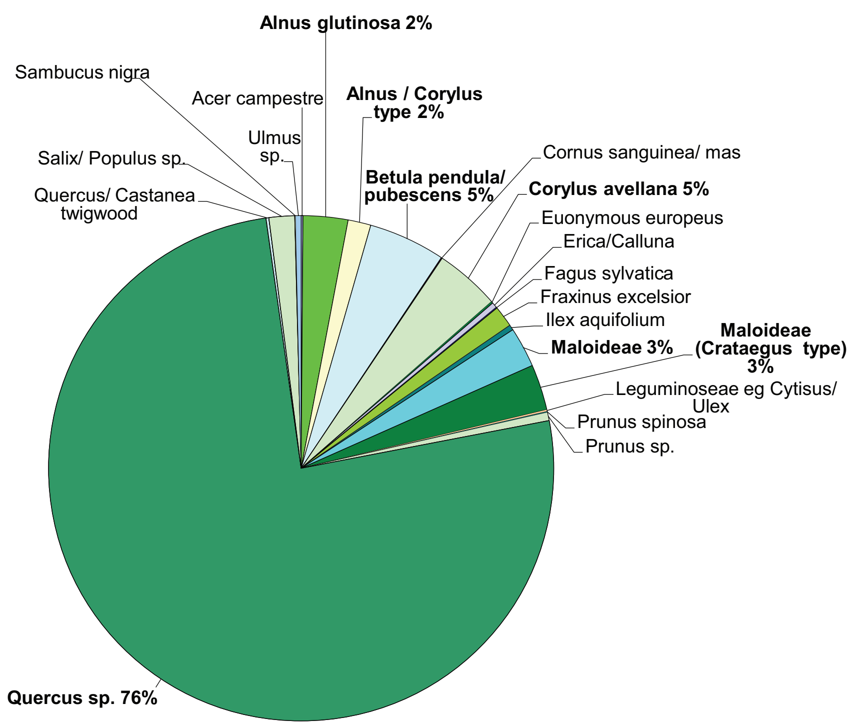

FIG. 144. The charcoal species present in the total assemblage by percentage. Values are given for those ≥2%.

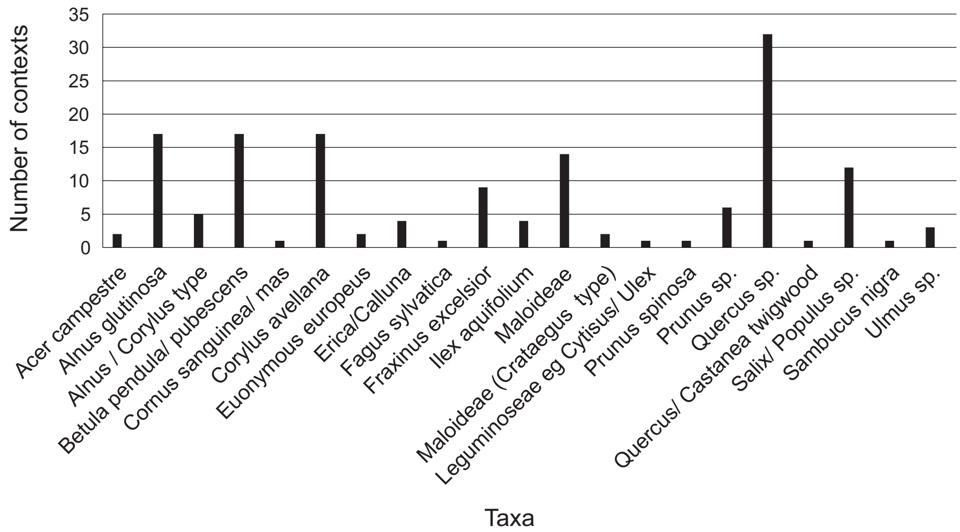

FIG. 145. Charcoal species ubiquity. Total = 32 contexts.

Yew, a native evergreen, was unique in appearing in the small waterlogged wood assemblage from Insula IX, but not in the much larger wood charcoal assemblage. It appears, therefore, to have been available and cut for use but not taken for fuel.

DISCUSSION

INTER-SITE VARIABILITY

The two wells analysed received repeated dumps of material, which would have contaminated the water, and so most of them would only have taken place after water extraction ceased. Thus, aside from primary contexts which proved unsurprisingly charcoal-poor, although waterlogged wood was found, the assemblages provide an indication of activity towards the end of the life of the well. Well 10421 was richer than 8328 in terms of identifiable charcoal, perhaps in part due to the inclusion of 2 mm fragments in the analysis. However, the types represented and the relative proportions have proved very similar, with deciduous tree and shrub types of more than one habitat represented, including wetland (alder and willow/poplar), recolonising open ground and scrub, and mixed deciduous woodland. Lodwick (Ch. 17) also reports a range of plant taxa associated with arable, disturbed and wetland habitats with low levels of grassland and heathland types in the waterlogged assemblages from Well 10421. Woodland types include *Rubus* sp. As discussed further below, the charcoal from both wells was often more highly reflective than other assemblages analysed here, indicating exposure to fierce temperatures, such as those required for metal smelting (1200–1600° C), smithing (1000–1200° C) or forging (850–1000° C) (Sim 1998, 7, 10, 101). It may be that the wells were chosen as a means of disposal of waste from these activities occurring in the immediate area.

It is noted that, despite being from a very different context, the taxa identified from the waterlogged wood of Well 10421, namely oak, birch, alder and hazel, are the same types identified by Morgan (1984) for piles and unworked wood within waterlogged layers at the rampart, thought to be late second-century A.D. in date, with the notable addition here of yew.

The latest fills of Ditch 11631 contained charcoal of a wide range of species, with frequent juvenile pieces, assemblages quite different in character from the wells. This and the chronological association with a period of remodelling of the site, lends to an interpretation of dumping of the remains of newly cleared or trimmed hedgerows and/or woodland fringes as well as spent fuel. The remains from underlying context 12847 differed from the upper fills, being dominated by tiny twigwood, cf. hawthorn, as well as a variety of common deciduous tree types. It is hard to discern specific use on site but immature hawthorn was also found with otherwise mature taxa (including alder, hazel, cherry type, oak and holly) in Iron Age Pit 527 at site WA 50157 during analysis of sites along the A303 (Barnett 2008). In both cases this might represent clearance but the possibility of disposal of spent animal fodder/bedding arises. Hawthorn may seem a spiky choice but modern wild ponies such as Exmoors routinely eat hawthorn and gorse during the winter and spring months (Baker 1998, 308–9); the new leaves and berries are palatable and nutritious to humans too.

The pit groups contained variable assemblages in terms of quantity, species diversity and proportions of mature roundwood and twigwood. This is unsurprising since a range of feature types and functions occurs within this large set of features. However, despite the dominance of oak, all samples apart from Tree-throw 11630, contained a variety of taxa, with birch and Maloideae (likely hawthorn) important, but with representation of other scrub and open woodland taxa such as blackthorn, hazel, spindle, ash, holly and wet-loving alder.

TAPHONOMY OF THE CHARCOAL AND ACTIVITIES REPRESENTED

It should first be noted that no primary contexts or *in-situ* burning areas such as cremation pyres, hearths or kilns were identified, with the possible exception of the much earlier, later Neolithic Tree-throw 11630. In most cases, the late Iron Age structures are represented by post-hole alignments, with no Period 0 floors or internal features preserved. The charcoal analysed has, therefore, in nearly all cases been removed from the point of burning and dumped into pits, wells and ditches as part of regular cleaning. The likelihood is that at least some of these assemblages contain fuel wood of more than one source mixed together. Since these are contemporary, their analysis is justified in terms of examining landscape and exploitation, but is less refined in discerning the remains of individual activities than would be preferred. No structural wood has been examined, since none of the post-holes contained waterlogged wood and, where assessed, little or no charcoal, indicating that it was intrusive or related to post-use burning, and not associated with the original construction/destruction.

In addition to the likely input of smithing waste to the wells, interpreted above from the large proportion of highly reflective pieces indicating a hot burn, Veal (2013) noted that a number of the fragments from Well 8328 displayed both iron staining and presence of blue vivianite crystals. The latter is hydrated iron phosphate that is typically formed in the joint presence of iron, phosphorus and water, as well as low oxygen and sulphide (McGowan and Prangnell 2006, 93–111). Its formation is associated with conversion of iron salts under conditions of high phosphorus such as those found in stable waste. Although iron redeposition in vessels was relatively common within the charcoal assemblage for Well 10421, no vivianite was apparent.

There is no clear evidence of widespread preparation (and potentially importation) of charcoal during the late Iron Age at Silchester, such as the presence of assemblages of reflective, even-aged pieces of suitable species such as alder and hazel (Kelley 1986, 2–10; Edlin 1949, 23, 160–5). However, a higher proportion of reflective pieces was found in Wells 10421 and 8328 than in the other contexts examined. These pieces had been used in fires which achieved a high-burn temperature such as that required for smithing. Given the quantity and heat required for smithing, use of prepared charcoal would be likely and would also, in part, account for the condition of the material in the wells. Construction of large charcoal-making pits and stacks or kilns has in modern times taken place within coppiced or pollarded woodlands, close to the source of raw material (Kelley 1986, 9; Edlin 1949, 160) and there is no reason to believe this differed during the Iron Age.

While a proportion of the charcoal examined from a few of the other site contexts, notably those heavily dominated by oak, was found to be highly reflective or glassy in appearance, this was not the norm. It might be postulated that a range of burn temperatures is represented away from the well dumps and that a variety of activities is evidenced. Most wood had seemingly been dried or seasoned to a degree but fragments from Pit 15142, context 15140, were puffy and fissured, from which the use of damp wood could be implied or that, perhaps, there was the introduction of liquids such as cooking juices to the fire. The source of charred material other than wood and prepared charcoal associated with metal-working is debateable; that it was plentiful is unsurprising given the scale of the *oppidum* and apparent intensity of settlement and does not in itself force an interpretation of industrial-scale processing or manufacture. The fills of some features such as Pits 15142 and 15684 proved particularly species diverse. Both have been interpreted as rubbish pits and it is proposed that this charcoal is domestic fuel waste, including from the preparation of food, coming from the hearths of nearby homes. Small-scale collection of available, dead, fallen firewood from nearby open woodlands is indicated by the charcoal from such features.

The reasons for the collection of heathers, gorse and broom may have been varied; for instance they make good kindling, but most likely they were targeted for use as animal fodder and bedding. The suggestion of burnt animal bedding and waste feed in context 12847 of Ditch 11631 is supported by the presence of stable manure in the waterlogged plant macrofossil evidence and raised phosphorus, strontium, calcium levels (Cook, p. 354) in the area (Lodwick, p. 301). Burning would be a wise practice, both to reduce the volume of waste to dispose of and to minimise disease, pests and smell within this residential area, although composting away from living areas would have sufficed equally well.

THE WIDER LANDSCAPE

All taxa identified are native types; no importation of wood/wooden objects has been identified. Deciduous trees and shrubs dominate but holly and yew, both evergreen taxa, have also been found in small numbers. Some types have overlapping environmental and habitat preferences but others are distinct and it is clear that a range of different habitats was exploited for timber and fuel at Insula IX. The following discussion draws on studies of modern plant ecology such as those of Peterken (1993) and Ellenberg (1988) and the British Flora (Stace 2010).

The presence of heath types, including heathers and gorse or broom, is supported by on-site plant macrofossil findings, such as Ericaceae capsules and a frond of *Ulex europeus* in Well 10421 (Lodwick, p. 289). Clearly heathland had established in places on the free-draining acid soils formed on the Silchester Gravels outcrop surrounding the *oppidum*. This presumably followed widespread clearance for agriculture during the Iron Age or earlier and was likely maintained by browsing animals, including, potentially, livestock. Open scrub types are well represented too, with downy or silver birch a common finding, forming 5 per cent of the total assemblage, but elder is also present. Birch charcoal was also found in small quantities in the earliest deposits at the forum basilica (Straker 2000, 515), but not in analysis of later deposits there or at Insula IX (Veal 2012). It can be postulated that establishment of secondary woodland was actively occurring nearby during the late Iron Age, perhaps following abandonment of previously cultivated areas, whether short or long term, and perhaps physically coinciding with the area(s) of heath.

Wetland habitats were also exploited, with alder and willow/poplar occurring in over half the samples (FIG. 143), and within both the charcoal and waterlogged wood assemblages. While these taxa may have grown in small numbers around springs and boggy areas in the immediate vicinity, notably on the fringes of the Silchester Gravels cap, more substantial areas of alder carr would have existed on the fringes of the rivers Kennet and Loddon *c.* 5 km to the north and east. The frequency of occurrence of alder and willow/poplar here and, indeed, their appearance in contemporary or slightly later deposits at the forum basilica (Straker 2000, 515–19) is in stark contrast to the findings for late Roman Insula IX, when they proved absent (Veal 2012), indicating a change in focus from the wetlands to other sources of fuel or perhaps a reduction in distance people were willing to travel to collect bulk firewood.

Taxa of typical British mixed deciduous woodland are also present, with oak dominant, but other large trees include beech, ash and elm. Types such as holly and hazel would have formed an understorey to these large trees, given sufficient light due to openings in the canopy. Other taxa identified, such as dogwood, field maple, hazel and spindle, may have grown amongst this mix or equally in hedgerows along with members of the Maloideae and blackthorn. That all these types were taken is interesting and indicates a willingness and culture of using a broad resource base over a potentially wide area. It may be that different households, groups and artisans focused on different areas and taxa but this cannot be determined.

It is of note that hazel formed a substantial proportion of the fuel wood for Period 0, the most common type (along with birch and alder) after oak, forming 5 per cent of the overall assemblage and present in over half the contexts examined. This is again in direct contrast to the findings from the late Roman pits and buildings at Insula IX where it proved scarce (Veal 2012, 234, 242). It appears that either its local success declined over the intervening period, perhaps having been over-cropped for fuel, or it ceased to be coppiced and/or exploited.

While woodland tree and shrub types were available and readily used in the late Iron Age, the substantial presence of heath and scrub elements indicates that this was by no means the heavily wooded landscape envisaged by Boon (1974, 49) for this time. The presence of types such as hazel and elder indicate that, even where woodland remained, it was most likely of open canopy and with gaps. This landscape was a complex mosaic of cultivated land, heathland/pasture, scrub and woodland by the late Iron Age, offering a range of wild as well as cultivated resources. However, clearance for agriculture before and during this time may well have limited the availability of larger timbers and substantial volumes of fuel wood and would have necessitated the use of woodland management systems (see below) for more demanding activities such as metal-smelting and working and any local pottery production.

The plant macrofossil data support evidence for the presence of some of the infrequently found woody types in the charcoal assemblage (Lodwick, p. 309): holly was represented by a partial leaf in the waterlogged plant macrofossil assemblage from Well 8328, while hazelnut shells and seeds of *Sambucus nigra* were a component of the charred plant assemblage, strengthening the assertion here that these were locally available and exploited tree- and shrub-types. In addition to those pieces identified further to cf. hawthorn and cf. whitebeams, the Maloideae indet. could embrace a variety of species, including potentially edible types such as apple and pear. Indeed a single apple pip (*Malus* sp.) was found in Well 8328 (Lodwick, p. 287), although there is no evidence for its cultivation at the site.

Yew and beech were singular occurrences in this analysis. Although they can tolerate neutral or slightly acid soils as long as they are free-draining, both taxa favour base-rich soils, notably over chalk strata, which are lacking in this area of North Hampshire. The rarity of the charcoal here is thought to be a reflection of rarity of the trees around the *oppidum* rather than a lack of selection.

WOODLAND MANAGEMENT

The dominance of oak is clear, with one or more oak species forming 76 per cent of the charcoal analysed overall. This far exceeds the oak component of typical mixed woodland and strongly suggests the targeted exploitation of this species for fuel and, most likely, structural wood. Oak is an exceptionally good fuel choice, being highly calorific and capable of a long steady hot burn, even as raw wood. A substantial proportion (at least 10 per cent of the total assemblage, 14 per cent of the oak) has been found to be roundwood, cut (where discernible) at just 3–5 years old. The ability to target such a quantity of young oak for fuel strongly implies the existence of a woodland management system such as coppicing or pollarding to increase or maintain the supply of fuel wood (Rackham 1990, 8–9; Edlin 1949, 155–7). This may have been through coppicing or pollarding of solely oak stands. Management of mixed stands is more likely, particularly given the presence of small hazel roundwood in the assemblage, but, since most of that was found in contexts with mixed taxa and also hazel twigwood, this interpretation remains only a suggestion.

Despite the evidence for management and targeted selection of oak, a wide range of other taxa (≥20) has been identified in this analysis. Indeed, such a range of exploited and locally available taxa is somewhat surprising given the scale of the *oppidum* and impression of organised, urbanised living. Juvenile material, including small twigwood, was common for all major taxa represented; hedge or garden prunings and collected brushwood were frequently used either as kindling or fuel. The range of species and age of cutting/collection points, perhaps, to a more rural way of life, with the exploitation of locally available wood from a range of habitats over a wide area for small-scale craft and domestic activities rather than an absolute focus on managed stands to fuel industrial-scale activities.

BEYOND SILCHESTER

Large-scale wood-charcoal analyses are uncommon for late Iron Age British sites (cf. Huntley 2010, 19), including the *oppida*, in part due to a lack of bulk sampling in older excavations and a focus on plant macrofossils in isolation from wood charcoal in many recent post-excavation programmes, so direct comparators to this study are scarce. A body of work exists on cemetery sites or individual cremation contexts, but is not of direct relevance to this study. Comparisons are, therefore, made with charcoal assemblages from any broadly contemporary occupation deposits, regardless of degree of urbanisation. There is also a notable lack of detailed published pollen sequences for southern England (see Dark 2000) which heightens the usefulness of any such charcoal and wood analyses in providing data on landscape exploitation and management for this period. However, those that have been produced indicate extensive clearance of woodland during the late Bronze Age to early Iron Age (later moving northwards), with a substantial drop in arboreal taxa (ibid., 42–4). The degree of tree cover in the late Iron Age seems to have been highly variable by region but parts of southern England may have been as open as they are today (ibid., 79).

Late Iron Age assemblages have been described for Maiden Castle hillfort, Dorset (Salisbury and Jane 1940; Gale 1991), that indicate oak and ash were dominant in the landscape prior to construction, with hawthorn, cherry type and hazel in open woodland and on woodland margins. More open patches supported yew, berberis, dogwood and rose. Collection for fuel during occupation focused on oak, hazel and probable blackthorn, but field maple, ash, alder, gorse and willow/aspen were also present, as observed here. A narrower range of taxa was identified by Poole (1984c, 481–2) at Danebury hillfort, Hants., with oak, hazel and hawthorn dominant and ash and elm of greater importance than demonstrated at Silchester. The plentiful wood charcoal recovered from the six Danebury Environs Iron Age project sites has not yet been analysed, but the plant macrofossil remains were found to include occasional wild woodland taxa such as hazel nutshells and blackthorn (sloes) from Nettlebank Copse banjo enclosure (Campbell 2000, 56–7).

Charcoal analysis by Gale (2008a; 2008b) of an Iron Age to Roman farmstead and Roman settlement at Sites 29 and 15 of the M6 Toll (Birmingham Northern Relief Road) route demonstrated use of a wide range of native woody taxa for domestic use, and, unusually, as here, this included not only gorse or broom (*Ulex*/*Cytisus*) but heather (Ericaceae), indicating the presence and exploitation of open scrub. Members of the Ericaceae family are rarely identified in charcoal studies, in part because these small delicate pieces tend to be consumed by fire, but also, perhaps, because of the practice of targeting pieces >4 mm. This practice has its merits, as it is difficult to find sufficient anatomical characteristics in small fragments and can lead to the over-identification of easily recognised taxa such as oak. However, there is also a danger of missing small shrub types.

Heathland material may, however, also be discerned in plant macrofossil analyses, as here (Lodwick, p. 301) and, for instance, at Stanwick, N Yorks., where both *Erica* and *Calluna* species were identified (Van der Veen 2016). Metcalfe (1954) described a wood assemblage from Stanwick which included the major deciduous types in both worked and unworked form and also occasional elder and blackthorn, as collected here, but no heath material. Huntley (2016) identified a limited range of types in handpicked samples from recent work at Stanwick, with only oak, alder, hazel, willow/poplar and birch found.

Despite a large geographical separation and differing soils, the charcoal assemblages from late Iron Age–early Roman features, including late Iron Age Pit 3027 at Springhead and Northfleet, Kent (Barnett 2013), indicates substantial overlap with Insula IX in availability and use of lesser taxa, although they lacked the heathland taxa found here and showed a greater use of field maple. Also in Kent, mid-to-late Iron Age ditch and pit contexts at West Malling (Barnett 2009) also showed commonality, with the presence of substantial quantities of juvenile material. Hazel and oak were most important, but the presence of cherry types, including blackthorn, birch, beech, elder, willow/aspen, holly, elm and hawthorn, was also recorded. There again, however, field maple appeared in greater numbers and lime (*Tilia* sp.) was present. A dominant charcoal source of domestic refuse, including fuel waste and burnt hedge clippings/clearance was proposed for the site, in addition to context-specific pyre debris. The charcoal assemblage at The Dod, Northumbd., indicated an even greater reliance on twig and small roundwood, dominated by hazel with lesser alder, oak, willow/poplar, birch, ash and heather (although exceptional levels of unidentifiable material were noted, McCullagh 2000), while the larger waterlogged wood assemblage was of (larger) hazel, alder, and willow with Ericaceae and wild cherry (*Prunus avium*) (Crone 2000).

Analysis of Phase 2 (late Iron Age–early Roman) features, including a roundhouse and enclosure ditches, at Cambourne, Cambs. (Gale 2009), showed a far more restricted range of exploited taxa with oak dominant, a greater use of ash, and with Maloideae, blackthorn and willow/poplar also targeted for domestic use in this area of heavy clay soils. In the case of the assemblage at the late Iron Age–early Romano-British farmstead at Orchard Hill, Carshalton, Surrey, the remains of industrial (possibly metal-working) fuel also proved of restricted diversity, dominated by oak with lesser alder, hazel and ash (Barnett 2011) and at Dragonby, N Lincs. (Hayes and May 1996), only oak, hazel and ash were recorded.

Although it is generally accepted that the practice of woodland management continued to take place throughout late prehistory, actual evidence for management by coppicing and pollarding is rather limited for the Iron Age, particularly in comparison to that from Roman mass-production sites (e.g. Frith End, Hants. (Barnett 2012); Alice Holt Forest, Hants. (Chisham 2008)). It is, therefore, particularly useful to have been able to discern regular cropping of young oak at Insula IX. Most evidence comes from waterlogged sites such as Glastonbury lake village and Meare, Somerset, where substantial volumes of alder-oak wattle hurdles and fencing were recovered (Coles and Minnit 1995, 32–89; Orme *et al.* 1979, 9–12). At Danebury hillfort, hazel poles of 10–30 mm diameter were commonly used to form wattle walls and hurdles (Cunliffe 2003, 81–2). Approximately 75 per cent of the waterlogged wood from Sutton Common, near Doncaster, S Yorks., was of alder, at least some of which derived from immature coppice (Taylor 1997, 237–8). At Sidlings Copse, Oxon., Dark (2000, 120) observed that, within an already sparse woodland, mainly cleared by the late Iron Age, and despite wider clearance for arable fields, there is some pollen evidence for encouragement and/or planting of willow and oak by or during the early Roman period. The use of management techniques, such as the coppicing proposed in this study, and also pollarding, would have increased the productivity of remaining woodland resources and maintained supply.

CONCLUSION

A substantial body of new charcoal data has been produced for the late Iron Age, adding usefully to that already known for this somewhat under-studied period. A variety of activities has been proposed, including domestic use (heating, cooking), site clearance, provision of animal fodder/bedding, smithing and/or possible smelting. Evidence for the presence and exploitation of a large number of taxa has been presented, but clear targeting of oak as the fuel of choice can be seen, with management by short-rotation coppicing or pollarding to maintain supply proposed from the high proportion of roundwood cut at 3–5 years. A mosaic landscape has been described, with the presence and exploitation of heath, scrub, wetland and open, mixed, deciduous woodland demonstrated. The re-establishment of birch scrub/secondary woodland during this time is of interest, implying as it does, changes in patterns or intensity of arable or pastoral activity. The chronology established for the site has enabled consideration of a short period of time, at most 65 years. As work continues on Period 1 and 2 assemblages, changes in landscape, exploitation and management through time to the late Roman period will come to the fore, adding much to our understanding of the environment of this part of southern England. Of key interest will be the ability to examine changes in economy, exploitation patterns, management practices and landscape across the late prehistoric to Roman transition.

CHAPTER 19

POLLEN ANALYSIS FROM WELL 8328

By Alex Brown

INTRODUCTION

This report summarises the findings resulting from pollen analysis of waterlogged deposits and dung in 17 samples from Well 8328. A further nine samples were assessed for Well 10421 and Pit 11026 but pollen preservation proved too poor for meaningful analysis.

The results of pollen analysis from Well 8328 are discussed in the context of previous pollen analyses of late Iron Age and early Romano-British contexts from the site of the forum basilica (Wooders and Keith-Lucas 2000), amphitheatre (van Scheepen 1989) and south-east gate (Keith-Lucas 1984). These studies suggest the existence of a largely open landscape of pasture, arable and heathland in the vicinity of Silchester from the late Iron Age. In almost all previous analyses, bacterial decay had resulted in the uniformly poor preservation of pollen grains and spores, introducing a potential interpretative bias in favour of those pollen/spore types more resistant to decay processes. By contrast, pollen from Well 8328 was well preserved, with only small quantities of indeterminable grains. The quality of preservation of pollen from the well provides an opportunity to consider in more detail the evidence for environment and land-use during the late Iron Age to Roman transition.

METHODS

In Well 8328, 17 samples for pollen assessment, *c.* 1 cm^3 in volume, were taken from a column sequence through waterlogged deposits and from three dung cakes preserved in context 9309. Two *Lycopodium* tablets were added to enable calculation of pollen concentrations. Samples were prepared following standard laboratory techniques (Moore *et al.* 1991) and mounted in glycerol jelly stained with safranin. A minimum of 300 pollen grains of terrestrial species were counted for each level. Pollen percentages are calculated based on terrestrial plants. Fern spores are calculated as a percentage of terrestrial pollen plus the sum of the component taxa within the respective category. Identification of cereal pollen followed the criteria of Andersen (1979). Indeterminable grains were recorded according to Cushing (1967). The pollen diagram was produced using Psimpoll version 4.10 (Bennett 2002).

RESULTS

Pollen data from Well 8328 are described in the context of three local pollen assemblage zones (LPAZ; FIG. 146). Pollen from dung samples 3214, 3215 and 3227 is presented in FIG. 147. Pollen was well-preserved throughout the well sequence and dung samples, with few indeterminable grains.

WELL 8328 (FIG. 146)

Zone 8328–1 (2.57–2.08 m), context 9680

The zone is dominated by herbaceous pollen (*c.* 50 per cent), principally Poaceae (grass family), and a range of other herb taxa occurring in small quantities, including *Ranunculus*-

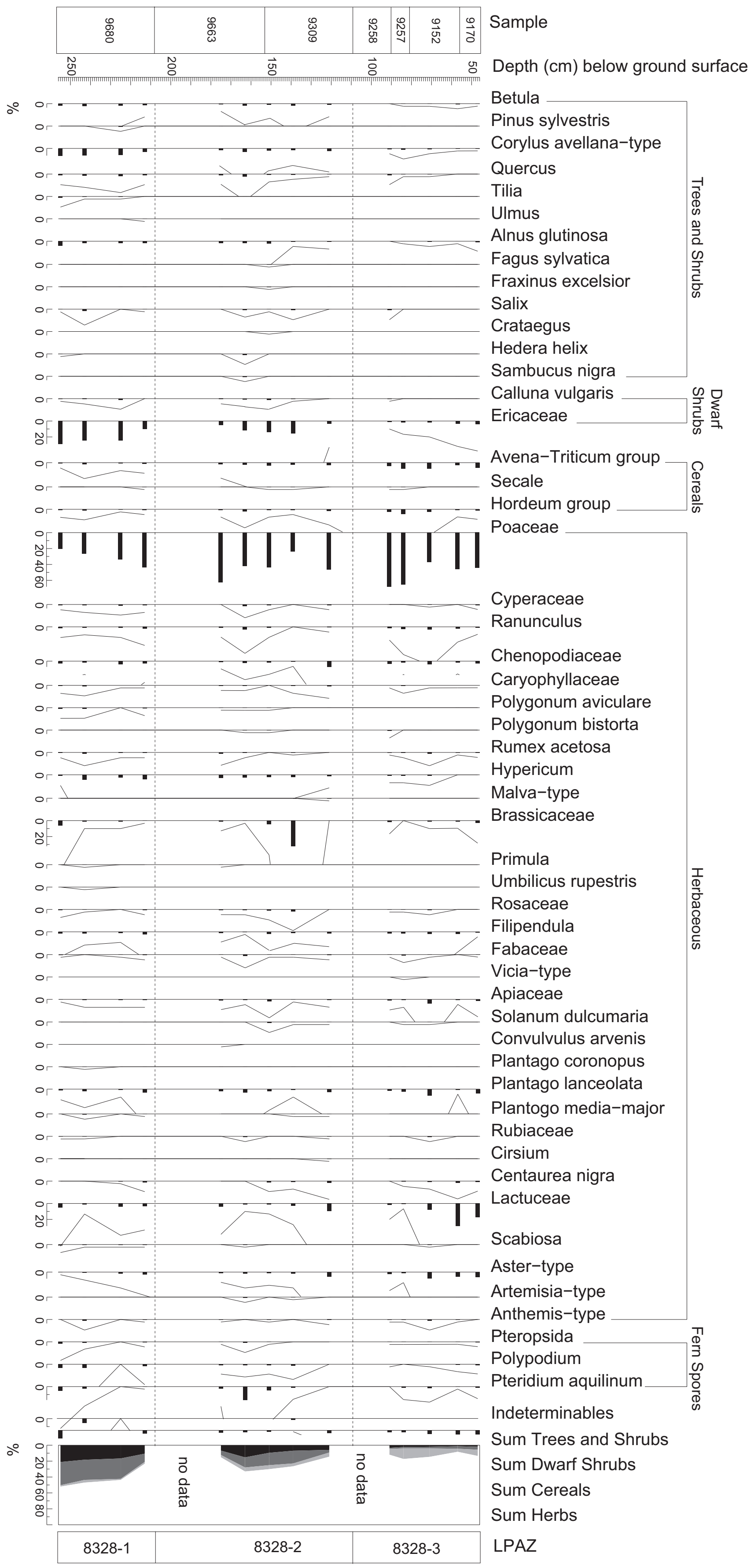

FIG. 146. Percentage pollen diagram for Well 8328. Silhouettes are values exaggerated x10. No data refer to those parts of the core from which sediments were not recovered.

type (buttercups), Chenopodiaceae (goosefoots), *Hypericum* (St John's wort), *Filipendula* (meadowsweets), *Plantago lanceolata* (ribwort plantain), Brassicaceae (cabbage family) and Lactuceae (lettuce family). Occasional cereal-type pollen grains of the *Avena-Triticum* (oats and wheat) and *Hordeum* (barley) groups, and a single grain of *Secale* (rye), were recorded. Pollen of dwarf shrubs, principally *Ericaceae* (heathers), are also present in high values (*c.* 25 per cent), although declining to *c.* 10 per cent at the top of context 9680. Arboreal pollen values are comparatively low (20 per cent, declining to 10 per cent), represented primarily by *Corylus avellana*-type (hazel), *Alnus glutinosa* (alder) and *Betula* (birch), with only occasional pollen of *Quercus* (oak), *Tilia* (lime), *Pinus* (pine) and *Salix* (willow).

Zone 8328–2 (2.08–1.09 m), contexts 9663 and 9309

This zone is characterised by the increased dominance of herbaceous pollen (70–85 per cent). The main taxon present is Poaceae (maximum 62 per cent), with a peak in Brassicaceae to 32 per cent (1.38–1.40 m) and an increase in Chenopodiaceae, Lactuceae and *Aster*-type (daises) at 1.20–1.22 m. Cereal-type pollen increases (maximum 5 per cent). *Ericaceae* is well represented, although values range from 3 to 15 per cent. There is a continued decline in arboreal pollen. Spores of *Pteridium aquilinum* (bracken) increase to 15 per cent (1.62–1.64 m), but along with other fern spores, otherwise occur in low frequencies through the well profile.

Zone 8328–3 (1.09–0.46 m), contexts 9258, 9257, 9152 and 9170

Herbaceous pollen taxa continue to dominate the pollen assemblage, with reduced values for pollen of trees, shrubs and dwarf shrubs. The main taxon present is Poaceae (45–68 per cent), whilst several other herbaceous taxa increase in contexts 9152 and 9170, including Apiaceae (carrot family), *Plantago lanceolata*, Lactuceae and *Aster*-type. The zone is also characterised by an increase in values for cereal-type pollen (maximum 13 per cent), primarily *Avena-Triticum*. Arboreal pollen grains are notably sparse, accounting for no more than 2–3 per cent of the terrestrial pollen sum.

Dung samples 3214, 3215 and 3227 from context 9309 (FIG. 147)

The pollen assemblages from the three dung samples contained within context 9309 are characterised by their homogeneity, dominated overwhelmingly by herbaceous pollen (95–8 per cent), and the notably restricted diversity of pollen taxa recorded (maximum 19 pollen taxa) compared to sediments from Well 8328 (maximum 41 pollen taxa recorded from context 9309). The main taxon recorded was Poaceae (73–86 per cent), with lower values for cereal-type pollen (4 per cent <3214>; 2.5 per cent <3215>; 9 per cent <3227>), *Ranunculus*-type (maximum 2.5 per cent), *Plantago lanceolata* (maximum 4.6 per cent), Lactuceae (maximum 3.6 per cent) and *Aster*-type (maximum 3 per cent). Pollen of trees, shrubs and dwarf shrubs account for no more than 4.5 per cent of the terrestrial pollen sum in sample 3227 and as little as 1.5 per cent in sample 3215.

INTERPRETATION AND DISCUSSION

Consideration of the sources of pollen recorded from Well 8328 is vital to interpretation. The most likely sources of pollen include:

(1) Pollen from plants growing at various distances in the landscape surrounding the town.
(2) Pollen from plants growing inside the town, either on waste ground or perhaps small horticultural plots.
(3) Pollen from plants deliberately brought into the town, particularly economic plants, including fruits, vegetables and herbs, but also pollen contained amongst plant materials, such as straw, used in thatch or daub, or for animal feed.
(4) Pollen may also be contained within waste material deposited into the well, including food waste or within human and animal faeces.
(5) Pollen within the animal dung was derived from the above sources, but may also reflect

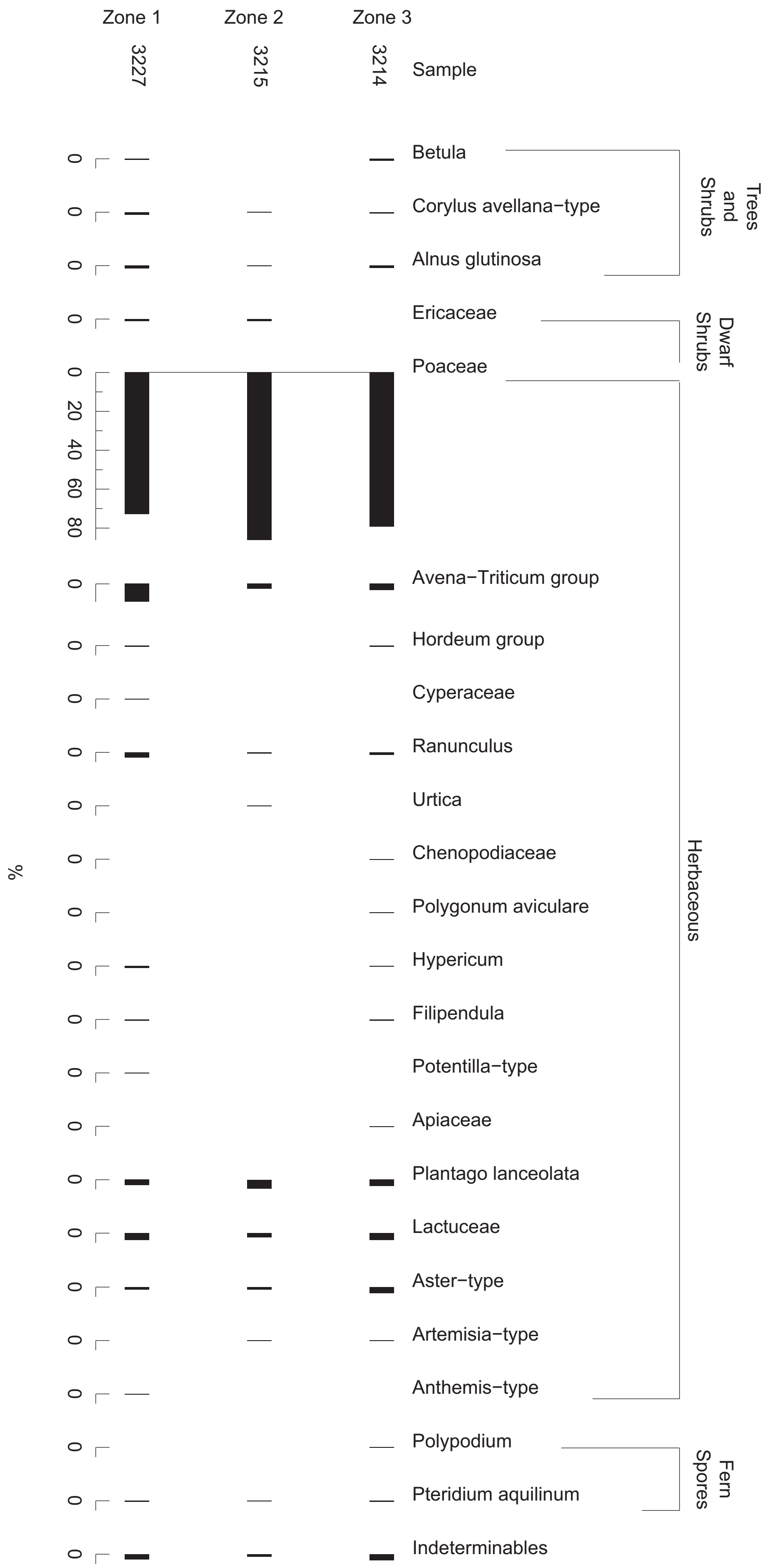

FIG. 147. Percentage pollen diagram for dung samples 3214, 3215 and 3227 from Well 8328, context 9309.

the specific sourcing of food materials by humans (e.g., grass, hay and other agricultural waste) and the individual dietary preferences of animals grazing outside the town.

(6) Deposits, particularly those at the base of the well, will include a mixture of pollen from the sources described above, in addition to pollen eroded from earlier sediments exposed in the well shaft.

The pollen from Well 8328 indicates that the vegetation environment surrounding Silchester was predominantly cleared of woodland by the late Iron Age and early Romano-British periods with only patches of scrub woodland remaining, primarily including *Quercus*, *Tilia* and *Corylus avellana*-type (see also Barnett, p. 323). Tree and shrub pollen reach a maximum of 21 per cent, declining to 10 per cent, within the basal context 9680 in Well 8328, much lower than the basal context 2099 within Well F672, dated to 25–15 B.C., and sealed by the site of the forum basilica (Wooders and Keith-Lucas 2000). The lower values for arboreal pollen could suggest that the lower deposits of Well 8328 post-date those of Well F672 (i.e. are later than 15 B.C.) or that a more heavily cleared, immediately local environment is represented.

Instead, the pollen assemblage suggests a range of environments surrounding Silchester. Heathland is indicated in the vicinity (particularly within contexts 9680, 9663 and 9309) by pollen of *Ericaceae*, *Calluna vulgaris* and *Betula* and spores of *Pteridium aquilinum*. The high values for Poaceae may reflect a variety of environments, including pasture, arable and waste ground, each supported by accompanying herbaceous pollen taxa. Pastureland is suggested by pollen of Lactuceae, Brassicaceae, *Plantago lanceolata*, *Ranunculus*-type and *Aster*-type. However, pollen of Brassicaceae includes several species which are morphologically too similar to separate, including crops such as *Sinapis alba* (mustards) and *Sinapis arvensis* (charlock). Arable land is most apparent in the occurrence of cereal-type pollen grains of *Avena-Triticum*, *Hordeum* and *Secale*. Cereal-type pollen is differentiated from wild grass pollen on the basis of the mean annulus and grain diameter, surface sculpturing and protrudance of pore. The *Hordeum* group includes several wild grasses but only two cultivated species: *Hordeum vulgare* (barley) and *Triticum monococcum* (Einkorn wheat). A proportion of *Hordeum* group pollen could conceivably reflect wild grasses growing within marshy environments. Areas of marshy ground, including carr-woodland, are suggested by pollen of *Alnus glutinosa*, *Salix*, Cyperaceae and species of *Filipendula* and *Hypericum*. However, the *Avena-Triticum* group includes several cultigens and only one wild grass (*Avena fatua*), whilst *Secale* pollen is easily distinguishable because of its elongated prolate form. Weeds associated with cultivation are present, including *Centaurea nigra* (common knapweed), *Malva* (mallow), *Convolvulus arvensis* (field bindweed) and *Scabiosa* (scabious), although these taxa are also characteristic of waste ground. Taxa such as *Polygonum aviculare* (common knotgrass), Apiaceae and *Rumex acetosa* (common sorrel) may equally reflect pasture, arable and waste ground. Apiaceae also includes a large number of wild and cultivated plants, most notably celery (*Apium graveolens*), parsnip (*Pastinaca sativa*) and dill (*Coriandrum sativum*), two of which are represented in the plant macrofossil assemblage for Period 0 (Lodwick, p. 310).

The pollen sequence from Well 8328 suggests a greater contribution of heathland pollen within the basal half of the well (contexts 9680, 9663 and 9309), reducing gradually in favour of pollen taxa characteristic of grassland/pasture, arable and waste ground within the upper contexts of the well (9258, 9257, 9152 and 9170). A similar progression is apparent in the pollen sequence from Wells F762 and F718/719 (forum basilica). Heather pollen is abundant within the lower fills of Well F762, with taxa of arable, pasture and waste ground more abundant in the upper fills and within Well F718/719 (Wooders and Keith-Lucas 2000). Heathland indicators are also apparent in the pollen sequence from the buried soil sealed beneath the south-east gate (Keith-Lucas 1984). The elevated levels of heathland pollen taxa in Well 8328 support suggestions that heathland environments were an important component of the late Iron Age/early Romano-British landscape in the vicinity of Silchester, most probably located on plateau gravels to the north-west (Keith-Lucas 1984) and as supported by plant macrofossil and wood charcoal data presented in this volume (Chs 17 and 18).

Heathland is typically maintained by grazing pressure, so it is interesting that heathland should subsequently decline in both Wells 8328 and F762, given the corresponding increase in pastoral indicators. An increase in *Pteridium aquilinum* (FIG. 146, context 9663) could reflect bracken invasion of heathland, which can occur in situations of reduced livestock grazing (Måren *et al.* 2008). The reduction in heathland could also reflect a change in land-use from open heathland habitats to a more organised form of land-use involving permanent rotational field-systems. This is supported by the presence of pollen of both winter and summer crops and pollen taxa characteristic of pasture and hay meadows.

The contribution of pollen from food plants processed and consumed within Silchester should not be overlooked. Many of the pollen families and genera recorded from Well 8328 (e.g. Apiaceae, Fabaceae and Brassicaceae) include plant species that may have been derived from 'economic plants'. Cereal pollen is the most obvious evidence for plant foods, but this cereal pollen could equally derive from hay used in thatch and daub or animal feed and subsequently deposited in the well. The peak in Brassicaceae pollen in particular may reflect food waste deposited in the well, perhaps from vegetables such as cabbage, mustards and charlock. Apiaceae also increases in contexts 9152 and 9170, perhaps reflecting the consumption of vegetables (e.g. carrots, celery and parsnip) and the use of herbs (e.g. dill, fennel and parsley).

The occurrence of *Malva* (mallow) pollen is interesting as it rarely occurs in off-site sequences owing to its poor pollen production and dispersal characteristics. *Malva* pollen has been recorded from Silchester in deposits from Cess-pit 5251, dating to the early second century (Dark 2011, 297). Seeds of *Malva* were also recorded from a pot deposited within Well 8, Insula XXII (Fulford 2001, 206). Both the leaves and flowers of *Malva* have medicinal uses (Launert 1989, 50), and are commented on by both Pliny and Cicero for their beneficial medicinal properties (Jashemski and Meyer 2002, 125).

The dung samples recovered from context 9309 provide an additional dimension to the pollen analysis of Well 8328. Faeces can be studied as a means of determining the dietary preferences of animals, although much of this work has focused on the macrofossil content. The pollen assemblages from dung samples 3214, 3215 and 3227 (context 9309) are notable for their homogeneity and restricted range of pollen taxa compared to pollen samples from the surrounding sediment, with a maximum of 19 pollen taxa (sample 3214) compared to 41 from the rest of context 9309. The overwhelming dominance of grass pollen, along with cereal-type pollen and plant taxa indicative of pasture, could suggest the grazing of animals in pasture/hay meadows outside Silchester, but could also represent the consumption of collected animal feed comprising hay and agricultural waste. It is likely therefore that the pollen assemblages from the dung reflect the dietary preference of the animal.

CONCLUSION

The formation processes of well deposits, and interpretation of the palaeoenvironmental data which they contain, can be complex. Nonetheless, the pollen record from Well 8328 provides a valuable picture of the vegetation and land-use history of pre-conquest Silchester. The pollen record demonstrates that the landscape surrounding Silchester was predominantly open in the late Iron Age. The lower fills of the well are dominated by pollen taxa indicative of heathland and pasture, whilst the upper fills of the well contain pollen characteristic of pastoral and arable land. Pollen of weeds associated with arable fields is also likely to have been growing in waste ground within the town, whilst cereal pollen may also have been brought in on hay used for thatch or in animal feed. Many of the pollen types are from economic plants, including vegetables and herbs, possibly derived from food waste subsequently deposited into the well. The animal dung deposited in the well contains pollen consistent with the pasturing of animals in meadows and/or the feeding of grass and agricultural waste. The picture presented above is consistent with the results of previous pollen studies of late Iron Age and early Romano-British contexts at Silchester, particularly from the forum basilica, that show a similar change from heathland-pasture-dominated to a mixed, pastoral-arable landscape. It is suggested here that this may reflect the development of a more organised farming landscape, perhaps comprising permanent rotational field-systems involving the cultivation of both summer and winter crops and pasturing of animals in hay meadows during the fallow season.

CHAPTER 20

PHYTOLITHS FROM WELL 8328

By Sarah Elliott

INTRODUCTION

This chapter presents the results of the phytolith assessment of ten samples from late Iron Age Well 8328 and associated overlying late Iron Age to early Roman (Period 1) slumps.

Phytoliths survive and are stable in a pH range of 3–9 (Harvey and Fuller 2005). Phytoliths form within a plant in a number of different locations, conforming to cell shape or intercellular spaces (Rovner 1983). Phytoliths can be identified to specific parts of plants — stems, leaves or husks — which are not normally represented by macro-botanical remains. Differentiating plant parts enables inferences to be made relating to crop-processing, particularly by identifying crop-processing waste (Harvey and Fuller 2005). Phytolith deposition is archaeologically important due to their preservational properties and representation of plant use/exploitation in the immediate area within a wide range of contexts (Rovner 1983). Phytoliths make an important contribution to the archaeological record because other plant remains often only survive once charred. Monocotyledons (monocots) and dictoyledons (dicots) can both be identified by their phytolith assemblages. Any given species of grass produces a wide array of morphologically distinct types (Rovner 1983), but dicots often do not produce uniquely shaped phytoliths (Tsartsidou *et al.* 2007). It is important to bear in mind when analysing assemblages that grasses (monocots) produce on average twenty times more phytoliths than dictoyledons (Albert *et al.* 2002). Phytolith studies are rare in Britain but there is potential for this proxy to make a real contribution to archaeobotanical analysis, especially in situations where charred or waterlogged plant remains are not preserved. However, even where such remains are present, as here in Insula IX, phytoliths play a complementary role, evidencing the presence of plant parts and plant material not otherwise represented.

Grasses produce phytoliths which are morphologically distinct to a certain family and can be categorised into C4 and C3 species. This enables the analyst to make inferences about vegetation and climate. At high temperatures and relatively low CO_2 concentrations (e.g. high light environments, therefore warm, humid climates), plants can most efficiently fix carbon to form carbohydrates through C4 photosynthesis rather than through the ancestral and more widespread C3 pathway (moist, wet conditions in well-watered habitats colonised by plants usually inefficient at using water) (Vincentini *et al.* 2008). Those phytoliths which help us to identify different species of grass and can give us more detail about the vegetation and climate are short-celled phytoliths. The shapes of the individual opal phytoliths from grasses are indicators of C3 and C4 photosynthetic pathways (Twiss 1992). Bilobes most frequently form in panicoid grasses (C4 grasses), which prefer warm and humid climates (Twiss 1992; Barboni *et al.* 1999). Rondels most frequently form in pooid grasses (C3 grasses) and they prefer moist and wet environments (Barboni *et al.* 1999). The pooideae include cereal grains such as *Hordeum* (barley), *Lolium* (rye), *Avena* (oats) and *Triticum* (wheat) (Twiss 1992). The two different photosynthetic pathways in grasses as in all higher plants are the three carbon photosynthetic pathway (the Calvin-Benson Cycle) and the four photosynthetic pathway (the Hatch-Slack Cycle) (Twiss 2001). These two different pathways convert carbon dioxide and the different pathways result in significant physiological and anatomical differences. These are referred to as C3 and C4 grasses. The C3 and C4 photosynthetic pathways tend strongly to have different numbers and shapes of short-celled phytoliths and indicate different environments of growth (Piperno 1988). Therefore, depending on which phytoliths we find in the samples, we can infer which pathways they came from and subsequently which type of environment they may have come from.

Count size, the number of phytolith specimens tallied on a slide, is the last in the series of steps of sub-sampling (Strömberg 2009). Various studies have been carried out on the number of phytoliths needed to accurately represent the phytolith assemblage (Pearsall and Piperno 1990; Ball *et al.* 1996; 1999; Albert and Weiner 2001; Piperno 2006). Hundreds, thousands and sometimes millions of phytoliths can be produced per slide; to count all would not be realistic. The most common value lies between 200 and 400 phytoliths counted per slide (e.g. Alexandre *et al.* 1997; Carter 2000; Blinnikov *et al.* 2002). In addition to a minimum count of 200 phytoliths (at x400 magnification), a quick scan is carried out at a magnification of x200 to look for rare morphotypes.

METHODS

A range of samples was available for sub-sampling for phytolith analysis for Well 8328. Ten were selected at regular intervals throughout the upper layers slumping into the top of the well and from the well shaft itself (Table 29).

Samples were processed in the Archaeology Department at the University of Reading. Each sample was screened through a 0.5 mm mesh to remove any coarse particles; approximately 1 g of dried raw sediment was then weighed out. Calcium carbonates were dissolved using a dilution of 10 per cent hydrochloric acid and then washed in distilled water three times. Clay was removed using a settling procedure and sodium hexametaphosphate (Calgon) as a dispersant. Distilled water was added and the samples left for 75 minutes before pouring off the suspense. This was repeated at hourly intervals until the samples were clear. Samples were then transferred into crucibles and left to dry at a temperature of less than 50° C. After drying, samples were placed in a muffle furnace for two hours at 500° C to remove organic matter.

Phytoliths were then separated from the remaining material using a heavy liquid calibrated to a specific gravity of 2.3, transferred to centrifuge tubes and washed three times in distilled water. They were then placed in small Pyrex beakers and left to dry. Approximately 2 mg of phytoliths per sample were mounted onto microscope slides, using the mounting agent Entellan. Microscope slides were examined under a Leica DMLP transmitted light microscope at magnifications ranging from x200 to x400. Full counts were attained by counting a minimum of 200 identifiable

TABLE 29. PHYTOLITH SAMPLE NUMBERS, ASSOCIATED CONTEXTS AND CONTEXT DESCRIPTIONS
(The top five samples are from slumps associated with Well 8328 and the bottom five samples from the well shaft itself)

Sample	Context	Description
2626	8363	Floor or levelling deposit with areas of burning. Slumps over Well 8328
2723	8428	Occupation deposit with high amounts of burning and charcoal
2774	8442	Clay floor surface slumping into Well 8328
2942	8452	Occupation layer. Possible floor or levelling deposit slumped into Well 8328 containing burning and charcoal
3025	9183	Occupation / accumulation layer. Possible floor of an Iron Age structure. Earliest slump into Well 8328 before the well fills begin
2980	9170	Blue/grey clayey well deposit with some charcoal
3189	9152	Highly organic fill of well
3197	9258	Well fill with high amounts of wood and burning. First fill of secondary shaft
3214	9309	Highly organic peaty well deposit, containing plant remains and animal dung. Possible stable floor?
3380	9663	Well fill with high amounts of organic material and four whole pots. Possible ritual deposition

phytoliths (where applicable). The phytoliths were counted and categorised into types (Table 30). Phytoliths were further classified as deriving either from woody (dicotyledon) or non-woody (monocotyledon) taxa. The stems and leaves of all monocots produce elongate smooth phytoliths, the elongate dendritic phytoliths come from the husks of plants and hair/trichome phytoliths are found in all cells from monocots. Making a comparison between elongate smooth phytoliths and elongate dendritic phytoliths can give an indication of crop processing. Rondels are produced by C3 Pooid grasses and bilobes and polylobes are produced by C4 panicoid grasses. Multi-cells enable identification to genus level (e.g. barley, wheat, millet). The results given in Table 30 are based on a minimum count of 200 phytoliths per slide where possible plus the scan.

RESULTS

The key phytolith results are tabulated in Table 30. No dicotyledons are represented in this table as phytoliths produced by trees and shrubs were not common in the assemblages. The results indicate that phytolith preservation is very good and that there are abundant numbers of phytoliths in each sample.

Phytolith concentrations do vary between the samples (FIG. 148). Sample 3189 has considerably more phytoliths compared with the other nine samples. Samples 3025, 3197 and 3214 have increased numbers of phytoliths compared to the remaining six samples.

All ten samples contained phytoliths from both monocotyledons and dictoyledons. The landscape around the site would therefore have contained both grasses and shrubs/trees, as attested by the plant macrofossil and wood charcoal analyses. However, there is an apparent predominance of monocots (grasses) over dicots (shrubs and trees), with monocot phytoliths representing over 90 per cent of the total assemblage in all samples (FIG. 149). A direct comparison of monocot to dicot counts is not reliable as monocots tend to be over-represented in phytolith assemblages due to levels of phytolith production.

All ten samples contain phytoliths from the leaves and stems of monocots, represented both with single cells (elongate smooth and elongate sinuate phytoliths) in FIG. 148 and multi-cells (conjoined elongate smooth and sinuate phytoliths) in FIG. 151. All ten samples also contain single-celled phytoliths from the husks of monocots (elongate dendritic phytoliths) (FIG. 150), whereas only eight out of ten contain multi-cells from the husks (conjoined elongate dendritic phytoliths) (FIG. 151).

Only four of the ten samples contained husk multi-cells that can be positively identified to genus level (*Triticum*, *Hordeum*, *Avena* and *Phragmites*) (Table 30). Eight out of ten samples

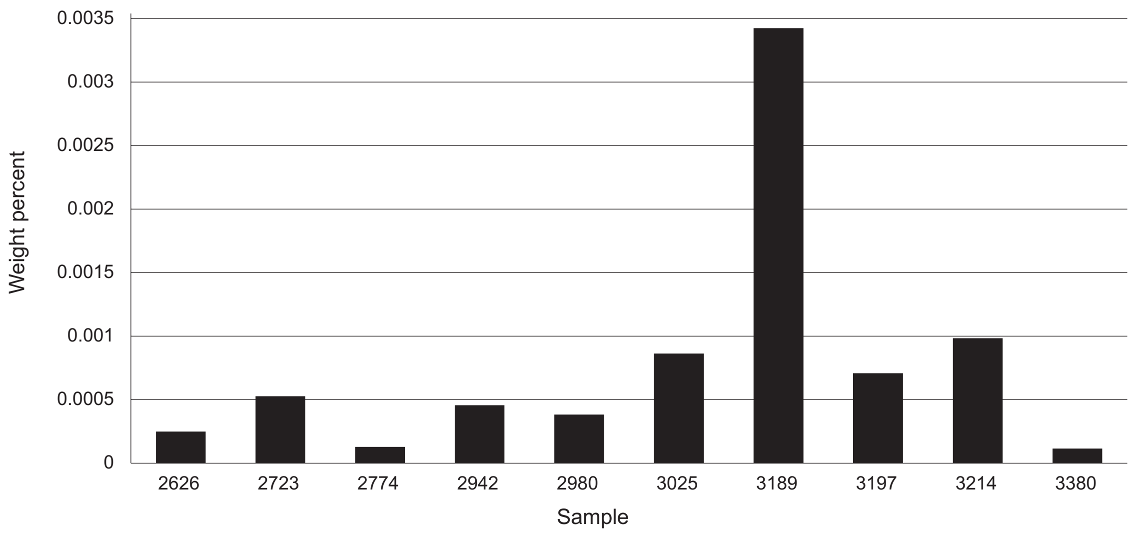

FIG. 148. Graph showing weight percentage of phytoliths produced by each sample from Well 8328.

TABLE 30. TABLE SHOWING THE MOST ABUNDANT AND IMPORTANT MONOCOTYLEDON TAXA PER SAMPLE

		Main phytolith taxa																	
Sample no.	Context no.	bilobe	crenate	hair/ trichome	long dentritic	long sinuate	long smooth	rondel	Aegilops	barley husk	leaf/stem	Phragmites stem	unidentifi- able husk	*Triticum* husk	*cf. Hordeum*	*cf. Triticum*	*cf. Aegilops*	*cf. Avena*	Cyperaceae cones
2626	8363	5	19	16	21	15	109	22			42		4					1	
2723	8428	2	7	10	36	40	83	42			58	3	6		5	1	1		1
2774	8442	4	15	24	27	30	70	29			28		1	2	1	1		2	
2942	8452	4	12	4	31	14	95	47			8			1					
3025	9183		10	13	8	20	86	57			22					1			
2980	9170	3	15	13	6	24	94	40			16				1	1			
3189	9152	2	17	26	20	18	82	17			22	1				5			
3197	9258	2	11	6	24	27	122	34	2	2	67	2	12	5	8	8			
3214	9309		10	17	5	27	108	50			89								
3380	9663	2	6	29	30	16	93	27			13								

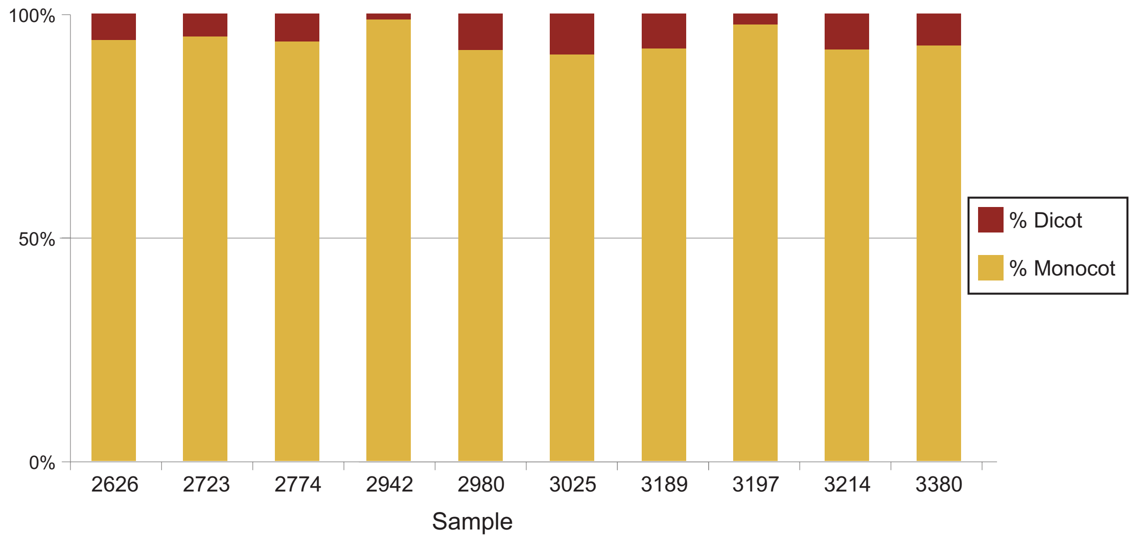

FIG. 149. Graph showing the percentage of monocot phytoliths and dicot phytoliths from Well 8328.

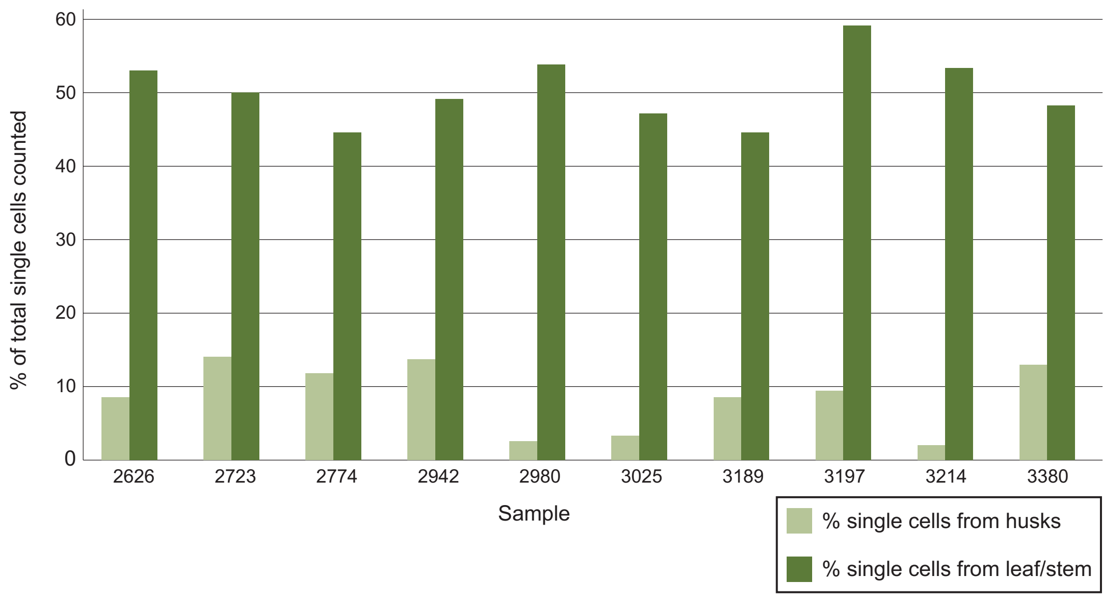

FIG. 150. Graph showing percentages of the total single cells counted for phytoliths from leaf/stem cells and from the husks of plants.

contained multi-celled phytoliths that were difficult to categorise but were likely to belong to one of the following genera: *Hordeum*, *Triticum* and *Avena*. These phytoliths were described as comparing favourably (*cf.*) with the aforementioned taxa and assigned on this basis. These multi-cells did not have all of the criteria for positive identification but had one of the identifiable characteristics of a particular genus.

Phytoliths produced by Cyperaceae were present in low numbers in seven of the ten samples. Two samples (2626 and 2773) contained two types of phytoliths which are found in Cyperaceae. Sample 2942 contained the highest percentage of phytoliths produced by Cyperaceae (FIG. 152).

All samples contained rondels indicating the presence of pooid grasses; eight out of ten samples contained bilobes, while nine out of ten samples contained polylobes, both suggesting the presence of panicoid C4 grasses. The family pooideae includes cereal grains: *Hordeum*, *Lolium*,

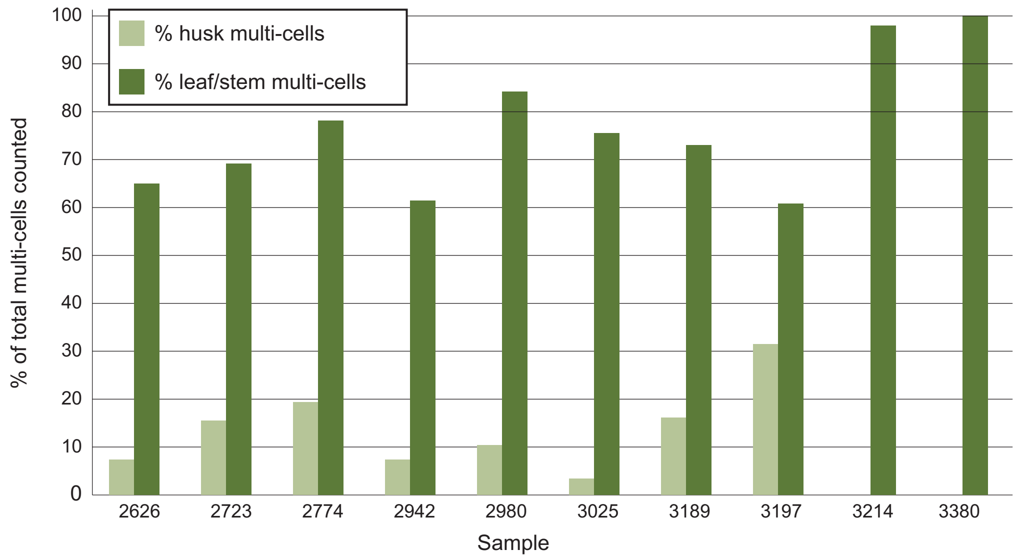

FIG. 151. Graph showing percentages of the total multi-cells counted for phytoliths from leaf/stem cells and the husks of plants.

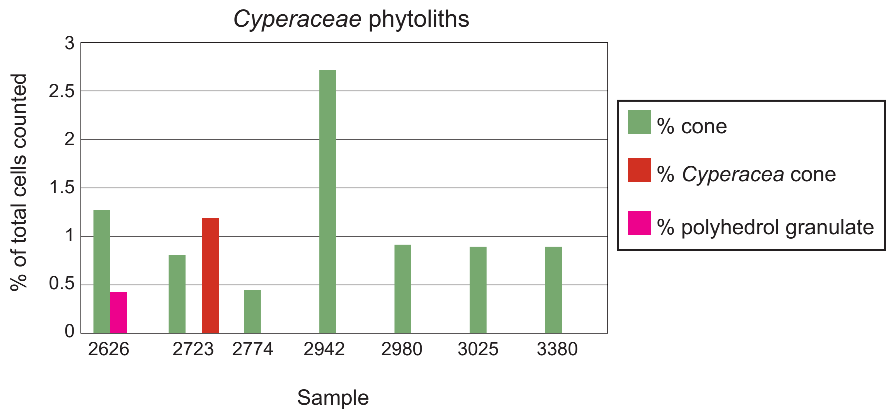

FIG. 152. Graph showing percentages of the total number of cells counted for Cyperaceae phytoliths (cone, polyhedrol granulate and conjoined Cyperaceae cone). Note: cone and polyhedrol granulate are percentages of total single cells counted whereas Cyperaceae cones are a percentage of the total multi-cells counted.

Avena and *Triticum* (Twiss 1992). All samples are dominated by rondels (7.5–25.5 per cent of total phytoliths counted) with lower amounts of polylobes and bilobes (0.89–4.24 per cent of total phytoliths counted) (FIG. 153).

All ten samples contained some phytoliths which had darkened centres. Some archaeologists argue that these darkened phytoliths (occluded carbon) provide evidence of fire histories (Parr 2006) and that direct contact with fire induces darkening (charring) of phytoliths (Piperno 1988; Kealhofer 2003). However, it is also recognised that some species are known to possess these properties naturally (*Myrtaceae* species and some Poaceae), and there are marked differences between the naturally dark phytoliths and phytoliths darkened by burning. Naturally occurring colours have a transparent and opalescent appearance as opposed to the dull, opaque finish of charred phytoliths (Parr 2006). All of the phytoliths with darkened centres appear to exhibit the characteristics of burning as opposed to natural discolouration. To make an estimation of the concentration of phytoliths with occluded carbon centres, burnt phytoliths were counted over a

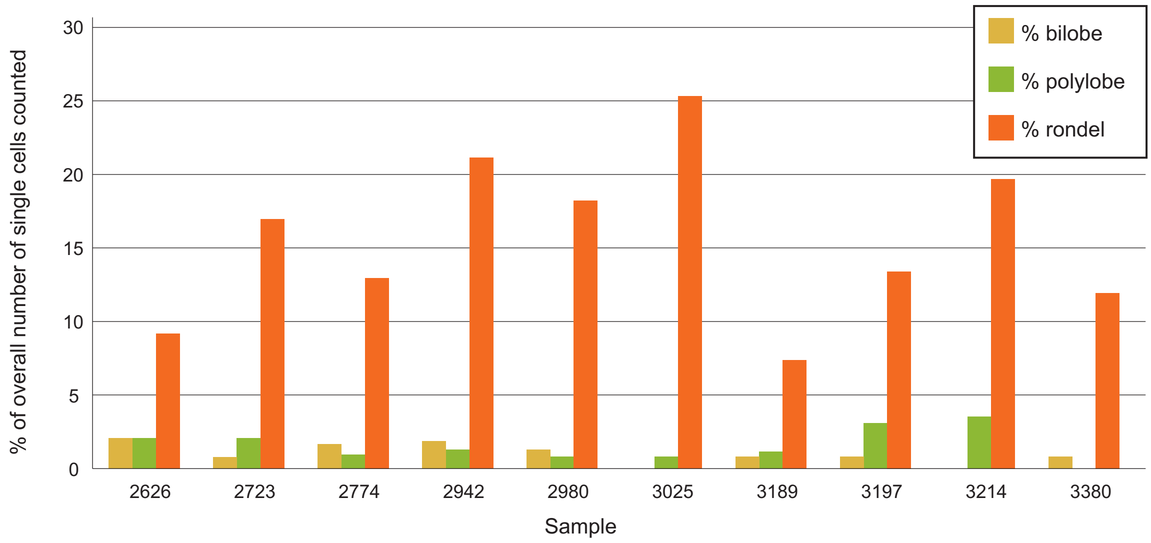

FIG. 153. Graph showing percentages of the total number of single cells counted for short cells: bilobes, polylobes and rondels.

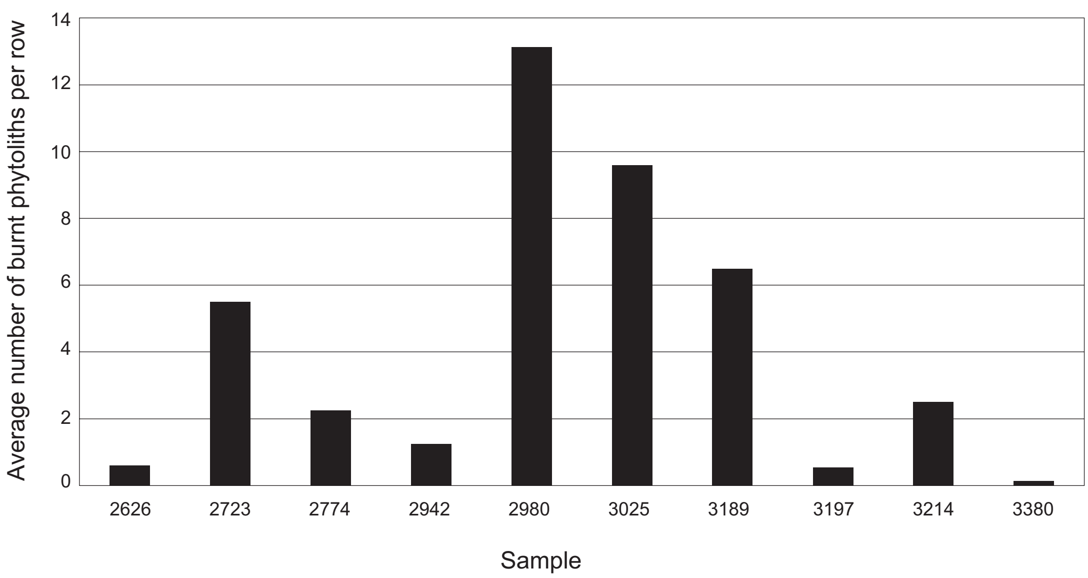

FIG. 154. Graph showing the estimated number of burnt phytoliths per row for each sample.

set number of rows while scanning at a lower magnification for multi-cells (burnt phytoliths are easily identified at lower magnifications). An average per row was then taken in order to produce an estimation of the number of burnt phytoliths per row for each sample (FIG. 154).

According to the field descriptions, four contexts contained burning properties visible to the eye (8428, 8452, 9170 and 9258). Samples from these contexts all contained burnt phytoliths, with sample 2723 from context 8428 containing the highest concentration. Contexts that had no visible traces of burning also contain burnt phytoliths (8363, 8442, 9183, 9152, 9309 and 9663).

DISCUSSION

The sample with the highest weight percentage of phytoliths (3189) originates from a context which was described by the excavator as a 'highly organic fill' (9152). If plant remains were

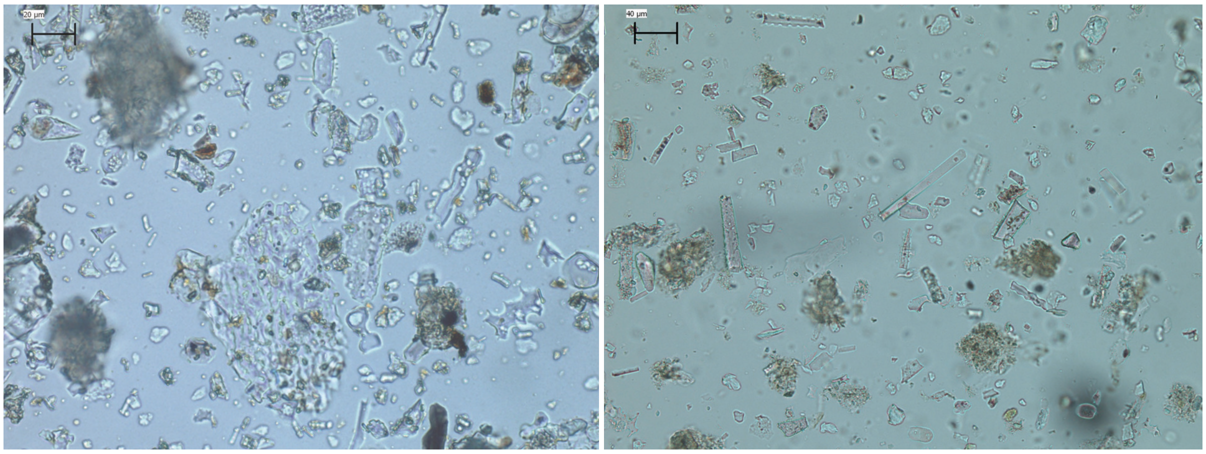

FIG. 155. Photomicrographs from samples 2626 and 3189, showing high percentages of phytoliths.

visible to the naked eye it is unsurprising that there was such a high concentration of phytoliths (FIG. 153). Three other samples that have fairly high weight percentages of phytoliths (3025, 3197 and 3214) originate from samples which you would expect to have high concentrations of plant remains and therefore a strong phytolith record. These samples are from accumulation/ floor layers and a deposit which is thought to be rake-out from a stable floor as it contained animal dung (9183, 9258, 9309). Phytoliths can pass through the gut of an animal in plant material and be preserved in animal dung, giving an indication of diet.

The two samples with the lowest weight percentage of phytoliths come from a Period 1 clay floor surface (8442) and the deepest well deposit (9663). The low concentration of phytoliths from the clay floor could indicate the cleanliness of this specific area of the structure, which seals and slumps into the well. If, for example, this was an area where people slept and was not used for cooking or eating, it could be largely devoid of plant remains and therefore yield low concentrations of phytoliths. On the other hand plant material could have been present in this area of the structure and thorough sweeping and cleaning could account for the lower numbers of phytoliths from this sample. Sample 3380 from the base of the well was associated with four complete ceramic vessels, the lower numbers of phytoliths suggesting that the deposition of plant remains was not an important aspect of this 'ritual'.

Overall, all samples exhibit a dominance of grasses (>90 per cent) over shrubs and trees (<10 per cent). Even accounting for the over-production of monocot phytoliths, this indicates an open landscape mainly consisting of grassland species. The presence of some phytoliths from woody taxa (dicots) in all samples indicates that woodland vegetation may have grown locally in the surrounding landscape during the Iron Age. The samples which show a slight increase in woody type phytoliths (3025, 2980, 3197 and 3380) could, however, be significant to the plant remains present in these samples. Because dicots produce smaller quantities of phytoliths these slight increases are probably significant. For example, the increased woody taxa in sample 3025 from the floor surface of the structure could indicate remains of wooden beams in the beam slots adjacent to the floor itself. During excavation, charcoal was visible in sample 2980. As such, the increased dicot phytoliths could indicate the presence of wood brought in as fuel for a fire/hearth. Sample 3197 visibly contained signs of woody material and, therefore, supports and reinforces this increase in woody taxa in comparison with some of the other less organic fills. Although sample 3380 generally had a lower weight percentage of phytoliths overall, the phytolith record shows a higher percentage of dicot phytoliths compared with some of the other samples. Although plant remains may not have played a large part in the deposition of the four complete vessels at the bottom of the well shaft, it may be significant that there was a higher proportion of woody remains compared with the other samples from the well.

All samples contained more single- and multi-celled phytoliths originating from the leaves and stems of monocotyledons (grasses) than from the husks (FIGS 156 and 157). However, single cells

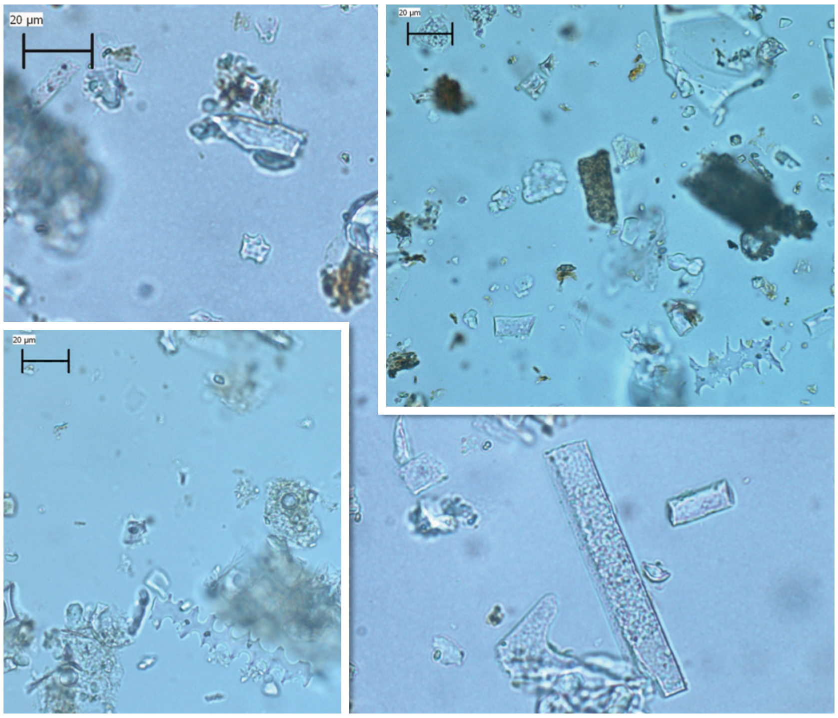

FIG. 156. Photomicrographs showing single long cells. Upper inset: dendritic long cell from sample 3197. Lower inset: dendritic long cell from sample 3189. Main photomicrograph: smooth long cell from sample 3197.

FIG. 157. Photomicrographs of conjoined smooth long cells from the stems and leaves of monocotyledons. Upper inset from sample 3189, lower inset from sample 3197 and main photomicrograph from sample 3189.

from the husks are present in all ten samples and eight of the ten samples contain multi-celled phytoliths from the husks (FIG. 158); the two exceptions being samples 3214 and 3380. Sample 3214 is from a layer which has been described as a 'stable floor' (9309) and contained large quantities of animal dung. It is unsurprising, therefore, that phytoliths from the inflorescences

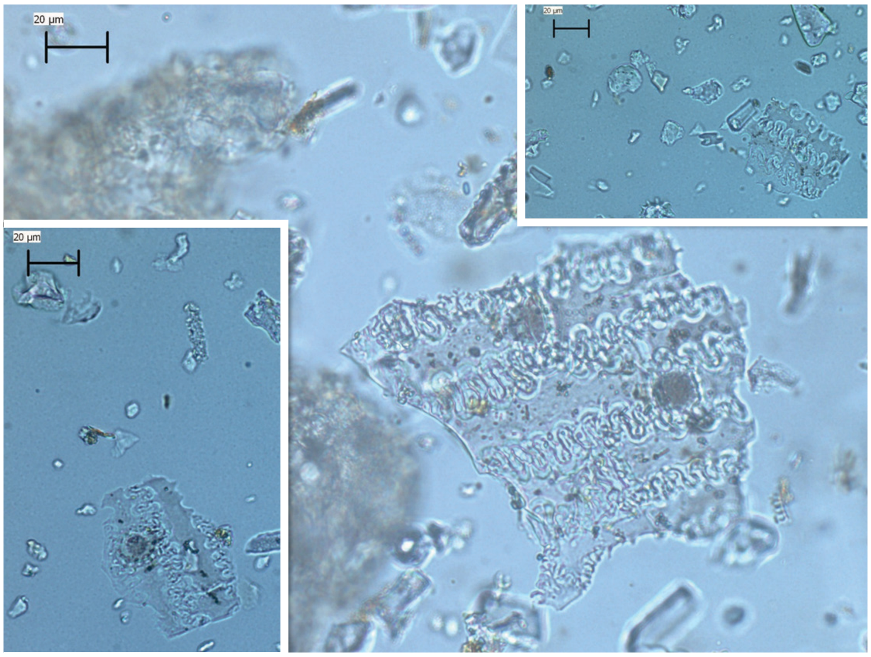

FIG. 158. Photomicrographs of husk multi-cells. Upper inset: *Triticum* husk multi-cell from sample 2774; lower inset: *Triticum* husk multi-cell from sample 2774; main photomicrograph: *Triticum* husk multi-cell from sample 3197.

are largely absent from this assemblage. The phytolith assemblage suggests that animals in the stable were only consuming the leaves and stems of the grasses rather than the floral bracts. The low number of single cells originating from husks in the sample overall (<2 per cent) could just represent husk or husk fragments which randomly got integrated with the feed or the contents of the stable floor. Sample 3380 also was devoid of multi-cells from husks, although it contained a large number of single cells from husks (*c.* 13 per cent). It is surprising that this sample, containing one of the higher values for single cells from husks, did not contain any multi-cells from husks. This may reflect taphonomic breakdown as this sample is the lowest in the well profile.

All the samples with increased evidence for husk remains contain large quantities of leaf/stem cells which could be evidence of waste material from crop processing. The increased husk remains could be evidence for winnowing or de-husking the cereals (Harvey and Fuller 2005). Sample 2723 shows increased husk remains in both single and multi-cells and comes from an occupation deposit, suggesting that crop processing went on in this area of occupation. Sample 2774 from a floor surface is similar, with increased evidence for crop processing in both single and multi-cells. Sample 2942 exhibits increased husk remains in multi-cells only but also comes from an occupation deposit. However, sample 3197 is from a well fill and contains increased husks from multi-celled phytoliths only. This deposit is organic, wood- and charcoal-rich and so could represent a hearth dump possibly used for cooking due to the presence of multi-celled husks (specifically *Triticum* and *Hordeum*). Sample 3189 is from another well fill that is highly organic and contains multi-celled husk remains. This deposit therefore could be a dump of material from crop processing.

A number of phytoliths were identified to genus level. Some can provide us with information about the range of crops present in the late Iron Age, while others can provide information relating to the surrounding environment. *Triticum* (FIG. 159), *Hordeum* (FIG. 160) and *Avena* were identified from multi-celled phytoliths. Some of the multi-cells were put into the *cf.* category as they have only one out of two or three identifying features. Six samples contained *Triticum*: three from the well shaft itself (3197, 2980, 3189) and three from the floor and occupation layers slumping into the well (2774, 2723, 2942). Five samples contained *Hordeum*: two from the well shaft itself (3197, 2980) and three from the slumps (2723, 2774, 3025). Only two

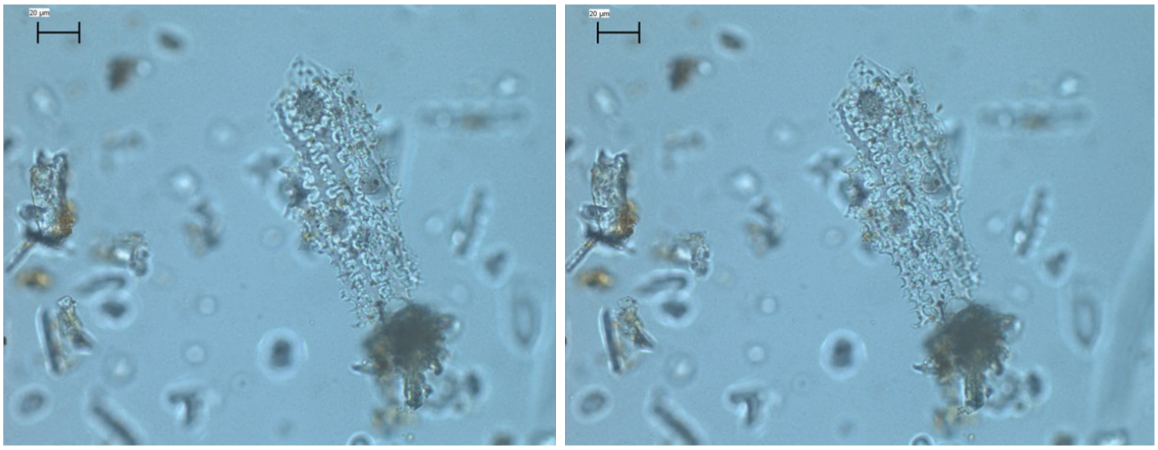

FIG. 159. Photomicrographs showing *Triticum* multi-celled phytolith from sample 3197. Left: clearly showing 11 pits on the papillae; Right: clearly showing erratic waves on long cells.

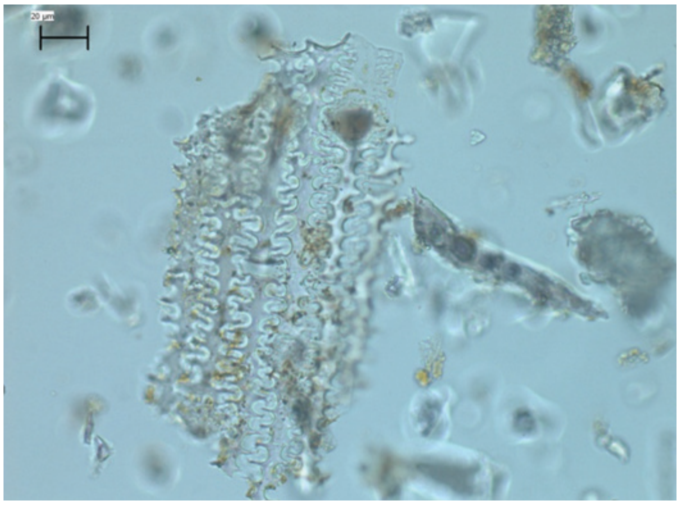

FIG. 160. Photomicrograph showing *Hordeum* husk from sample 3197.

samples contained *Avena*: both samples from the slumps at the top of the well (2626 and 2774). The *Avena* phytoliths could represent wild oat rather than cultivated oat given the absence of cultivated oat in the charred cereal assemblage. The domestication or wild status of the *Avena* cannot be determined from the multi-celled phytoliths.

Cyperaceae and *Phragmites* were also present in some of the samples. Both are associated with wetland environments and can grow in damp ground or standing water. Members of the Cyperaceae family are often associated with poor soil conditions. *Phragmites* could be used as building material such as thatching or as furnishings such as mats, baskets and bedding. These wetland plants could have been growing in the vicinity of the site but could also have been brought into the town from further afield as fodder, flooring or bedding.

Samples 3197 and 2723 contain the highest number of taxa identifiable to genus level. Sample 3197 came from the well shaft and contained *Phragmites*, *Triticum* and *Hordeum*. Sample 2723 came from an occupation deposit which contained lots of burning and charcoal. The taxa identified were Cyperaceae, *Phragmites*, *Triticum* and *Hordeum*. This sample came from an occupation layer with associated burning and the presence of cereals (*Triticum* and *Hordeum*) and possible furnishing/ construction debris (*Phragmites*) suggests a food-processing and cooking area, perhaps a kitchen.

All ten samples contained rondels indicating the presence of pooid grasses representative of a moist and wet environment (FIG. 161). Eight out of ten samples contained bilobes and nine

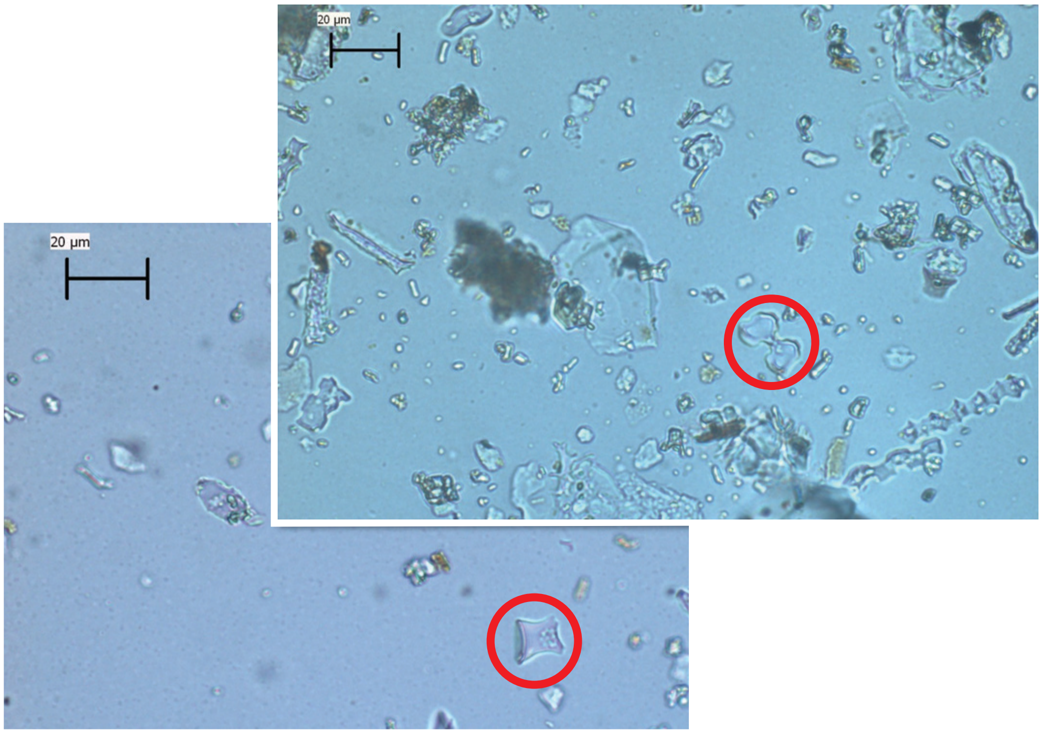

FIG. 161. Upper photomicrograph showing a bilobe short-celled phytolith from sample 2626. Lower photomicrograph showing a rondel short-celled phytolith from sample 2626

FIG. 162. Photomicrographs showing burnt phytoliths. Left: sample 3189. Right: sample 2626.

out of ten contained bilobes and polylobes. These are likely to have derived from panicoid C4 grasses, which prefer warm regions with a moderate amount of soil moisture (Twiss 1992). Rondels dominate the assemblage in all ten samples. Different types of grasses can co-exist, although one is usually dominant. A variety of local environmental conditions is indicated by the presence of pooid and panicoid grasses in the phytolith assemblage. Pooid grasses dominate the assemblage indicating the presence of perhaps largely open, wet and moist conditions in the surrounding environs with pockets of slightly drier ground, as indicated by the presence of panicoid phytoliths.

Occluded carbon phytoliths (burnt phytoliths) were found in all ten samples (FIG. 162) but those contexts with visible signs of burning do not in all cases contain higher concentrations, sample 2980 being the exception. The contexts containing visible charcoal are not the same as contexts with the highest quantity of burnt phytoliths because of differences in the types of material being burnt. Charcoal survives mainly from wood (dicot) remains being burnt, whereas burnt phytoliths survive from both wood (dicots) and grass (monocots) remains. The phytolith record indicates a dominance of grass over shrubs and trees. These phytoliths do not remain in the soil as macro-botanical remains in the same physical form as wood charcoal as the plant material disintegrates altogether. As a consequence, the burning signature for monocots will be visible in the microscopic phytolith record but largely unseen by the naked eye.

CONCLUSION

The suite of phytoliths identified from Well 8328 demonstrates that grasses dominate over shrubs and trees in the surrounding environment, indicating a predominantly open landscape with perhaps patches of woodland surrounding the site as indicated by low numbers of dicotyledonous phytoliths.

Crop processing is suggested due to the presence of both phytoliths from waste material (leaves and stems) and phytoliths that represent the de-husking process. This represents a key contribution from the analysis of phytoliths as these practices cannot be distinguished from pollen or macrobotanical analyses. In particular, sample 2723 indicates a food-processing or kitchen area due to the presence of leaf/stem cells, husk cells and identifiable crops. Numerous multi-celled phytoliths were identified to genus level, namely Cyperaceae, *Phragmites*, *Avena*, *Hordeum* and *Triticum*. Evidence of burning is present in all samples, although the burnt phytoliths do not always correlate with the visible charcoal remains. This results from charcoal derived from burnt wood (dicot) remains, which produces low quantities of phytoliths, whereas the majority of burnt phytoliths represent grasses (monocots) which show evidence of burning.

There is evidence for both pooid and panicoid grasses indicating the suite of grasses living in the surrounding environment. Rondels representing the C3 pooid grasses dominate, but areas of C4 panicoid grasses are indicated by the presence of bilobe and polylobe phytoliths. The remains suggest a mostly moist and wet environment at the time when the area surrounding the well was occupied in the Iron Age, although there were also stands of vegetation more suited to drier ground. The moist and wet environment is further represented by the presence of both *Phragmites* and Cyperaceae which grow in wetland environments.

CHAPTER 21

RADIOCARBON DATING

By Catherine Barnett

INTRODUCTION

Dating of activity through use of ceramic typology at the *oppidum* is exceptionally good (see Ch. 8). The quantity and quality of pottery and indeed small finds in most features has enabled the construction of a chronology for use on the site, with late Iron Age activity believed to occur from *c.* 21 B.C.–*c.* A.D. 43. In general, absolute dating methods such as radiocarbon dating cannot be expected to match or improve upon this chronology unless numerous samples were dated and Bayesian modelling employed. However, a few of the more ambiguous features and individual remains have required direct dating due to a lack of association with dateable finds, complex stratigraphy or because they were so unusual (e.g. an early plant introduction) that they required clarification. A modest programme of dating was therefore undertaken, and eleven waterlogged wood, wood charcoal and bone samples were submitted to SUERC for AMS radiocarbon dating. The results are given in Table 31 and discussed below.

METHODS

A rigorous examination of the questions surrounding the events to be dated, taphonomy of remains and relationship to that event and stratigraphic integrity was undertaken before eleven samples of identified and short-lived terrestrial plant macrofossils and one articulated dog bone were selected from securely stratified contexts. These were submitted to the Scottish Universities Environmental Research Centre, East Kilbride, in consultation with Professor Gordon Cook. The charcoal and waterlogged plant remains were processed using an acid-alkali-acid pre-treatment as described by Stenhouse and Baxter (1983). CO_2 obtained from the pre-treated samples was combusted in pre-cleaned sealed quartz tubes (Vandeputte *et al.* 1996) and then converted to graphite (Slota *et al.* 1987). The samples were dated by Accelerator Mass Spectrometry (AMS) as described by Freeman *et al.* (2010). One sample failed to date (charred *Hordeum* sp. grains from context 12117) and a replacement charred twigwood sample was submitted.

The returned radiocarbon determinations given in conventional years B.P. (Table 31) were calibrated using OxCal v4.2.4 (Bronk Ramsey 1995; Bronk Ramsey and Lee 2013) using the IntCal13 atmospheric curve (Reimer *et al.* 2013) and expressed at the 94.5 per cent confidence level (2 sigma level). The end points of the calibrated date ranges have been rounded outward to ten years as recommended by Mook (1986) and the date ranges given as years cal B.C./cal A.D. All results were found to have δ13 (‰) levels within normal ranges for terrestrial plant material.

RESULTS AND DISCUSSION

The calibration curve for the late Iron Age–early Roman period produces a rather wide date range and is seen as problematic (see for instance Cunliffe 2005, 652–4) and, therefore, unable to be used to improve on a chronology based on a range of material culture. However, the use of Bayesian modelling has in some instances overcome this and, indeed, has called into question some chronologies based on ceramic typologies (Pickstone and Mortimer 2013; Hamilton *et al.* 2015). In this case, specific questions regarding particular features and remains have been successfully answered and the results will enable inter-site comparison with other well-dated late prehistoric sites.

WELL 10421

Three dates on waterlogged twigwood and plant macrofossils from the primary (10442) and early secondary (10441) fill of Well 10421 confirm that they were both deposited during the late Iron Age, with overlapping date ranges of 100 cal B.C.–60 cal A.D. and 120 cal B.C.–30 cal A.D. Of particular note is that the olive stone identified by Lodwick (p. 289 and Lodwick 2014) (sample 4165, context 10442) is confirmed as being the earliest known occurrence of this imported non-native food type in the UK at 100 cal B.C.–60 cal A.D. (2014+/-29 B.P., SUERC-65371).

MINIATURE DOG BURIAL, FEATURE 12746

A long bone from the articulated skeleton of a miniature dog buried in the foundation trench of Structure 9 (object 500334) has been dated to the late Iron Age at 110 cal B.C.–60 cal A.D. (2024+/-30 B.P., SUERC-65374), indicating it was an early feature, and one which also dates the initial construction of Structure 9.

TREE-THROW 16630

Oak sapwood charcoal from a large, single species charcoal assemblage associated with scorched earth within the tree-throw has been dated to the later Neolithic at 2570–2340 cal B.C. (3943+/-29 B.P., SUERC-65375). The deposit was securely stratified, which together with the coherent nature of the assemblage allows the conclusion that this is a much earlier *in-situ* context than all others at the site, long predating the establishment of the *oppidum*.

PIT GROUP 3

Hazel and birch charcoal from the basal fills (12714 and 11117) of two possible storage pits (12696 and 11131) within the footprint of Structure 9 and also oak twigwood charcoal from Pit 12179 (12117) have all been dated to the late Iron Age (to earliest Roman) at 100 cal B.C.–60 cal A.D., confirming they relate to Period 0 activity associated with Structure 9, not an earlier phase of activity as had been believed feasible. However, charred peas from Pit 14658 (14653) have been dated to 120 cal B.C.–50 cal A.D. (2034+/-29 B.P., SUERC-65381). The calibrated range overlaps with the others described but does perhaps indicate that there may also have been a slightly earlier phase of activity represented.

PIT GROUP 14

Dates were also sought for Pit 11026, located to the south-west of Trackway 1. Charred plant remains and charcoal for both the basal and second fill gave dates at 50 cal B.C.–80 cal A.D. and 120 cal B.C.–30 cal A.D. (1992+/-29 B.P., SUERC-65383; 2039+/-26 B.P., SUERC-65382). The calibrated date ranges overlap but with a longer early tail to the upper sample. The two are broadly contemporary with the activity represented in Pit Group 3.

CONCLUSION

The targeted radiocarbon dating programme employed has been successful in dating features and remains related to Period 0 and earlier activity at Insula IX. The dates complement those associated with the pottery and other finds, although with a greater range within the calibrated dates, as would be expected. It is anticipated that they will be useful in comparing activity at Calleva with sites in the wider landscape beyond the town to be dated using radiocarbon under the Silchester Environs project.

TABLE 31. DETAILS OF THE SAMPLES SUBMITTED
(Wood/charcoal identified by Dr Catherine Barnett, plant macrofossils by Dr Lisa Lodwick)

Sample Type	Species Dated	Sample	Context	Feature	Context description	Comments, questions, relationship of sample to event, comments after dating	Lab and code	Result	Error +/-	δ13 ‰	Cal range B.C./A.D. 95.4% prob*	Period
Charred plant macrofossil	*Olea europaea* stone, 2 halves	4165	10442	Well 10421	Waterlogged organic rich primary fill of 3 m deep well (really primary given contents? More likely dumped basal fill rather than natural silting)	Stored in ethanol in fridge since wet flotation (without deflocculant). Believed LIA, earliest olive stone in Britain, need confirmation, have two others from later (RB Period 1) contexts. Confirmed	SUERC-65371	2014	29	-23.6	100 cal B.C.–60 cal A.D.	LIA (to earliest Roman)
Waterlogged wood	*Corylus avellana* twigwood	4165	10442	Well 10421	As above. Wood from basal context with olive stone. Mixed spp inc. juvenile so not timber lining	To date context in parallel with early olive stone	SUERC-65372	2038	26	-27.0	100 cal B.C.–60 cal A.D.	LIA (to earliest Roman)
Part-charred wood	*Alnus glutinosa* juvenile	5723	10441	Well 10421	Waterlogged organic rich secondary fill of 3 m deep well	Piece described as a possible worked wooden peg but dried and warped on examination, no evidence of working but is charred on one end	SUERC-65370	2020	29	-25.4	120 cal B.C.–30 cal A.D.	LIA
Animal (dog) long bone	*Canis lupus* subsp., miniature	6517	12751	Dog burial 12746	Associated with the foundation of Structure 9 (object 500334)	Poss. hall earlier than expected, LIA? Or actually cut in later (RB)? Confirmed LIA	SUERC-65374	2024	30	-20.2	110 cal B.C.–60 cal A.D.	LIA (to earliest Roman)
Wood charcoal	vitrified *Quercus* sapwood	10897	15685	Tree throw 16630	Fill of tree throw, incl. scorched earth and charcoal tip lines	Early deforestation hypothesised. This is a large, coherent sample of same species (oak), unlikely to be residual, this is therefore a much earlier (later Neolithic) feature at the site	SUERC-65375	3943	29	-25.1	2570–2340 cal B.C.	Later Neolithic
Wood charcoal	*Corylus avellana*	6530	12714	Pit 12696. Pit Group 3	Basal fill. Possible storage pit under Structure 9	Confirms is Period 0, contemporary with Structure 9	SUERC-65376	2017	29	-25.3	100 cal B.C.–60 cal A.D.	LIA (to earliest Roman)
Wood charcoal	*Betula* sp.	5245	11117	Pit 11131. Pit Group 3	Ditto	Ditto	SUERC-65380	2020	29	-26.6	100 cal B.C.–60 cal A.D.	LIA (to earliest Roman)

Sample Type	Species Dated	Sample	Context	Feature	Context description	Comments, questions, relationship of sample to event, comments after dating	Lab and code	Result	Error +/-	δ13 ‰	Cal range B.C./A.D. 95.4% prob*	Period
Wood charcoal	*Quercus twig*	7140	12117	Pit 12179. Pit Group 3	Ditto	Ditto	SUERC-66262	2015	26	-23.9	100 cal B.C.–60 cal A.D.	LIA (to earliest Roman)
Wood charcoal	*Pisum sativum* x2	9655	14653	Pit 14658. Pit Group 3	Ditto	Indicates that elements of this group are earlier than others	SUERC-65381	2034	29	-25.4	120 cal B.C.–50 cal A.D.	(end of MIA to) LIA
Wood charcoal	*Corylus avellana* knotwood	5594	11602	Pit 11026. Pit group 14	Second fill of pit	Ditto	SUERC-65382	2039	26	-26.6	120 cal B.C.–30 cal A.D.	(end of MIA to) LIA
Charred plant macrofossil	*hordeum* sp. grain	5595	11603	Pit 11026. Pit group 14	Basal fill of pit	Located to the south-west of trackway. Contemporary with later pit group elements above	SUERC-65383	1992	29	-24.9	50 cal B.C.–80 cal A.D.	LIA–early Roman

*Calibrated using OxCal v4.2.4 Bronk Ramsey (2013) IntCal13 atmospheric curve (Reimer *et al.* 2013)

CHAPTER 22

ELEMENTAL GEOCHEMISTRY

By Samantha R. Cook

INTRODUCTION

During the course of the excavations at Silchester Insula IX a programme of soil and sediment sampling was undertaken with the aim of using simple bulk geochemical analyses to support archaeological evidence for both general human occupation and, potentially, crafts and metal-working.

Soil can accumulate residues from a great range of organic and inorganic materials, from food, clothing, buildings, household utensils and industrial activity as well as human and animal waste products, and many soils are capable of holding elements in relatively immobile forms (James 1999). Soil geochemical data can provide important information on specific activities (e.g. industrial activity or animal husbandry) within a given area, especially when interpretation has been difficult using artefact data alone. The different uses of space may also exhibit chemical anomalies that coincide with archaeological features (e.g. Lippi 1988; Ball and Kelsey 1992; Kanthilatha *et al.* 2014; Oonk and Spijker 2015).

A suite of elements was investigated, with a special emphasis on strontium (Sr) and phosphorus (P) as indicators of human habitation. Phosphorus leaches from bone and organic tissue and concentrates in locations where organic materials were left to decay (Sarris *et al.* 2004). Phosphorus, in the form of phosphate, is relatively immobile and can be used to distinguish between living areas and middens, pits, stalls and pasture (see for example Bethell and Mate 1989; Conway 1983). Strontium can be an indication of bone deposition whether as ritual burial or for use in cupellation. The trends in trace-metal distribution (Cu, Zn, Pb) have also been investigated with a view to identifying possible metal-working activities (both craft and production-related).

METHODS

Ninety-one soil samples were taken from pits, post-holes, wells and trackways associated with Period 0. These were dried and disaggregated before being passed through a 1 mm sieve, then ground and pressed into pellets for analysis by x-ray fluorescence (XRF) using a Philips PW1480 XRF with Philips X40 analytical software. All the material was clay loam to sandy loam in character, in many cases with large (of several centimetres in size) flint pebbles. Samples were also taken from each of the major local lithologies — the Silchester Gravels, the Bagshot Sands and the London Clay — to determine background elemental concentrations. The concentration of chosen elements was then compared in an attempt to further our understanding of occupation at Silchester during Period 0.

Occupation within Insula IX during the late Iron Age is represented by a variety of feature types. The following groups have been investigated using geochemical analyses: (a) Ditch 11631 and post-holes associated with Pit Group 2 where iron smelting and forging is evidenced (FIG. 163); (b) Trackways 1 and 2 as well as samples from the junction of these two tracks (FIG. 164); (c) Well 8328 and pits in Pit Groups 1, 2, 3, 8, 9 and 14 (FIG. 165).

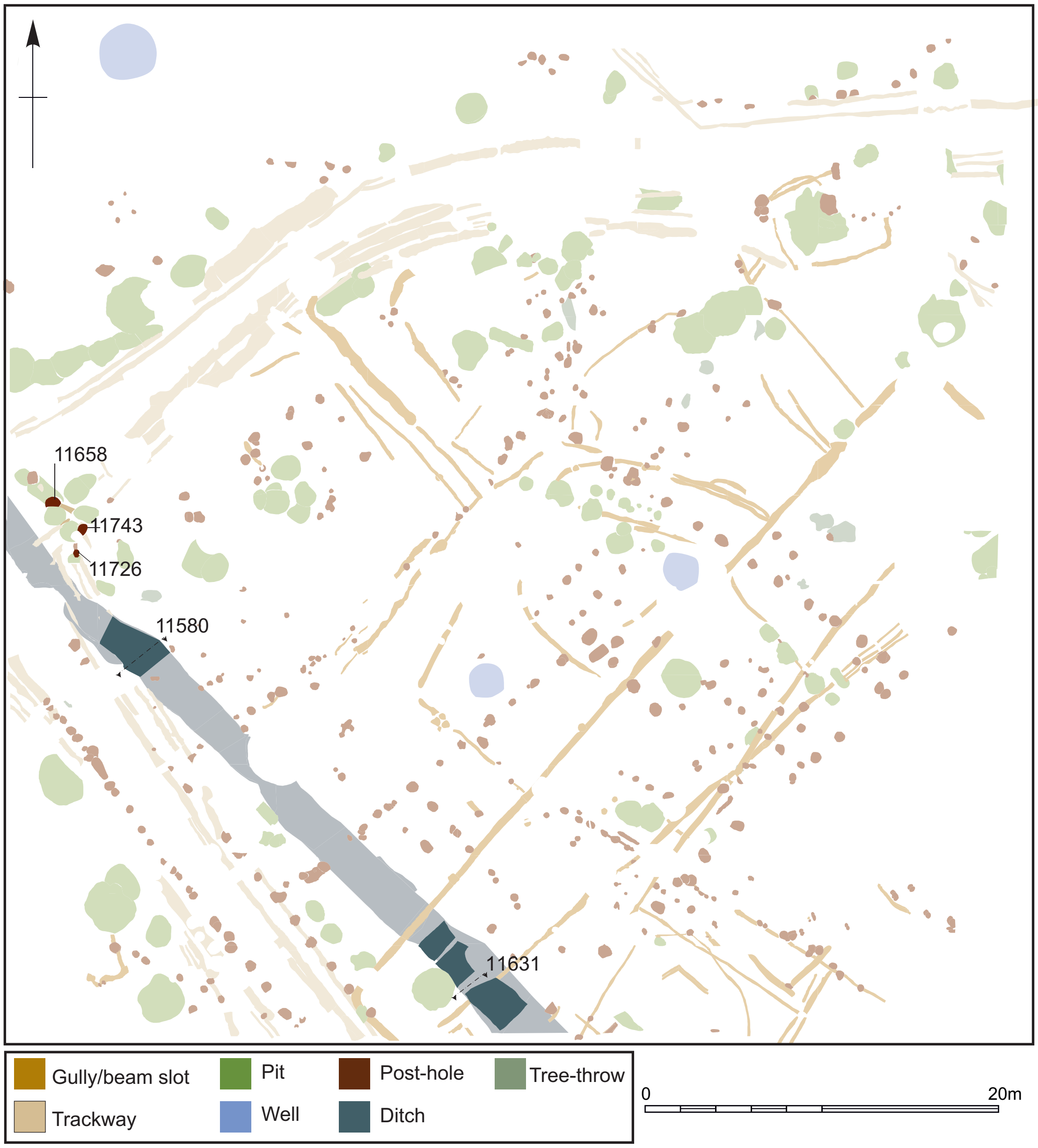

FIG. 163. Location of geochemistry samples: Ditch 11631 and post-holes associated with Pit Group 2.

RESULTS AND DISCUSSION

A COMPARISON OF FEATURES

The location of features sampled is shown in FIGS 163–165 whilst Table 84 shows the results of the analysis of the samples from all feature groups studied and Table 85 shows the average concentrations of elements found in the off-site background samples.

These results are compared as average values in FIG. 166. It can be seen that all samples from the excavation have higher concentrations of individual elements than the background samples (e.g. Cu background is 9.9 mg/kg while all the features have average Cu of over 20 mg/kg). The elevated trace metals copper, zinc, lead and strontium as well as the higher concentrations of calcium and phosphorus are all indicative of anthropogenic influence, both from metal-working activities and waste in the form of shells, bones, faecal material and plant debris.

Trackway 1 generally has the lowest average concentration of elements (with the exception of

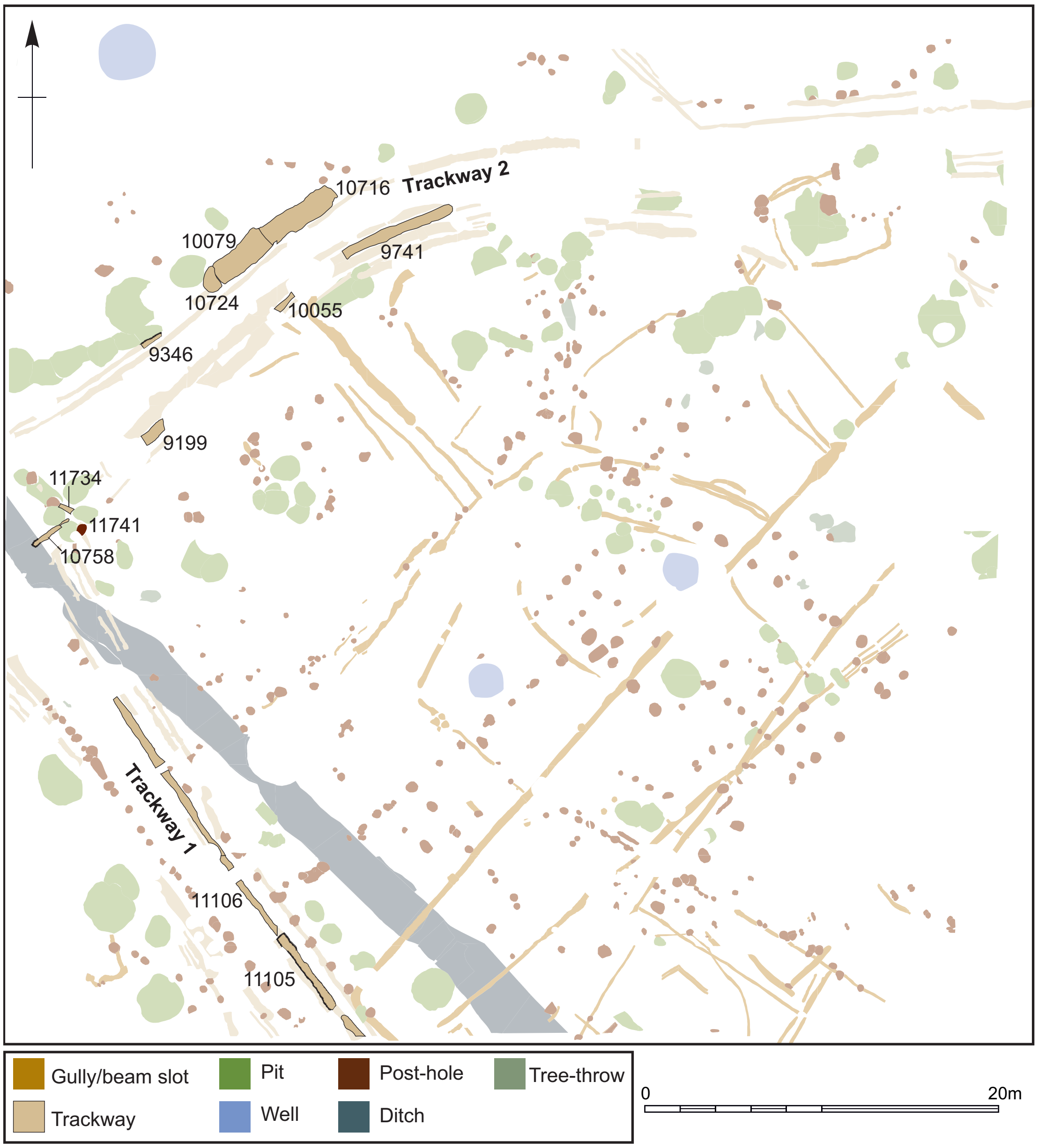

FIG. 164. Location of geochemistry samples: Trackways 1 and 2.

Pb which is lowest in the ditch samples), suggesting a general lack of rubbish/waste deposit on its surface, and/or low usage (see below).

Trackway 2 samples have, on average, higher elemental concentrations than Trackway 1. For example, phosphorus concentrations are higher at 5762 mg/kg than Trackway 1 at 3117 mg/kg, perhaps suggesting that Trackway 2 was in heavier use or was dirtier than Trackway 1.

In comparison to the other features, the samples from the pits and the well (see below) are enriched in all elements except lead. The pits contain more strontium, perhaps suggesting the disposal of bone and/or shells. Both pit and well samples contain significantly higher phosphorus concentrations than do the samples from the other features (e.g. average P from pits 8116 mg/kg, average from Trackway 2 5762 mg/kg).

The well samples contain the highest concentrations of copper, zinc and lead; this is perhaps not surprising given that the infill of the well is likely to have comprised a variety of household rubbish including animal waste.

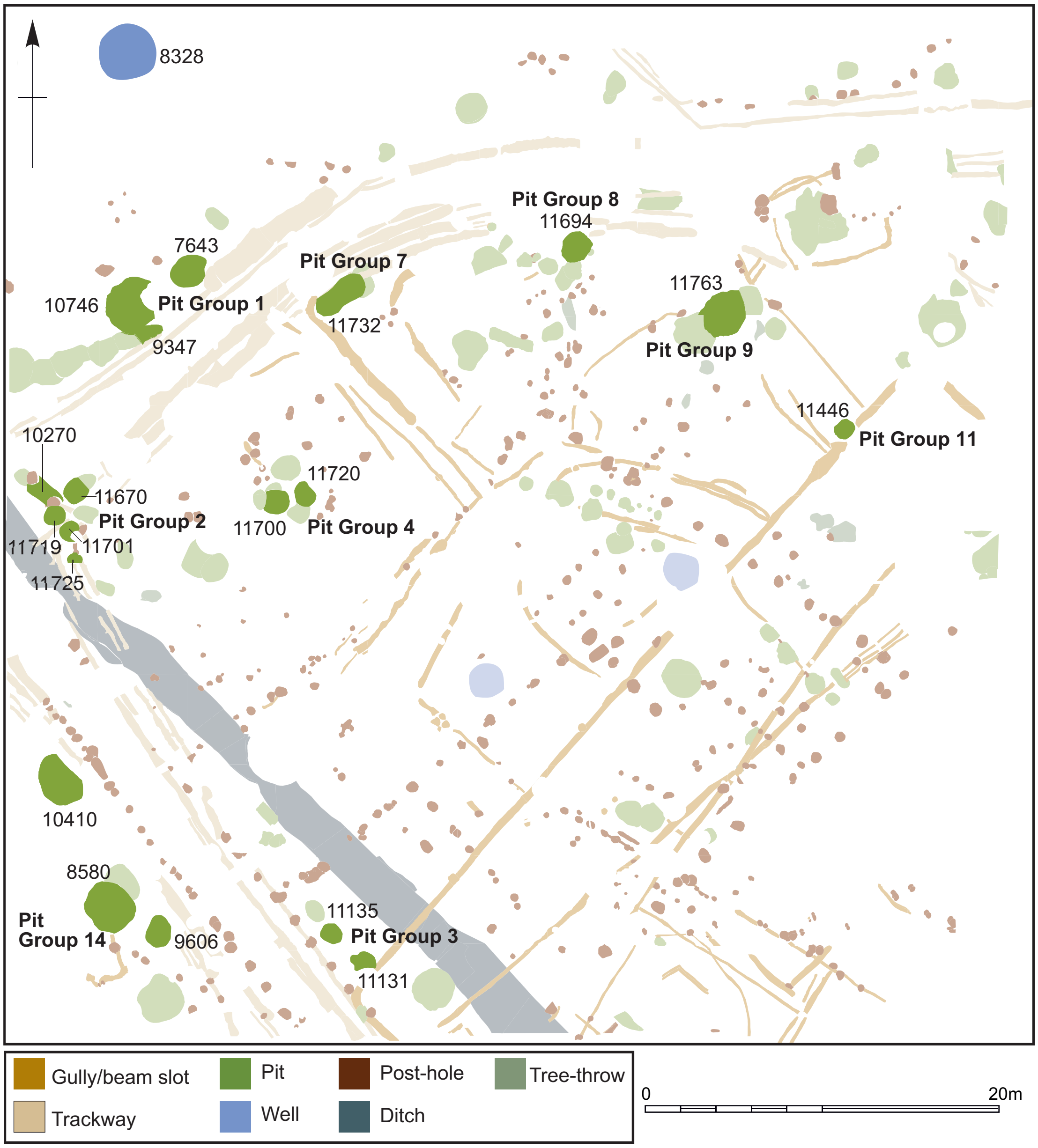

FIG. 165. Location of geochemistry samples: Well 8328 and pits in Pit Groups 1, 2, 3, 4, 7, 8, 9, 11 and 14.

(a) Ditch 11631 and post-holes associated with Pit Group 2

The post-holes that are associated with a group of pits which contained iron-smelting and forging debris do not contain especially elevated concentrations of metals. Copper, for example, is found at around 3x background concentration; this is not particularly high compared to other peak concentrations of copper (Table 84). Indeed other areas (e.g. the south-east workshops of Period 2; Cook *et al.* 2010) with metal-working evidence within Insula IX contain over 100x background metal concentrations. We may infer from these results that these post-holes were not exposed to debris from metal-working during, or soon after, their use. However, the post-hole samples do have higher lead concentrations than the samples from all other features (except the well) and the concentrations of strontium and zinc are comparable to the ditch and Trackway 2, perhaps suggesting general anthropogenic activity rather than deliberate refuse disposal, for which we might expect to see higher concentrations of phosphorus as is seen in the pit samples.

Sample 5396 from Ditch 11631 (context 11040) contained elevated concentrations of copper,

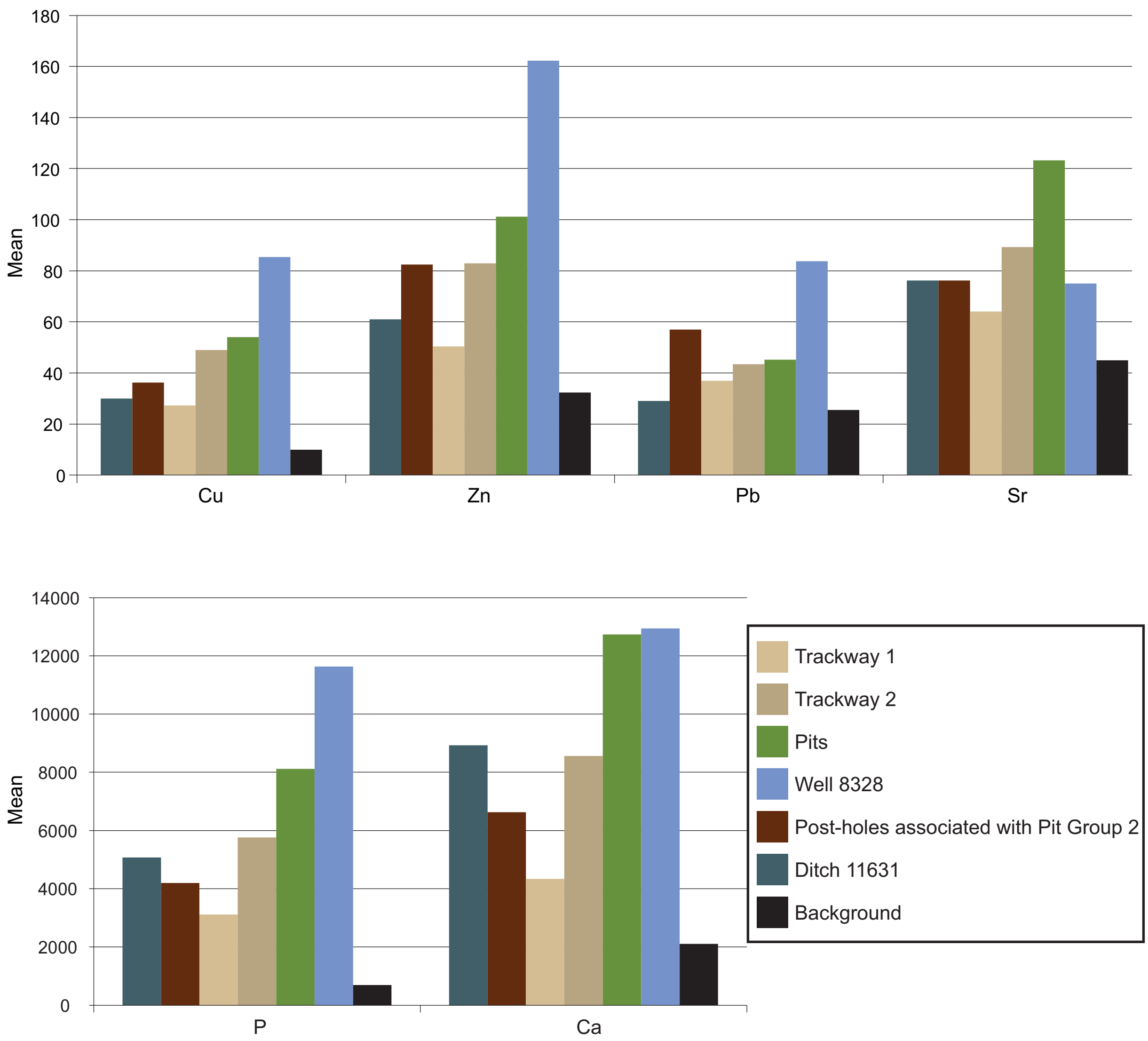

FIG. 166. Average concentrations of elements found in each type of feature.

zinc, strontium, phosphorus and calcium. Context 11040 was described at the time of sampling as rubbish fill which may have contained animal waste. Elevated concentrations of the other elements are also likely to be a result of waste-water run-off containing debris from both animal and plants. It is interesting to note that the other ditch-fill samples (5407, 5429, 5581 and 5587) do not have the same elemental signature; it may be that the elevated elemental concentrations are recorded in a particularly organic-rich sample or that this part of the ditch was in closer proximity to animals and/or was used for domestic waste disposal.

(b) Features associated with Trackways 1 and 2

Ditch 10079/10716/10724 (FIG. 164), flanked the northern edge of Trackway 2. Many of the samples from this feature contain elevated copper, zinc and phosphorus (e.g. 99 mg/kg Cu, 117 mg/kg Zn, and 12178 mg/kg P). This would suggest Trackway 2 was well used and that the ditch was receiving waste in the form of faeces, organic matter and general domestic waste.

None of the Trackway 2 contexts analysed (a total of 21 samples, see Table 84) have hot-spot elemental signatures. If this road was well used, perhaps it sloped at these locations to the extent that the surface was depleted in elements through erosion. The samples from the junction of the trackways (contexts 11733, 10751, 11740) are in the same area as those from

Pit Group 2. As with the post-holes discussed above, these samples show no evidence of metal-working taking place. The metal-working associated with Pit Group 2 pre-dates the trackway and the absence of elevated metal concentrations in this area appears to support this. Of the samples from the gullies flanking the northern side of Trackway 1, those from contexts 11066 and 11734 only contain slightly elevated (10x) phosphorus concentrations, with other elements above background but not markedly elevated. This suggests that Trackway 2 was more heavily used (dirtier) than Trackway 1.

(c) Well 8328 and Pit Groups 1, 2, 3, 8, 9 and 14

A total of 69 samples were analysed from Period 0 pits and from a single well, 8328 (FIG. 165). The samples from this group with elevated metal concentrations (here again elevated means at least 10x background concentration) belong to three distinct sets. The samples from Well 8328 in the North-West Compound and Pit 8580 in Pit Group 14 in the South-West Compound contain elevated phosphorus, copper, zinc and strontium. All of these elements are indicative of mixed waste disposal (food debris, animal/human waste, metal-working debris/sweepings).

Well 8328 contained the highest concentration of phosphorus in fill 9152 samples taken from the well profile (Table 32). FIG. 167 shows a clear peak in elemental concentrations half-way down the well profile, with zinc and lead concentrations increasing dramatically. This peak coincides with samples taken from context 9152; this layer was described as a substantial waterlogged accumulation concentrated towards the centre of the feature. It also contained a substantial number of pottery sherds.

The sorption of heavy metals by soil materials is highly dependent on pH and redox conditions and involves adsorption by non-specific and specific interactions (see, for example, Schulthess and Huang 1990; Naidu *et al.* 1994; Alloway 1995), and precipitation reactions with carbonates, phosphates, sulphates and sulphides (Tiller *et al.* 1984). The peak in zinc, copper and lead may, in part, be due to the waterlogged nature of this layer, as waterlogged soils have been shown to absorb more of these elements than their air-dry counterparts (Phillips 1999), and is a reflection of the translocation of elements down-profile with leaching. Alternatively this layer may have received metal-rich waste during infilling.

There are two peaks in phosphorus concentration, one near the surface and one towards the bottom of the well (sample 7 on FIG. 167). Without further investigation via thin-section analysis it is impossible to say at this juncture whether these peaks represent episodic use for waste disposal or migration/down-profile leaching. In either case the high concentration of phosphorus confirms the filling of this well with human/animal waste matter.

The samples from contexts 9287, 10731, 10779, 10782 and 11662 in Pit Group 1 are from the Pits 9347 and 11665 that flanked the northern edge of Trackway 2 in the North-West Compound. They contain elevated phosphorus concentrations as one might expect from features receiving run-off from a trackway used by animals. The fills of Pits 7643 and 10746 also have elevated zinc,

TABLE 32. SAMPLES TAKEN FROM DOWN PROFILE OF WELL 8328

Sample	Context		Ni	Cu	Zn	Pb	Sr	P	Ca
2980	9170	1	15	86	112	44	42	1320	53983
2945	9152	2	20	83	69	48	201	30844	16016
3163	9152	3	14	110	125	79	41	6204	9081
3164	9152	4	10	65	89	25	56	9196	8652
3189	9152	5	22	133	373	316	42	9328	8294
3190	9152	6	19	114	308	111	35	4840	15587
2945	9152	7	20	83	69	48	201	3300	13371
3196	9258	8	17	36	76	24	58	7832	10010
3197	9258	9	13	56	146	23	125	22220	22523

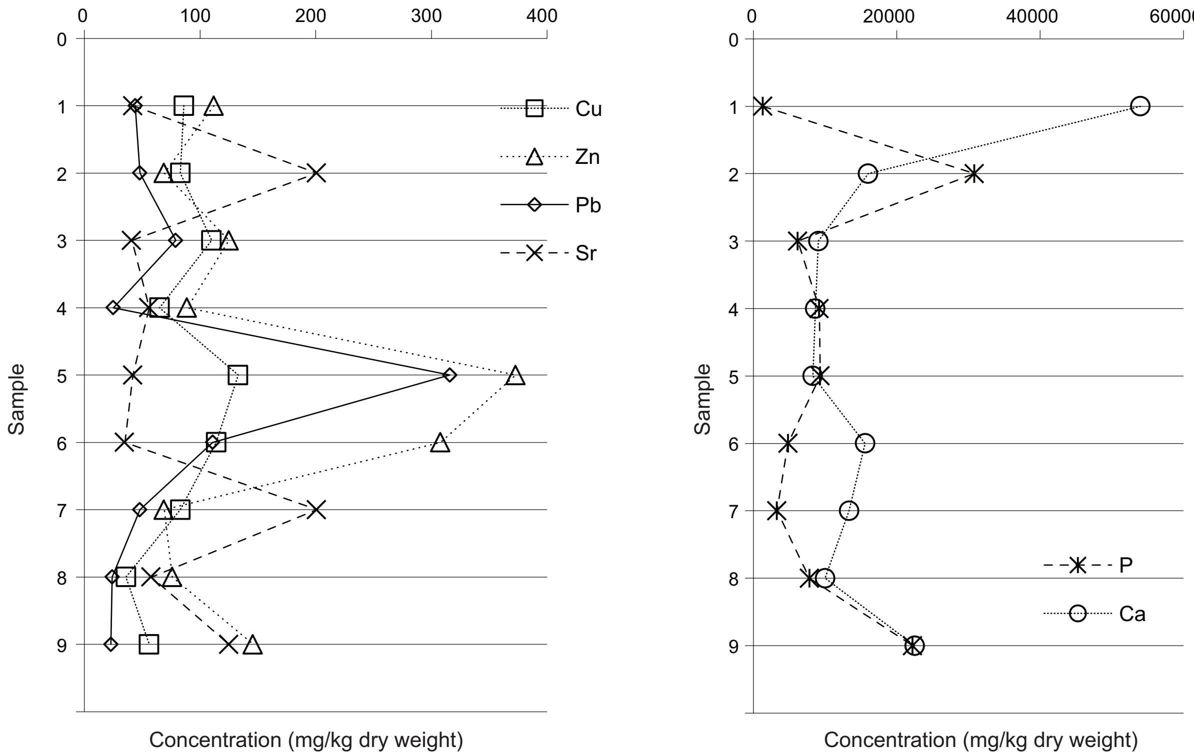

FIG. 167. Down profile elemental concentrations for Well 8328.

copper and strontium indicative of waste disposal (whether accidental or deliberate) perhaps including shells and/or bone.

The fills of some elements of Pit Group 2 contained metal-working debris. Iron-working slag was recovered from Pits 10770 and 11725, with the former also containing charcoal dumps and fragments of a slag basin in context 10200. Of the seven samples analysed, 5826 and 5828 from contexts 11676 and 11677 contain elevated zinc and copper. The concentrations of copper and zinc in the rest of the samples are comparable to those found in the samples from Pits 9347 and 11665 and the fills of Well 8328. The geochemical signal, therefore, indicates that the disposal of debris was patchy and/or that metal-working was occurring on a smaller scale in this area.

Contexts 9128 and 9618 from Pit 9606 in Pit Group 14 were described in the field as being a fill of cess and rubbish. The samples from this pit were found to contain elevated levels of zinc, which supports the notion that this was a rubbish pit, but the lack of phosphorus (with the exception of one sample) suggests that this was not heavily used for animal/human faecal matter.

SUMMARY AND CONCLUSION

The combination of geochemical analyses, albeit using a bulk analytical technique, can provide the archaeologist with extra information that may not be deducible from field descriptions alone. In general, different features exhibit unique elemental signatures and this may help in determining function when interpretation using archaeology alone is ambiguous due to taphonomic factors (as has proven to be the case at Insula IX), for example pits tend to be more enriched in elements than do post-holes.

Trackway 2 is more enriched in elements than Trackway 1 which is 'cleaner' leading us to infer that occupation activity in the area to the north of Trackway 2 was more intensive than in the area around Trackway 1. The pit samples taken from alongside Trackway 2 support this, being particularly enriched in phosphorus compared to other samples (e.g 11916 mg/kg in context 9287 compared with an average value for all the pits of 8116 mg/kg).

The wells were backfilled with material which contained elevated phosphorus concentrations suggesting a fill of human/animal waste and many of the pit groups are enriched in a suite of elements which suggests the disposal of mixed rubbish. None of the pits contained concentrations of metal-working elements (Cu in particular) comparable to those found in later occupation at Insula IX; one hearth from Period 2 contained over 2000 mg/kg (Cook *et al.* 2014, 113), whereas here the maximum concentration of copper found is 183 mg/kg.

In summary, the geochemical analyses suggest an area of general human occupation with a mixture of activities, none of which is particularly intensive in nature (general food preparation, craft work, animal husbandry) and with activity zones that extend to the north of Trackway 2. Activity zones at Silchester in later periods have been delineated using the same technique and we have been able to distinguish between 'clean' and 'dirty' areas using the presence or absence of anthropogenic elements (in particular P). Indeed the Period 2 (late first–early second-century) buildings which sit in the south-east corner of the excavation can be divided into clean and dirty or craft/industrial/domestic based on the elemental signatures (Cook *et al.* 2014). Later occupation of the site within House 1 (mid-first to late third century) was also shown to include metal-working in the form of the large Hearth 3681 which contained elevated copper, zinc and lead (Cook *et al.* 2010). None of the contexts associated with Period 0 contains metal concentrations equivalent to the later samples.

CHAPTER 23

THE MICROMORPHOLOGY OF REFUSE DISPOSAL AND USE OF THE EARLIEST FEATURES IN INSULA IX

By Rowena Banerjea

INTRODUCTION

Micromorphology is well established as an analytical tool that enables the depositional and post-depositional processes of a stratigraphic unit to be examined *in situ* and at high resolution (Goldberg and Macphail 2006; Weiner 2010), and has been previously applied at Silchester to examine the diachronic use of internal settlement space (Banerjea 2011; Banerjea *et al.* 2015b). It is applied here to examine the use and formation of some of the earliest features in Insula IX, which are external features comprising a ditch, rubbish pits and a fill of a well (Table 33). Both the timescales relating to deposition of refuse and use of pits (Shillito *et al.* 2011; Shillito and Matthews 2013; Banerjea *et al.* 2015c), and the rate at which sediment infilled these features are particularly important to understanding how long the ditch and rubbish pits were in use, and how these features were infilled. Understanding deposit formation-processes informs the interpretation of refuse cycles and disposal practices. In particular, identifying and differentiating between the structured deposition of refuse through symbolic routine, the accumulation of 'midden' material, and the storage of refuse for reuse as a resource such as fertiliser (Simpson *et al.* 1998) is a crucial strand of research that is required to understand the character, organisation and history of a site (Schiffer 1987; Simpson and Barrett 1996; Needham and Spence 1997). The development of early urbanism within Insula IX has also been considered; specifically, were features abandoned and infilled as a result of colluvial and/or rain erosion processes, or were they rapidly infilled by human activity (Lisá *et al.* 2015) prior to a new phase of building and use of an area?

SAMPLING METHODS

Four micromorphology samples were collected from section 679 (FIG. 168) through Ditch 11631 (Table 33). The samples were collected through the profile of the upper fill, context 11111, to understand the infilling process of this feature, the cut of which is believed to be the earliest feature in Insula IX dating from the late first century B.C.

The fills of four pits were sampled (Table 33). Pit 11749 is associated with Pit Group 4, while Pit 11694 is part of Pit Group 8, both in the Central Compound. Pits 9606 and 10410 are part of of Pit Group 14 in the South-West Compound flanking Trackway 1. Their fills were sampled to understand the nature of the early occupation by identifying traces of micro-refuse to provide indications of activities that took place within adjacent buildings, and the formation processes of the individual fills.

Sample 4031 was collected from context 10436 in Well 10421 (Table 33). The sample was collected to determine the composition and formation of this deposit within the well.

TABLE 33. LIST OF FEATURES, MICROMORPHOLOGY SAMPLES AND ASSOCIATED FIELD AND MICROSTRATIGRAPHIC UNITS (SURFACE TO BASE)

Feature type	Feature no.	Context no.	Sample no.	Microstratigraphic unit
Ditch	11631	11111	5374	a
Ditch	11631	11111	5374	b
Ditch	11631	11111	5375	c
Ditch	11631	11111	5375	d
Ditch	11631	11111	5376	e
Ditch	11631	11111	5377	f
Well	10421	10436	4031	a
Well	10421	10436	4031	b
Well	10421	10436	4031	c
Well	10421	10436	4031	d
Pit	9606	9615	3606	
Pit	9606	9622	3606	
Pit	9606	9618	3606	
Pit	9606	9623	3606	
Pit	10410	10403	3508	
Pit	10410	10405	3508	
Pit	10410	10409	3509	
Pit	11749	11748	7221	a
Pit	11749	11748	7221	b
Pit	11749	12508	7221	
Pit	11694	11671	5728	

LABORATORY METHODS

The procedure followed is the University of Reading standard protocol for thin section preparation. The samples are oven-dried to remove all moisture and then impregnated with epoxy resin while under vacuum. The impregnated samples are then left overnight so resin can enter all of the pores. The samples are then placed in an oven to dry for 18 hours at 70°C before they are clamped and cut to create a 10 mm slice through the sample. The surface of the 10 mm slice is flattened and polished by grinding on the BROT. The prepared surface of the 10 mm slice is then mounted onto a frosted slide and left to cure. This is followed by cutting off the excess sample, so the sample is down to a thickness of 1–2 mm. The mounted sample is ground down to approximately 100 µm in thickness using the BROT. The 100 µm section is lapped on a Logitech LP30 precision lapping machine to the standard geological thickness of 30 µm.

Micromorphological investigation was carried out using a Leica DMLP polarising microscope at magnifications of x40–x400 under Plane Polarised Light (PPL), Crossed Polarised Light (XPL) and where appropriate Oblique Incident Light (OIL). Thin-section description was conducted using the identification and quantification criteria set out by Bullock *et al.* (1985) and Stoops (2003), with reference to Courty *et al.* (1989) for the related distribution and microstructure, Mackenzie and Adams (1994) and Mackenzie and Guilford (1980) for rock and mineral identification, and Fitzpatrick (1993) for further identification of features such as clay coatings. Photomicrographs were taken using a Leica camera attached to the Leica DMLP microscope.

Micromorphology enables the following properties to be examined at magnifications of x40–x400 under PPL, XPL and OIL: thickness, bedding, particle size, sorting, coarse:fine ratio, composition of the fine material, groundmass, colour, related distribution, microstructure, orientation and distribution of inclusions, the shape of inclusions, and, finally, it enables the inclusions to be identified and quantified. In addition, post-depositional alterations can be identified and quantified such as: effects on the microstructure by mesofaunal bioturbation and cracking due to shrink-swell of clays or trampling; translocation of clays and iron; chemical alteration such as the neoformation of minerals such as vivianite and manganese; organic staining as a result of decayed plant material; and excremental pedofeatures such as insect casts and earthworm granules.

DITCH 11631

Micromorphology shows that the upper fill identified during excavation, context 11111, is actually formed from five separate fill events (Table 34; FIG. 168): fill 1 (unit 11111a), sample 5374, is 7.0–8.0 cm in thickness; fill 2 (units 11111b and 11111c), samples 5374, 5375 (i) and 5375 (ii), is *c.* 7.0 cm in thickness; fill 3 (units 11111d and 11111e), samples 5375 (ii), 5376 (i), and 5376 (ii) is *c.* 17 cm in thickness; fill 4 (unit 11111f), sample 5377 (i) is 4.5–4.8 cm in thickness; and fill 5 (unit 11111g), samples 5377 (i) and 5377 (ii) is 11.5 cm in thickness. All units have coarse particle sizes, but there are subtle differences in the abundance and size of flint gravel fragments, as well as colour, that distinguish the microstratigraphic units.

ORIGIN OF FILL SEDIMENT

All fills have a dominant mineral component that mostly comprises flint and quartz minerals (Table 34). With the exception of poorly preserved fragments of charred wood, anthropogenic inclusions do not feature as abundantly within the ditch fills as geological components, which have an abundance of 65–85 per cent of all inclusions. There is no significant variability in the range of geological inclusions within the ditch fills, which suggests they have come from a similar source. The abundance of fragments of charred wood increases towards the top of the feature, from <5 per cent in fill 5 at the base of context 11111, to 20 per cent in fills 1 and 2 at the top (see Barnett, p. 315). The abundance and diversity of anthropogenic inclusions also increases towards the top of the ditch in fills 1 and 2, which, in addition to charred wood, contain fragments of daub, earthen building material (i.e. wall or flooring), unburnt bone and coprolite fragments (Table 34). There are also some unburnt bone fragments, at 20 per cent, in fill 5 at the base of context 11111.

DEPOSITIONAL PROCESSES OF FILL SEDIMENT

Fills 1–5 all show evidence of haphazard depositional processes. There are no internal micro-laminations within these microstratigraphic units, suggesting that they are single depositional events, rather than a series of rapid small depositions (Goldberg and Macphail 2006). The unsorted nature of the deposit, and unoriented and randomly distributed inclusions are characteristics of dumped discard material (Matthews 1995). The inclusion of large gravel-sized flint fragments, up to 35 mm, in fills 1, 3 and 5 suggests more vigorous depositional events, perhaps involving the rapid mass movement of sediment by human activity, or substantial erosion of the sides of the feature (Lisá *et al.* 2015, 72); whereas fills 2 and 4 may indicate periods of greater stability and gentler processes of sedimentation. Fill 2 has a spongey and vughy microstructure, which indicates the presence of trapped moisture and air suggesting that the sediment was damp when it was deposited, possibly when it rained. Fill 4 has a finer, loamy sand/sandy clay loam particle size than fill 2, which is coarse loamy sand with pea gravel-sized inclusions (Table 34), and this indicates that slower, less vigorous depositional processes took place.

In summary, the upper part of the ditch, context 11111, infilled gradually in five stages with more substantial erosion or massive dumping events interspersed with periods of greater stability and gentler sedimentation processes. The abundance and diversity of anthropogenic inclusions is low throughout the ditch profile; however this increases towards the top of the feature, most probably as the intensity of the surrounding occupation increased.

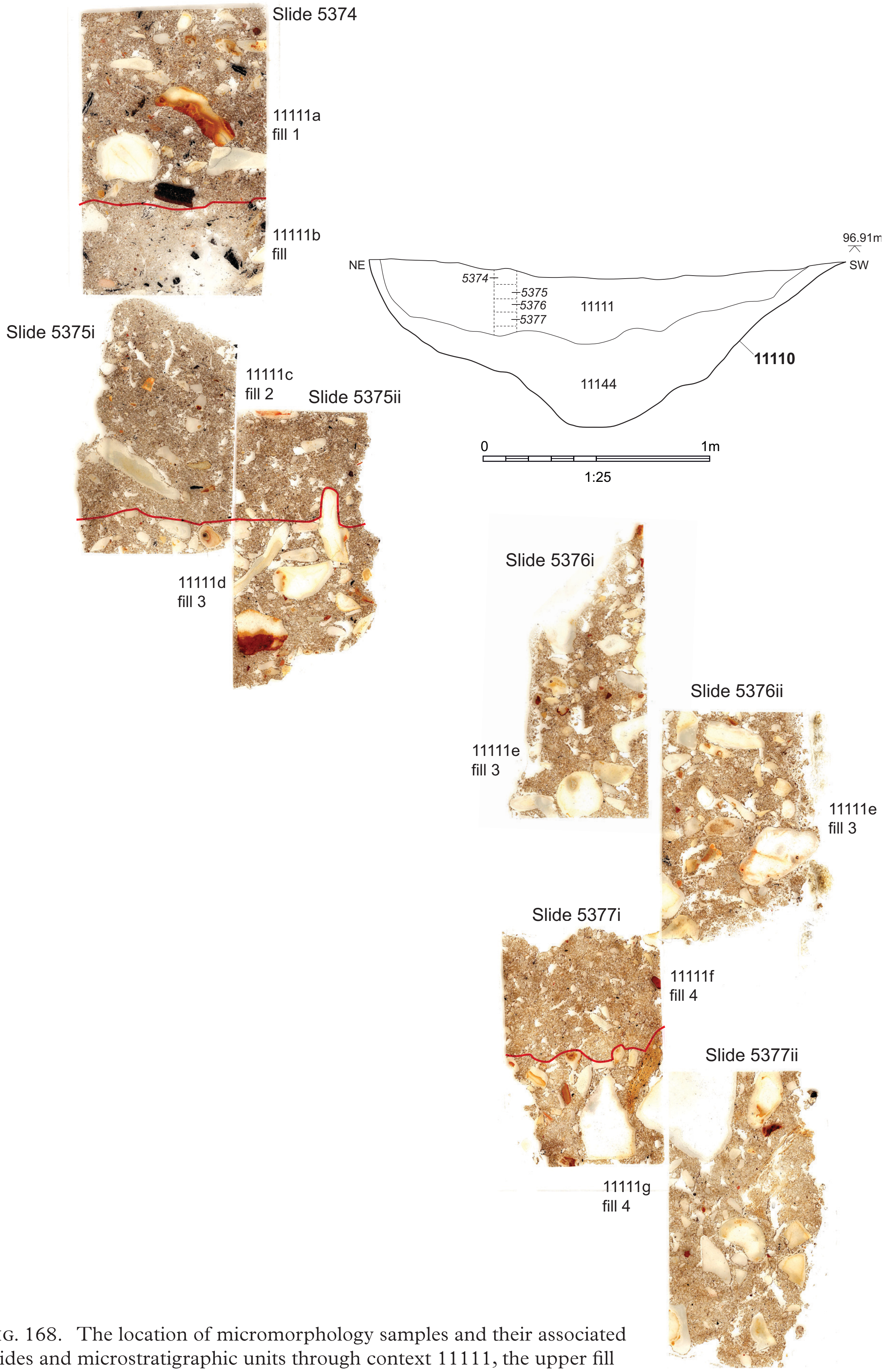

FIG. 168. The location of micromorphology samples and their associated slides and microstratigraphic units through context 11111, the upper fill of Ditch 11631.

TABLE 34. SUMMARY DESCRIPTIONS OF MICROSTRATIGRAPHIC UNIT FROM DITCH 11631 AND PITS 9606, 10410, 11749 AND 11694

Feature	Context no.	Deposit type	Sample/ slide	MM Unit no.	Particle size	Sorting	% Inclusion categories	Main anthopogenic inclusions (in order of most abundant)	Key post-depositional alterations (in order of most abundant)
Ditch 11631	11111	Fill 1 (rapid mass movement)	5374	a	Coarse sandy clay loam with gravel-sized inclusions	Unsorted	Geological 65% Anthropogenic 35%	Charred wood, pottery, daub, earthen building material	Silty clay translocation, bioturbation, Fe, Mn neoformation, mica weathering
		Fill 2 (slow sedimentation)		b	Coarse loamy sand with pea gravel-sized inclusions	Unsorted	Geological 55% Anthropogenic 45%	Charred wood, bone, charred seeds, pottery, earthen building material	Silty clay translocation, Fe, bioturbation
			5375/i	c	Coarse loamy sand with pea gravel-sized inclusions	Unsorted	Geological 65% Anthropogenic 35%	Charred wood, bone, coprolite	Silty clay translocation, bioturbation, Fe, Mn neoformation, authigenic P, mica weathering, vivianite
			5375/ii		Coarse loamy sand with pea gravel-sized inclusions	Unsorted	Geological 65% Anthropogenic 35%	Charred wood, bone	Silty clay translocation, bioturbation, Fe, Mn neoformation, authigenic P, mica weathering
		Fill 3 (rapid mass movement)	5375/ii	d	Coarse loamy sand with coarse gravel-sized inclusions	Unsorted	Geological 100% Anthropogenic 0%	None	Silty clay translocation
			5376/i	e	Coarse loamy sand with coarse gravel-sized inclusions	Unsorted	Geological 75% Anthropogenic 25%	Charred wood	Silty clay translocation, bioturbation, Fe, Mn neoformation
			5376/ii		Coarse loamy sand with gravel-sized inclusions	Unsorted	Geological 85% Anthropogenic 15%	Charred wood	Silty clay translocation, bioturbation, Fe, Mn neoformation
		Fill 4 (slow sedimentation)	5377/i	f	Loamy sand/sandy clay loam	Unsorted	Geological 85% Anthropogenic 15%	Charred wood, amorphous organics	Silty clay translocation, bioturbation, Fe, Mn neoformation, mica weathering, organic staining
		Fill 5 (rapid mass movement)		g	Coarse sand with gravel sized inclusions/Coarse loamy sand with gravel-sized inclusions	Unsorted	Geological 75% Anthropogenic 25%	Bone, charred wood	Silty clay translocation, bioturbation, Fe, Mn neoformation, mica weathering
			5377/ii		Coarse sand with gravel sized inclusions/Coarse loamy sand with gravel-sized inclusions	Unsorted	Geological 75% Anthropogenic 25%	Bone, charred wood	Silty clay translocation, bioturbation, Fe, Mn neoformation, mica weathering

Pit 9606	9615	Discard deposit: kitchen waste	3606	9615	Sandy clay loam	Unsorted	Geological 50% Anthropogenic 50%	Charred wood, bone, amorphous organics	Silty clay translocation, bioturbation
	9622			9622	Sandy loam	Unsorted	Geological 30% Anthropogenic 70%	Charred wood, bone, amorphous organics, pottery	Silty clay translocation, authigenic P, bioturbation
	9618			9618	Sandy clay	Unsorted	Geological 20% Anthropogenic 80%	Charred wood, bone, amorphous organics	Silty clay translocation, bio-tubation
	9623			9623	Sandy clay loam	Unsorted	Geological 50% Anthropogenic 50%	Charred wood, bone, amorphous organics	Silty clay translocation, authigenic P, bioturbation
Pit 10410	10403	Fill (rapid mass movement)	3508	10403	Sandy loam	Unsorted	Geological 50% Anthropogenic 50%	Charred wood, amorphous organics, bone, pottery	Silty clay translocation, bioturbation
	10405			10405	Loamy sand	Unsorted	Geological 50% Anthropogenic 50%	Charred wood, amorphous organics, bone, pottery	Silty clay translocation, vivianite, authigenic P, Fe, Mn neoformation
	10409		3509	10409	Sand (gravel)	Unsorted	Geological 70% Anthropogenic 30%	Charred wood, amorphous organics, bone	Silty clay translocation, bioturbation
Pit 11749	11748	Fill (rapid mass movement)	7221	a	Loamy sand with gravel-sized inclusions	Unsorted	Geological 70% Anthropogenic 30%	Charred wood, bone, amorphous organics	Silty clay translocation, bioturbation, Fe, mica weathering, Mn neoformation, mesofaunal excrement
				b	Sandy loam/ loamy sand with gravel-sized inclusions	Unsorted	Geological 80% Anthropogenic 20%	Charred wood	Silty clay translocation, bioturbation, Fe, mica weathering, Mn neoformation
	12508			12508	Loamy sand with gravel-sized inclusions	Unsorted	Geological 75% Anthropogenic 25%	Charred wood, bone, pottery	Bioturbation, silty clay translocation, Fe, Mn neoformation
Pit 11694	11671	Fill (rapid mass movement)	5728	11671	Loamy sand with gravel-sized inclusions	Unsorted	Geological 70% Anthropogenic 30%	Charred wood, daub, charred seeds	Silty clay translocation, bioturbation, Fe, Mn neoformation, mica weathering, authigenic P

POST-DEPOSITIONAL ALTERATION OF FILL SEDIMENT

Micromorphology shows that there is substantial chemical weathering within the five fills comprising context 11111 (Table 34). There is an interesting distinction in the range of chemical weathering processes between the fills. Fills 1 and 2 towards the surface of the profile both contain the greatest abundance of dusty impure clay coatings, as well as a diverse range of features that are attributed to chemical alteration and neomineral formations, specifically the mobilisation of iron, mica weathering, the formation of authigenic phosphate minerals (fill 2 only), vivianite and manganese neoformation. Translocation of clay and silty clay particles is influenced by factors related to water flow, chemical conditions and energy and gravity. Movement can occur under any kind of climate, although temperate environments provide the best evidence (Courty *et al.* 1989). Dusty clay coatings commonly occur due to the rotational movement of sediment and turbulent hydraulic conditions (Courty *et al.* 1989), such as the dumping and trampling of materials under wet conditions. Authigenic phosphate minerals form when microbial decay breaks down organic matter releasing the phosphate and acid, which lowers the pH. Phosphate is also released from bone if the pH drops below 7, dissolving the calcium hydroxylapatite. The phosphate that has been released from organic matter and bone reacts with cations, especially calcium, to form authigenic phosphate minerals (Weiner 2010, 295–7). Vivianite, and iron phosphate neomineral formation that forms under reducing conditions, occurs in very low frequencies, <2 per cent, in fill 2.

Iron and manganese neoformation occurs throughout context 11111. Some of the iron originates from weathering of the mica mineral muscovite (Bisdom *et al.* 1982) and iron and mica particles impregnate silty clay coatings. Free iron is highly mobile only when present in the ferrous state which occurs under anaerobic conditions (Courty *et al.* 1989, 179), but oxidises to produce intrusive and impregnative iron and manganese pedofeatures as a result of wetting/drying cycles (Lindbo *et al.* 2010). Manganese may accumulate at the top of either the water table or the capillary fringe (Bartlett 1988; Rapp and Hill 1998). Fluctuating water tables lead to alterations of reducing and oxidising conditions (Brammer 1971; Brown 1997; French 2003). Manganese neomineral formation is also likely to be due to the association of manganese with decaying organic matter. Organic matter becomes oxidised as Mn(III) accepts electrons to become Mn(II). The pH rises and the rate of redox is slowed. As organic matter is lost by oxidation, black precipitated MnO_2 will become evident. Most critical redox happenings occur in areas where the O_2 supply is partially restricted either by limited aeration or a predominating electron supply. Most of these regions are redox interfaces such as: meeting points between roots or microbial surfaces and the soil surface; aggregates and soil pores; sediments and free water; the boundary between an organic and a mineral horizon (Bartlett 1988, 59–73).

Fill 3, the middle microstratigraphic unit within context 11111, shows the least effects of weathering, and also contains fewer types of anthropogenic inclusions (Table 34); as a result, the localised decay processes resulting from the presence of anthropogenic materials such as bone are reduced.

Fills 4 and 5 in the lower part of context 11111, towards the base of the profile, show the most abundant silty clay coatings (20 per cent), many of which are also microlaminated (20 per cent). Clay translocation can be problematic to attribute to specific times in the formation of the archaeological record (French 2003; Goldberg and Macphail 2006), particularly as the fields overlying the Roman town of Silchester were used as arable land until 1979, and so it is important to consider that translocated clays may post-date a site by many hundreds or thousands of years (Banerjea *et al.* 2015b). Nevertheless, an intra-site comparison of features and contexts can provide information relating to the weathering process of the archaeology on site (Banerjea *et al.* 2015b). The abundance of microlaminated silty clay coatings slightly increases towards the base of the profile, which would suggest that clay particles have been repeatedly washed through the profile (Courty *et al.* 1989), probably as a result of the ditch sediments being exposed to rain. This could suggest that this feature, once infilled, had been left in an open area for some time, exposed to rain between infilling events, and once infilled. Micromorphological investigation of a later Neolithic rondel ditch at the site of Plotiště, Southern Morovia, showed that the intensity of clay coating did not vary with the depth of the section, and was therefore probably formed shortly after deposition (Lisá *et al.* 2015). The latest exposure and weathering could have occurred before being covered by later building activity, or as a result of exposure prior to excavation.

Bioturbation, as evident by channels and chambers in the microstructure, occurs throughout context 11111, but less abundantly in fill 1 (2–10 per cent) than fills 2–5 (10–20 per cent).

WELL 10421

Micromorphology established that context 10436 is actually formed from four microstratigraphic units (Table 33). The materials within the sediment have been deposited in a similar way as the units of compacted trampled material within buildings/semi-open spaces from Insula IX during Periods 2 and 3 (Banerjea *et al.* 2015b), and the formation processes of this type of deposit have also been observed experimentally at Butser Ancient Farm and St Fagans in the UK, and Lejre Historical and Archaeological Research Centre, Denmark (Banerjea *et al.* 2015a). These microstratigraphic units contain occupation material resembling kitchen waste, such as charcoal, burnt bone, calcined bone, as well as herbivore dung. Micromorphology has established that context 10436 is not a primary fill of Well 10421, but is actually later occupation material that has slumped into the well, and it may relate to a building from Period 1. Additionally, this finding provides valuable information relating to the extent to which later occupation material from a building can slump into negative features, as context 10436 is situated halfway down the well (FIG. 169).

PITS

DEPOSITIONAL EVENTS AND THE LONGEVITY OF PIT 9606 (PIT GROUP 14)

Four depositional events are represented in sample 3806. These deposits were single depositional events, which could have been deposited within close intervals as the boundaries between the units are clear (Burns 2010, 32) without pedogenesis at the surface of and boundaries between units, which could occur if the pits and fills had been left open for longer periods of time.

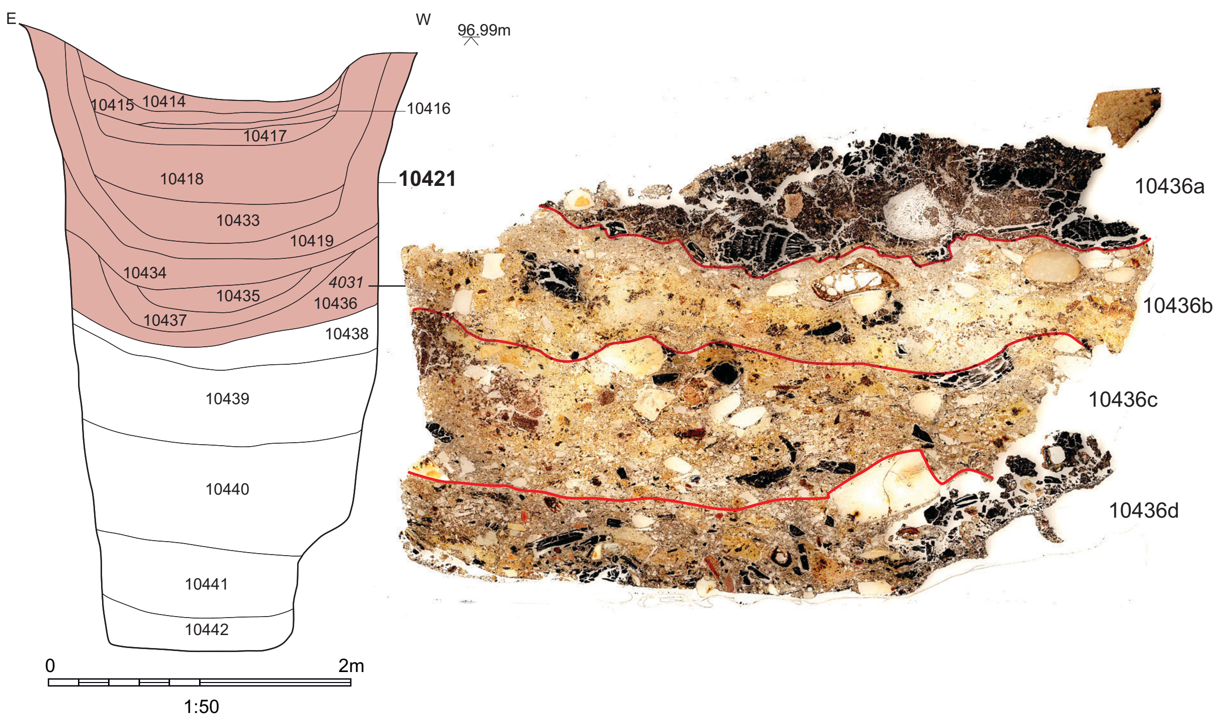

FIG. 169. The location of micromorphology sample 4031 and the associated slide and microstratigraphic units through context 10436, in Well 10421.

Experimental work indicates that stratigraphic units can completely turn to soil within 2.5 years (Banerjea *et al.* 2015a), but can begin to change within a season. The sorting and related distributions indicate that these units represent high energy depositions such as the dumping of discard material (Burns 2010, 32). The individual fills contain the same types of domestic refuse consistent with kitchen materials such as fragments of charcoal, bone (including burnt fragments), shell and pottery. The upper fill, 9615, contains more (burnt) bone and amorphous organic remains than deposits 9622, 9618 and 9623 below, and 9622 and 9618 contain more fragments of charcoal (Burns 2010, 21).

DEPOSITIONAL EVENTS AND THE LONGEVITY OF PIT 10410 (PIT GROUP 14)

Three depositional events are represented in samples 3508 and 3509: contexts 10403 and 10405 in sample 3508, and context 10409 in sample 3509. There are no internal microlaminations within these stratigraphic units, suggesting that they are single depositional events, rather than a series of rapid small depositions (Goldberg and Macphail 2006). The intergrain aggregate related distribution and unsorted nature of the deposits (Burns 2010, 21) is characteristic of dumped discard material (Matthews 1995). Three fills, 10403, 10407 and 10409, were rapidly deposited in close succession and the pit seems to have been sealed by a backfilling event, context 10402, followed by later slumping events.

The deposits within Pit 10410 contain a greater abundance of rock and minerals than Pit 9606 (30–70 per cent in Pit 10410, and 20–50 per cent in Pit 9606) and less amorphous organic material (Burns 2010, 21). The greater abundance of rock and minerals could either represent more erosion and instability of the sides of the feature, or suggest that the refuse itself is redeposited, i.e. tertiary. It is possible that the depositional events represent the regular maintenance of an outdoor yard area where secondary refuse has been deposited (Schiffer 1987, 60), and quite possibly contain some 'in transit refuse', which describes material that has been dropped or broken as people cross outdoor spaces (Schiffer 1987, 64). 1 kg of pottery was recovered from the upper fill, context 10403, which could represent the discard of some 'clutter refuse', which describes broken artefacts that were stored because they had potential future reuse (Schiffer 1987, 67).

DEPOSITIONAL EVENTS WITHIN PIT 11749 (PIT GROUP 4)

Sample 7221 was collected from across the boundary of field contexts 11748 and 12508 and represents three microstratigraphic units, as 11748 has proved to comprise two separate units (Table 34). The unsorted nature of the deposit and unoriented, randomly distributed inclusions are characteristic of dumped discard material (Matthews 1995), although there is some clustering of coarse flint rock fragments. Despite the evidence for bioturbation, the units still show compaction, suggesting the material was densely packed.

As observed in Pit 10410, the units, particularly 11748b and 12508, have a greater abundance of rock and mineral inclusions, 60–70 per cent, in comparison with anthropogenic residues (Table 34), which could again either indicate erosion of the sides, or material from the maintenance of an outdoor area (Schiffer 1987, 60). Anthropogenic inclusions (FIG. 170) are not abundant, <40 per cent, and comprise daub, pottery, (unburnt) bone and charred wood, which is very poorly preserved.

DEPOSITIONAL EVENTS AND THE LONGEVITY OF PIT 11694 (PIT GROUP 8)

Sample 5728 was collected from the second fill, context 11671, within Pit 11694, in order to understand more about the formation of this unit and the origin of the materials within it. The unsorted nature of the deposit and unoriented, randomly distributed inclusions are again characteristic of dumped discard material (Matthews 1995). The origin of the materials within this unit could be similar to those within deposits in Pits 10410 and 11749 (Table 34). There is a greater abundance of rock and mineral inclusions, 70 per cent, in comparison with anthropogenic

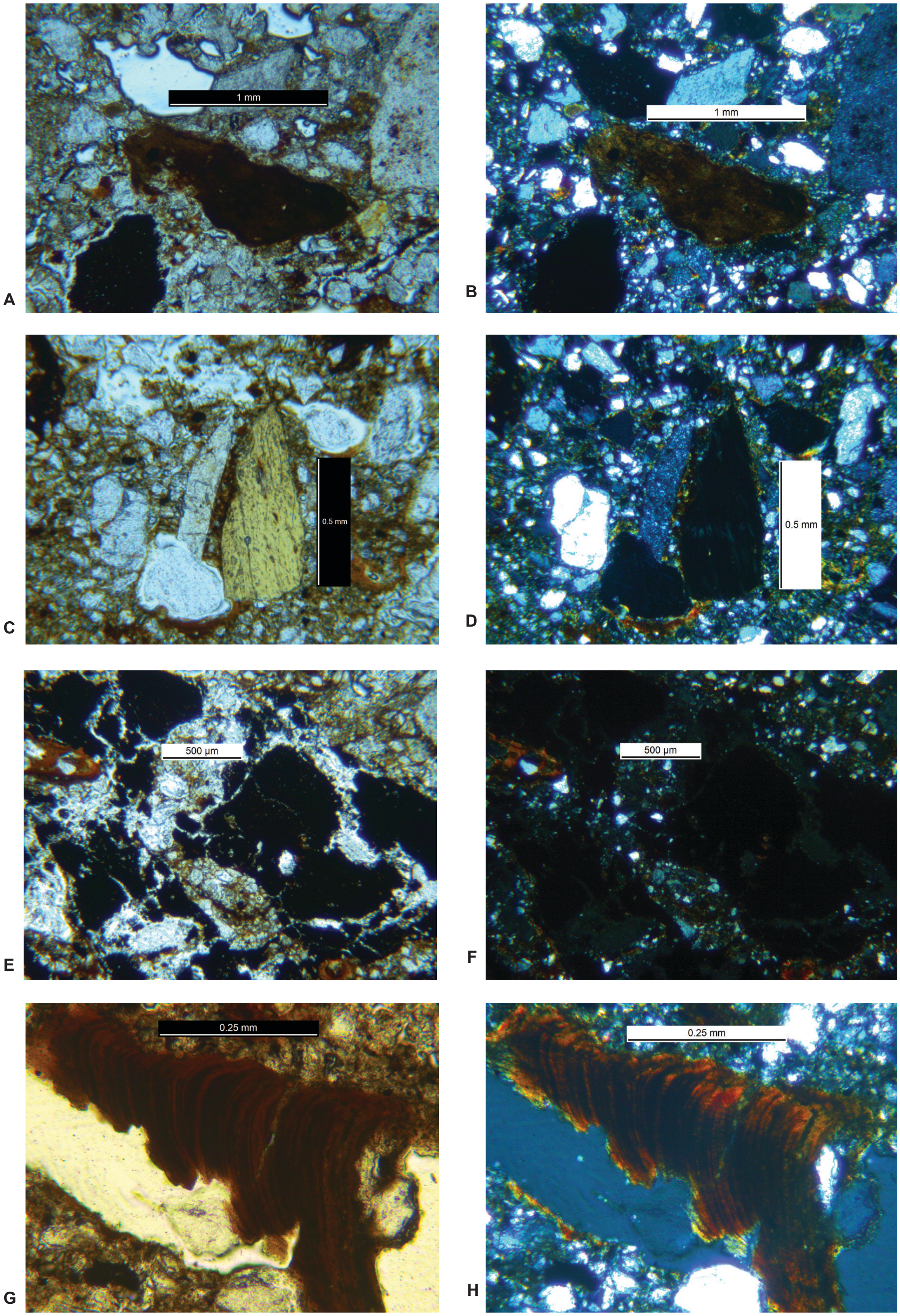

FIG. 170. Photomicrographs of a fragment of daub in unit 11748b, PPL (a), XPL (b), a degraded fragment of bone in unit 12508, PPL (c), XPL (d), poorly preserved charcoal in unit 11748b, PPL (e), XPL (f), and a microlaminated, iron-impregnated clay coating in a void space, PPL (g) and XPL (h).

residues, 30 per cent, the latter comprising fragments of daub, charred wood and charred seeds. The abundance of rock and mineral inclusions is similar to that in contexts 10403, 10405 and 10409. This again suggests that abundance of rock and minerals could either derive from eroded gravel from the sides, or that the refuse itself represents the regular maintenance of an outdoor yard area where secondary refuse has been deposited (Schiffer 1987, 60).

POST-DEPOSITIONAL ALTERATIONS WITHIN PITS 9606, 10410, 11749 AND 11694

Bioturbation

The effects of mesofaunal bioturbation, as evidenced by channels and chambers in the microstructure, are less substantial in Pits 9606 and 10410, <15 per cent, than in Pits 11749 and 11694 where is it very abundant at >25 per cent (Table 34); this may be due to the greater depth at which the samples were collected, as bioturbation tends to be more substantial higher up the profile, or to differences in their local environments due to their location on the site (FIG. 171). Microstratigraphic unit 11748a within Pit 11749 contains mesofaunal excremental pedofeatures (Kooistra and Pulleman 2010), which may indicate that this microstratigraphic unit was at some point open and susceptible to pedogenesis.

Chemical weathering

Pits 11749 and 11694, as well as showing more bioturbation, also contain a much greater abundance of translocated clay and microlaminated clay coatings (FIG. 170), and redoximorphic features such as evidence of iron translocation and manganese neomineral formation, than Pits 9606 and 10410 (Table 34). The natural geology within Insula IX can show some variability that may create localised depositional environments that would affect the extent of the chemical weathering: Pits 9606 and 10410 are located quite close to each other, whereas Pits 11749 and 11694 are located much further away (FIG. 171).

Context 11671 in Pit 11694, contexts 9622 and 9623 in Pit 9606, and context 10405 in Pit 10410 contain authigenic phosphate minerals. The application of FTIR analysis would be required to fully understand the origin of the phosphate within the authigenic phosphate minerals (Weiner 2010, 295–7), but it could originate from the breakdown of organic domestic waste, latrine waste, or bone. It is important to consider that the phosphate could also have leached through the profile and originate from the breakdown of materials higher up.

SUMMARY OF KEY OBSERVATIONS

There is a spatial difference in the post-depositional alterations between the pits and pit groups. Pits 9606 and 10410 are part of Pit Group 14 and are situated in the South-West Compound. Pit 11749 (Pit Group 4) is situated in the Central Compound, some distance from Pits 9606 and 10410 and to the west of Pit 11694 (Pit Group 8) which is also situated in the Central Compound. Pits 11694 and 11749 are affected by bioturbation and chemical weathering to a greater degree than Pits 9606 and 10410.

Pit 11749 contains mesofaunal excremental pedofeatures, which may indicate that microstratigraphic unit 11748a was at some point open and susceptible to pedogenesis, which could indicate a period of disuse for this feature before further infilling.

Context 11671 in Pit 11694, contexts 9622 and 9623 in Pit 9606, and context 10405 in Pit 10410 contain authigenic phosphate minerals which, assuming the phosphate originates from the breakdown of organic materials or bone within those specific units and, especially, in the case of Pit 9606, could indicate that these units were far richer in anthropogenic materials than the others.

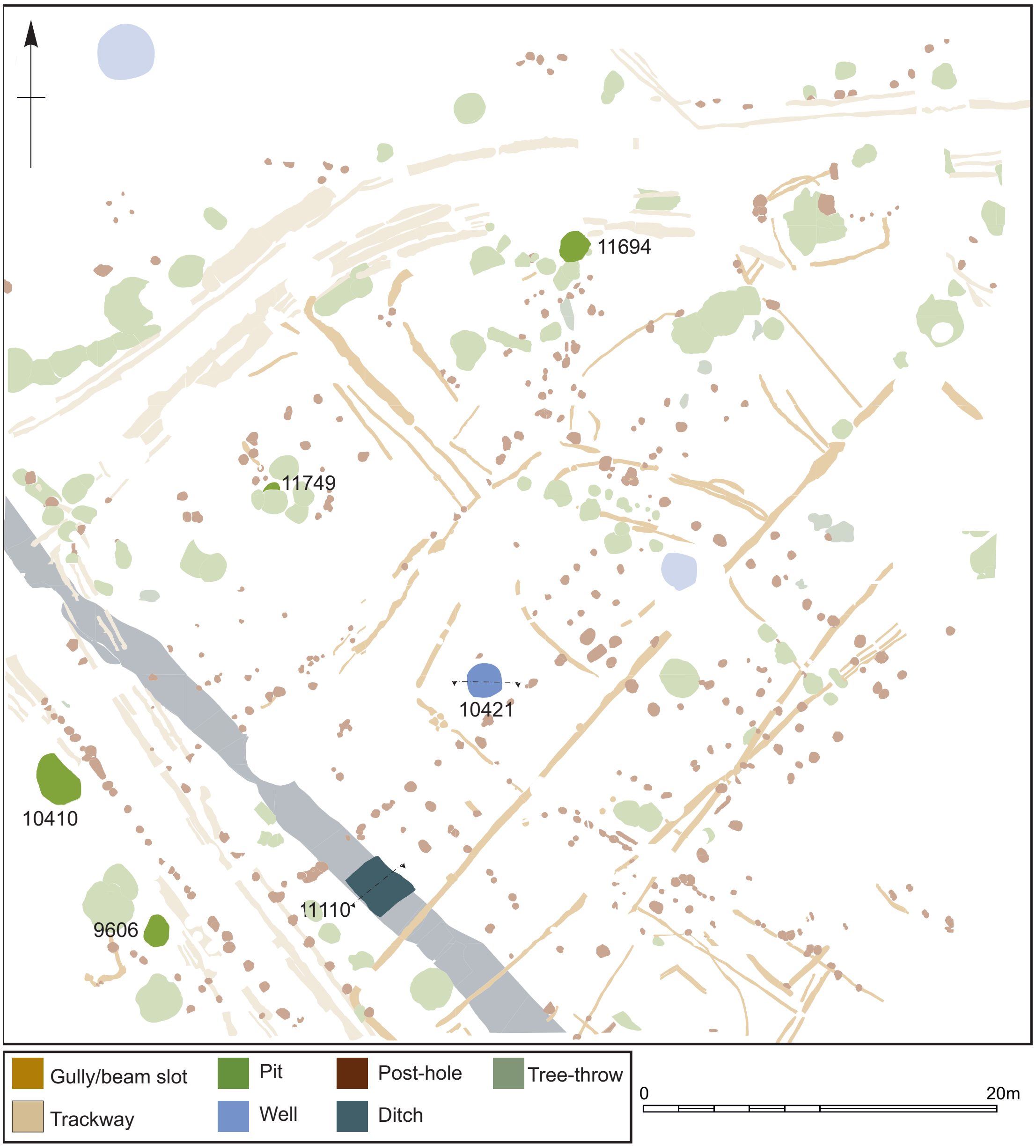

FIG. 171. Site plan showing the location of Ditch 11631 (11110), Pits 9606, 10410, 11749, 11694 and Well 10421.

CONCLUSIONS

USE OF PITS: REFUSE CYCLES AND DISPOSAL PRACTICES

Micromorphology shows that Pit 9606 (Pit Group 14) has been used differently to Pits 10410, 11694 and 11749. Pit 9606 was more intensively used for the disposal of kitchen waste than the others, and contains fewer rock and mineral inclusions. The bulk geochemistry results from this feature show that samples contain elevated levels of zinc, which supports the notion that this was a rubbish pit but the lack of phosphorus (with the exception of one sample) suggests that this was not heavily used for animal/human faecal matter (Cook, p. 356). Pits 10410, 11694 and 11749 mainly contain rock and mineral inclusions with lower proportions of anthropogenic inclusions relating to domestic waste.

The increased amount of geological inclusions within Pits 10410, 11694 and 11749 is interesting as it could imply that these pits were infilled with gravel and 'in transit' refuse resulting from the maintenance of external areas, and, for Pit 10410, with the inclusion of 'clutter refuse'. 'In transit' refuse describes material that has been dropped or broken as people cross outdoor spaces (Schiffer 1987, 64); whereas 'clutter refuse' describes broken artefacts that were stored because they had potential future reuse (ibid., 67). Some gravel could also have eroded into the features from the sides.

LONGEVITY OF FEATURES

Ditch 11631 is the earliest substantial late Iron Age feature in Insula IX, its secondary fills accumulating over some 20–30 years at the beginning of the first century A.D. Micromorphology samples collected from the upper context (11111) show that there are five separate infilling events within context 11111, which most probably formed as a result of natural infilling. Fills 1, 3 and 5 formed as a result of rapid mass movement of sediment, and are all quite substantial in thickness: 70–80 mm, 170 mm and 115 mm respectively. Fills 2 and 4, especially fill 4, formed as a result of gentler, slower sedimentation processes. Anthropogenic detritus is poorly represented in all fills, but it does increase in abundance towards the surface of the profile, which probably reflects a gradual increase in occupation activity around the ditch. The range of geological inclusions is consistent throughout fills 1–5, which suggests they originated from the same, probably local, sediment source. The fills of the ditch are more substantially weathered than the fills of Pits 9606 and 10410, which, in conjunction with the increased evidence for weathering towards the base of the feature, suggests that the feature could have been left open to weather substantially before being built over. At Silchester, in general, external features and occupation spaces are more substantially weathered than internal spaces (Banerjea *et al.* 2015a).

The micromorphology results indicate that Pits 9606, 10410, 11694 and 11749 all had a short life-span. Pits 10410, 11694 and 11749 were infilled rapidly by mass movements of sediment comprising mainly geological inclusions. Given the inclusion of 'in transit' and 'clutter' refuse, it is possible that the use of these features was limited, and represents specific clearance events such as the re-building and/or re-modelling of nearby structures and spaces, or the partial abandonment of nearby structures. Pit 9606, despite having a short life-span, was used and infilled in a different way to Pits 10410, 11694 and 11749. The micromorphology shows that Pit 9606 functioned as a regularly-used rubbish pit and infilled with rapid successions of kitchen waste.

Pit 11749 appears to have been left in a state of disuse at some point towards the end of its use. Soil forming processes, evident by the presence of mesofaunal excremental pedofeatures, had begun before the upper part of the feature was infilled and covered by later occupation.

THE NATURE OF OCCUPATION

The micromorphological evidence from Pits 9606, 10410, 11694 and 11749 and Ditch 11631 suggests that the occupation at Insula IX during Period 0 was not substantial, which is also supported by the low values for geochemical indicators of occupation such as phosphorus across the site during this period (Cook, p. 357). In comparison with the later occupation from Periods 2 and 3 (Banerjea 2011; Banerjea *et al.* 2015a), there is little evidence for residual microrefuse in these deposits; bulk geochemical values are also less enriched for Period 0 than the later periods (Cook, p. 357). In addition, micromorphology indicates that the use of the features was very short-lived.