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TWO THOUSAND YEARS OF SALT MAKING AT LYMINGTON, HAMPSHIRE

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ABSTRACT

A programme of archaeological fieldwork on land at Manor Farm, Pennington, south of Lymington, revealed evidence of the coastal salt making industry which was a major feature in the medieval and post-medieval landscapes, and upon which the town's prosperity in the 17th and 18th centuries was largely built. It also revealed an Iron Age settlement, comprising at least ten roundhouses and numerous pits, some apparently clay-lined; finds of briquetage from the settlement indicate that salt making was a significant component of its possibly seasonal economic base.

Although medieval salt making at Lymington is attested to in documentary sources these have little to say about the methods used until after well documented changes in the industry in the early 17th century, when saltern owners were required to replace their 'mounds' with 'floor pans'. Following these major developments, there are a number of precise descriptions and graphical depictions of salt production methods at Lymington. Despite the fact that 12th–13th century pottery was recovered from the site, the archaeological evidence for historic salt making corresponds more closely to the descriptions of the post-medieval industry, although in the absence of firm dating evidence questions remain about the precise date and function of the features uncovered.

INTRODUCTION

'Salt', said Pythagoras, 'is born of the purest of parents: the sun and the sea'. While the British climate does not allow for the production of crystalline salt by just the solar evaporation of sea water, the use of the sun and the wind to produce a concentrated brine from sea water has always been an essential element of coastal salt production in Britain. In the 18th century, Lymington's prosperity derived largely from the thriving salt making industry based in the Keyhaven and Pennington Marshes which flank the north shore of the western Solent between Avon Water and the Lymington River estuary (Fig. 1).

Evidence for the long-term nature of salt making in the area is provided by documents dating from the 11th to the mid-19th century, as well as by maps, drawings and historical accounts. Today, traces of the salterns can be seen in aerial photographs and, in places, are still visible on the ground as low banks, mounds and ditches (Momber *et al.* 1994). Yet there has been only limited archaeological investigation of this important industry, which at its height was exporting its product across the Atlantic to Canada and the United States.

A programme of archaeological works revealed evidence not just of medieval and post-medieval salt making, but also for its late Iron Age precursor. The fieldwork, including earthwork surveys, archaeological strip-and-record excavations and watching briefs, was undertaken on *c.* 8 hectares of land at Manor Farm, Pennington, south of Lymington, centred on NGR 431650 092500, in advance of gravel extraction and subsequent landfill (Fig. 2).

A key factor for salt making along the Lymington coastline was the storm protection offered by Hurst Spit to the west. The site occupies generally level ground at *c.* 0.7–1 m above Ordnance Datum (aOD) and, even accounting for sea level rise since the medieval period, would, if open to the sea, have been liable to flooding on spring tides when the

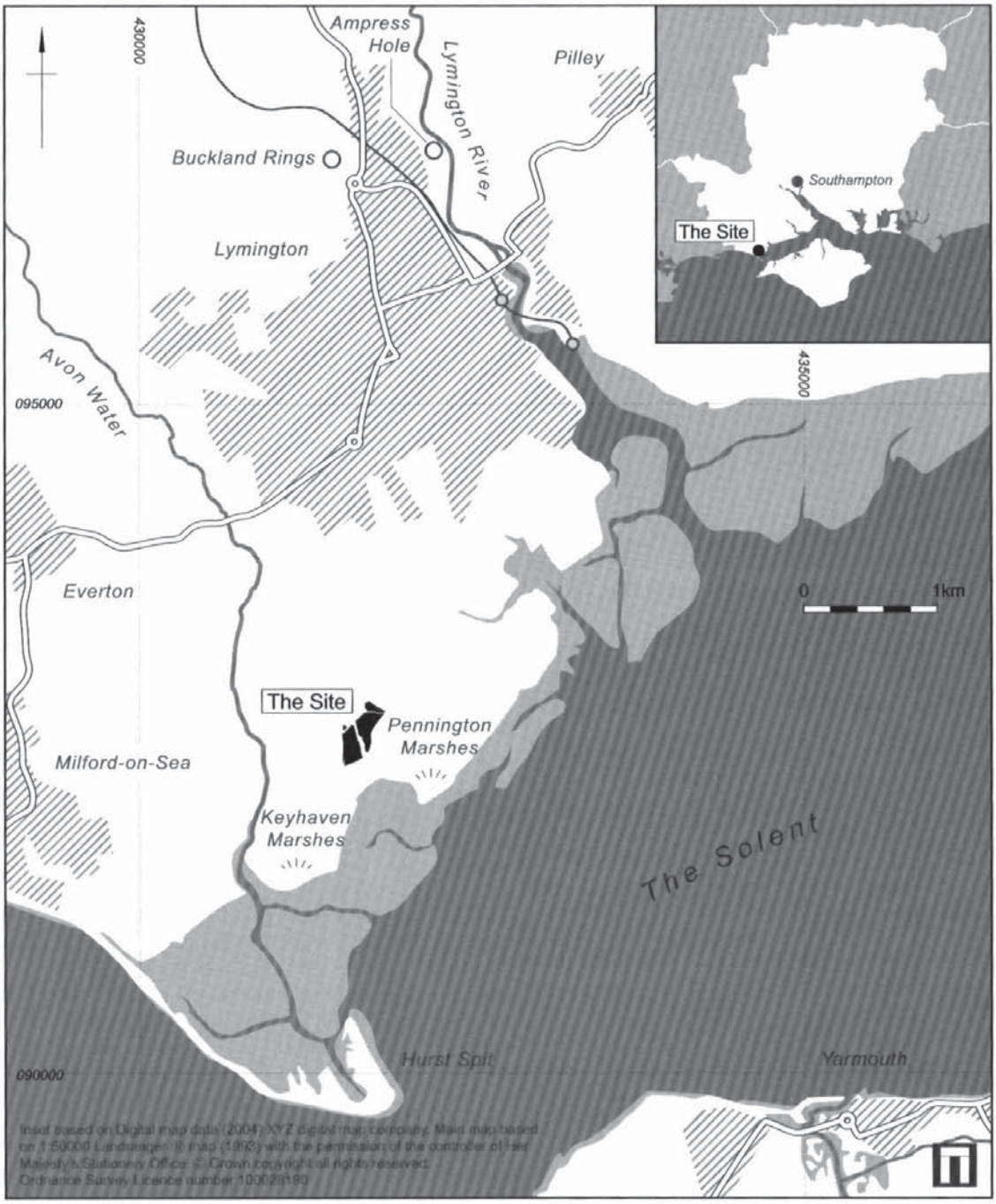

Fig. 1 Site location

mean high water reaches 0.87 m at Hurst Point and 1.02 m aOD at Lymington. The site is now bounded to the south by a bund that formerly separated Pennington Marshes from the farmland to the north, while further south is the sea-wall built in the 18th century.

The site lies within a belt of land mapped as alluvium (Geological Survey of Great Britain 1975). The alluvium marks the line of a small watercourse that runs off the 'Angular Flint and Gravel of the Downs' (AFGD) which lies inland of the coastal marshes. The AFGD deposits line all the extant watercourses in the area (e.g. the Lymington River and Avon Water) and appear to mark the course of several former streams that flowed into the marshes between these rivers. All the watercourses cut through Pleistocene Plateau Gravel. During excavation of the late Iron Age settlement at the northern end of the site the natural geology was recorded as sandy clay loam. The local soils are classified as Efford 1 (marine and river terrace gravel: well-drained fine loamy soils, often over gravel; Soil Survey of England and Wales 1983) although, on the ground, elements of the surrounding Shabbington (river terrace drift: slowly permeable seasonally waterlogged fine loam over clayey soils) and Wallasea 1 (marine alluvium: stoneless non-calcareous and calcareous clayey soils) soils were observed.

Fifteen episodes of fieldwork were undertaken as different areas were cleared for gravel extraction, the excavation in most areas being preceded by a topographic survey (Wessex Archaeology 1999; 2000). The site was divided by a bentonite dam into two parcels of land, the strip between them not being examined. The various areas are here combined into Areas A, B and C (Fig. 2).

RESULTS

Iron Age

The evidence for late Iron Age occupation, comprising mainly roundhouses, ditches and pits, was found exclusively in Area C, a triangle of land measuring 100 m by 240 m, at the north end of the site (Fig. 3). This area, which comprised the highest ground within the site, probably lay just above the tidal range, on the edge of the salt marsh. One sherd of flint-tempered pottery, recovered along with burnt flint and fired clay from a probable tree-throw (7281) cut by the gully of roundhouse 7 (below), could be late Bronze Age in date, but no other material of this date was found on the site.

Roundhouses

Ten possible roundhouses (numbered 1–10 from north-west to south-east) were recorded, defined by curved gullies *c.* 8–12 m in internal diameter (summarised in Table 1). They include a *c.* 8 m long arc of gully (roundhouse 4) with a projected possible diameter of 13–14 m, making it significantly larger than the other roundhouses, and possibly indicating some other function.

In spite of their often close proximity, none of the structures overlapped. In several cases, however, they appear to have been rebuilt – the gully of roundhouse 9 had been recut at least once (possibly twice), while roundhouses 2 and 6 both had concentric gullies. The three gullies in roundhouse 6 partly overlapped, but the two in roundhouse 2 were separated by up to 0.5 m, representing either a slight variation in size (8.7 m and 10 m diameter) or a slight shift in position.

Most of the roundhouses had entrances facing between north-east and south-east, although roundhouse 5 was notable in having a west-facing entrance (positioned less than 2 m from the south-east facing entrance of roundhouse 3). In addition, roundhouses 2 and 10 appear to have had entrances facing both east and west.

The gullies were generally of similar dimensions, averaging *c.* 0.5 m wide and 0.2 m deep. Roundhouse 9, which had a slightly square shape, had a more substantial gully, its first recut being up to 1.7 m wide and 0.5 m deep; in both of its main phases its entrance terminals had postholes cut into the gully base. The gully of roundhouse 1 appeared in places almost as a series of stakeholes/postholes.

Fig. 2 Fieldwork areas, showing Iron Age settlement (Area C) and medieval/post-medieval salterns (Areas A and B)

A range of finds was recovered from the roundhouse gullies, including late Iron Age pottery, fired clay including briquetage (fragments of vessels, rods and blocks) and burnt flint. This material was often concentrated in the gully terminals, the southern terminal of roundhouse 7, for example, containing a handled jar (Fig. 7.10) and pieces of a fired clay loomweight, while the southern terminal of roundhouse 2 contained large quantities of briquetage and burnt flint. The only animal bone from the site came from the gully of roundhouse 9.

Few features were noted within the roundhouses – two possible postholes in roundhouse 6, two pits and a *c.* 3 m long slot (7216) lying 3 m inside the entrance in roundhouse 7, and a number of pits in roundhouse 9. None, however, could be clearly associated with the structures.

Table 1 Summary of Iron Age roundhouses

Roundhouse	*Internal diameter (m)*	*Orientations of entrances*	*Number of gullies/cuts*
1	9.2	SE	1
2	inner 8.7 outer 10.0	ESE - WNW	2
3	9.5	ESE	1
4	<14.0	-	1
5	9.7	WNW	1
6	inner 9.6 middle 10.7 outer 11.7	E	>3
7	9.6	SSE	1
8	11.2	NE?	1
9	10.5	ESE	3
10	8.0	E - W	2

Pits

Numerous small circular features were recorded in Area C, many of them occurring in small groups (PG 1–6) (Fig. 3 and Table 2). Many of those that were excavated proved to be similar in form and contents, averaging 0.7 m in diameter and 0.2 m deep, with moderately steep sides and flat or slightly concave bases. They contained a similar range of finds to that found in the roundhouse gullies, comprising late Iron Age pottery, fired clay (including briquetage fragments) and burnt flint. A number also contained varying quantities of charcoal, but in only one (pit 2999, group 3), which had a patch of burnt clay above a basal clay layer, was there any evidence for *in situ* burning (Fig. 4).

The majority of the pits were recorded as 'clay-lined'. Some did have a layer of clay covering the base and extending up the sides of the pit (e.g. pits 2999, group 3; 7124 group 4; 7226, group 1) (Fig. 4), and a reasonable interpretation is that these pits were designed to hold water, possibly brine, so playing some role in the salt making process. There is some doubt, however, as to the identification of a number of the pits as clay-lined, particularly in those where a layer of clay was recorded only on the base, as for example in pit 2798 (group 3). It was observed during the excavation that those pits holding rain water rapidly accumulated a well-sorted puddled clay 'lining' in their bases, the clay having eroded out of the surrounding sandy clay loam geology.

Other features

A pear-shaped feature (2997) east of roundhouse 10, was 1.1 m long, with the rounded end 0.6 m wide and 0.2 m deep, narrowing to *c.* 0.3 m and the base sloping up to the east. Its single fill of dark brown silty clay contained over 2.5 kg of burnt flint as well as briquetage, including vessel fragments, but while there were occasional flecks of charcoal, there was no evidence of *in situ* burning.

Between roundhouses 9 and 10 there was a shallow oval cut (2882), 1.2 m by 1.5 m and up to 0.16 m deep, with a single fill with a scatter of burnt flint on its surface, while pit 2732 (cut by gully of roundhouse 8), measured 0.8 m in diameter and 0.2 m deep, with a basal clay layer extending up the sides, and a single fill containing fired clay, burnt flint, and a sherd of pottery.

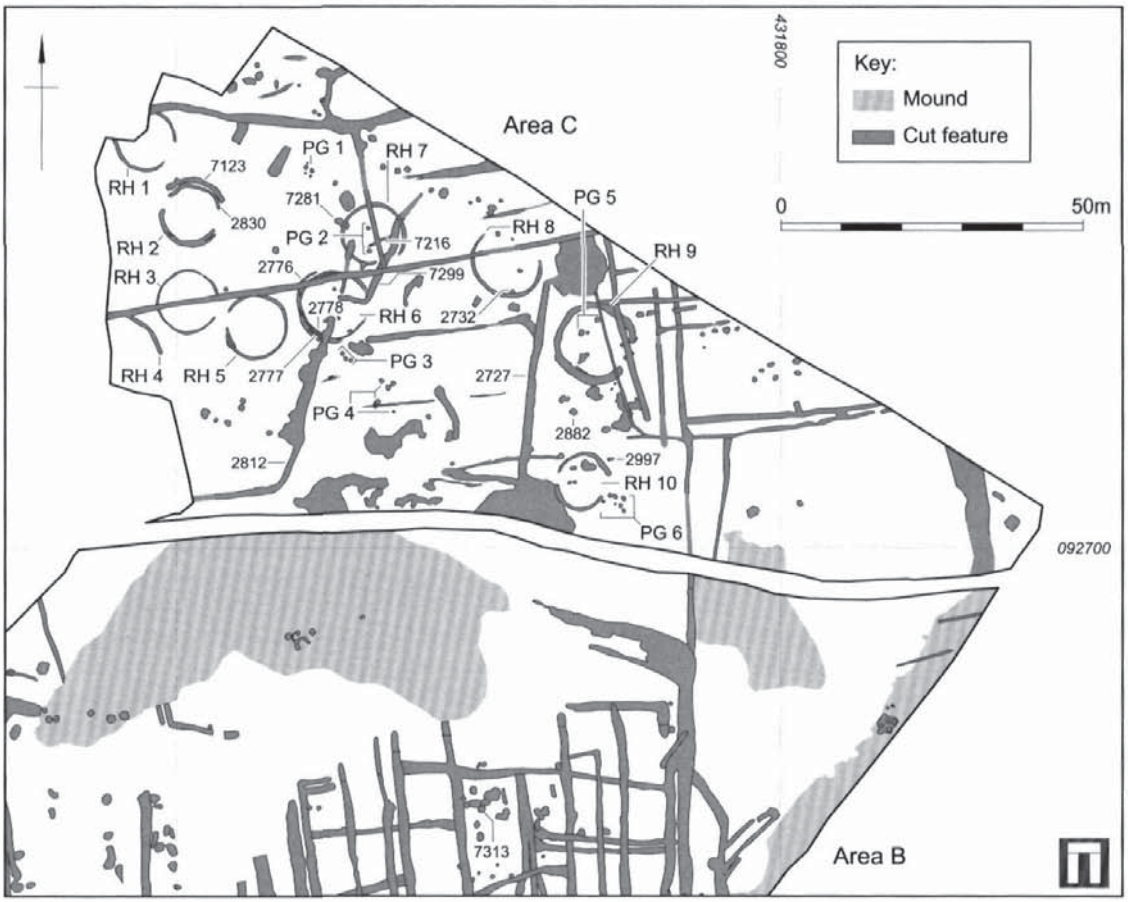

Fig. 3 Iron Age settlement in Area C

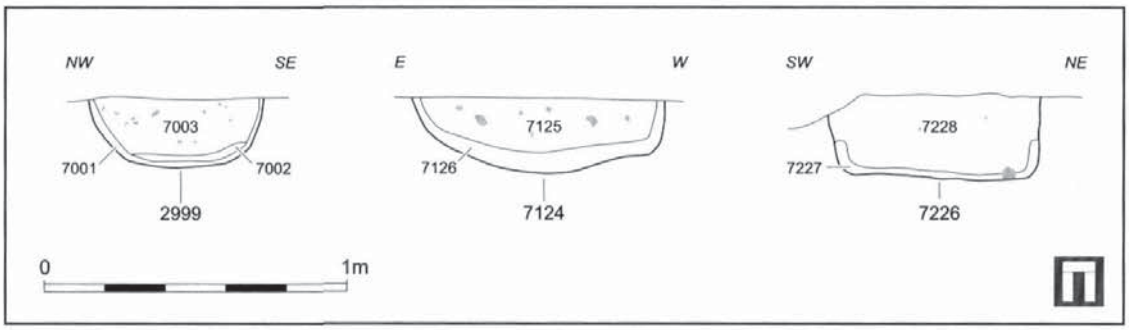

Fig. 4 Clay-lined Iron Age pits: 2999 (group 3), 7124 (group 4) and 7226 (group 1)

Table 2 Summary of Iron Age pit groups

Group	*Pit*	*Width*	*Depth*	*Fills*	*Contents*	*Evidence for clay lining*
PG 1	7226	0.7	0.3	2	burnt flint	Clay layer extending half way up vertical sides (Fig. 4)
	7249	0.7	0.2	1	burnt flint fired clay (incl. briquetage vessel frag.)	–
	+ 3 possible postholes					
PG 2	7301	0.7	0.1	2	Late Iron Age pottery burnt flint fired clay (incl. briquetage vessel frags.) Emmer wheat glume base	Clay layer on base
	7152	0.6	0.1	1	fired clay burnt flint burnt soil?	–
PG 3	2798	0.6	0.25.	2	Late Iron Age pottery burnt flint fired clay charcoal	Clay layer on base
	2999	0.7	0.2	3	Late Iron Age pottery burnt flint fired clay possible iron-working slag	Clay layer on base and sides, below patch of clay burnt *in situ* (Fig. 4)
	+ 1 unexcavated pit					
PG 4	7124	0.8	0.25	2	burnt flint fired clay	Clay layer on base and sides (Fig. 4)
	7043	0.6	0.1	1	burnt flint fired clay	-
	+ 4 unexcavated pits					
PG 5	7300	0.8	0.1	3	charcoal burnt soil/clay	Clay layer on base and sides
	7305	0.6	0.25	3	charcoal burnt soil/clay	Clay layer on base
	7247	0.6	0.15		fired and burnt clay (incl. possible briquetage frags.)	Clay layer on base
PG 6	7130	0.7	0.1	1	–	–
	7209	0.9	0.15		burnt flint fired clay charcoal	–
	7170	0.7	0.12		burnt flint fired clay (incl. briquetage block frags.)	–
	7204	0.7	0.1		burnt flint fired clay charcoal	–
	+ 1 unexcavated pit and 2 postholes					

Linear features

Area C was crossed by a grid of regularly spaced east-west ditches of probable post-medieval/modern date, some of which cut across the roundhouses (Fig. 3). However, a number of ditches had other orientations, some with less regular lines, and a few appear to pre-date some Iron Age features. These include a poorly defined and slightly meandering linear feature (7299) orientated north-east and traced for over 15 m from a possible terminal in the entrance of roundhouse 6. It also passed through the entrance of roundhouse 7 but was cut by the building's gully at the north, beyond which it appeared to peter out. It was up to 1.2 m wide and 0.2 m deep, with a single fill containing late Iron Age pottery, fired clay and burnt flint.

A similar feature (2812) on approximately the same orientation, but offset some 3 m to the south-west, ran south-west from a possible terminal within roundhouse 6, *c.* 6 m south-west of the terminal of feature 7299. After 30 m it turned to the west (parallel to the modern ditch bounding the area of higher ground), before petering out after a further 10 m. Although this feature cut across the gully of roundhouse 6, its shared orientation to feature 7299 and similar dimensions and contents – pottery, fired clay including briquetage and burnt flint (one section containing 4.6 kg of burnt flint) – suggest that they may be contemporary; a fragment of modern brick from the feature is probably intrusive.

Some 35 m to the east, and broadly parallel to features 7299 and 2812, there was a more clearly defined and substantial ditch (2727), which at the north passed between roundhouses 8 and 9 and at the south continued into an undefined spread of soil. It was 1.2 m wide and 0.3 m deep with a concave profile, and in its single excavated section, a charcoal-rich lowest fill was overlain by material slumped from either side, then a layer of possibly natural silting above which was an upper fill comprising a large quantity of dumped burnt flint (some 76 kg was recovered) and charcoal, along with late Iron Age pottery and fired clay including briquetage block fragments. This ditch was surveyed as cutting one of the post-medieval/modern ditches, although not excavated at that point, and while the quantity of material suggests that the ditch was contemporary with the Iron Age occupation of the site, the phasing of these linear features remains uncertain.

Medieval, post-medieval and modern

To the south of the area of Iron Age activity, the archaeological remains across the rest of the site (Areas A and B, Fig. 2) were different in character, comprising both cut and topographic features, and consisting mainly of low earthwork mounds and banks, areas of associated shallow ditches arranged in regular grid patterns and a range of pits, all these features likely to be directly related to salt production. Although it was possible, during most episodes of strip and record and watching brief, only to digitally survey many of these features, sample excavation has helped to clarify their nature, if not precisely their function.

Dating these features is also problematic since, although there is documentary evidence for salt working on the Lymington coastline through the medieval and post-medieval periods and beyond, few artefacts were found in this area of the site. The only datable finds from Area A and B were 26 sherds (470 g) of 12th–13th century pottery recovered from two relatively limited areas within the site.

Early features

Although no features clearly datable as medieval were identified on the site, a large number of undated pits, many in irregular clusters, were recorded within the ditch systems in Area B. Many were broadly similar in character, *c.* 1–2 m wide and 0.3–0.7 m deep, often with irregular profiles (due in part to erosion of the pit sides) and uneven bases. Their fills were quite mixed, often including lumps of redeposited natural, lenses of very dark peaty material and laminated silts. While some contained fragments of burnt or fired clay, none showed any traces of clay linings and their function is unclear. Although no datable material, either Iron Age, medieval or post-medieval was recovered from these pits, they appear to pre-date the ditches among which they were recorded, and the recovery from one

pit (7313, Fig. 3) of four seeds of *Anthemis cotula* (stinking mayweed) suggests that these features are more likely to be associated with a medieval phase of salt making than with the late Iron Age phase, to which pit 7313 had initially been tentatively assigned (see Pelling, below).

Five lengths of ditch in Area A also pre-dated those features clearly identifiable as relating to the historic salt works, none of them having the dominant north-south alignment of the saltern ditches in this part of the site. A group of three (4001) – two parallel ditches 30 m apart aligned WNW.-ESE. and one perpendicular between them – were located at the north (Fig. 5), while at the south-east and south-west, respectively, ditches 4002 and 350 were aligned approximately NE.-SW. (Fig. 2). In contrast to the later ditches they contained no burnt inclusions and their function is unclear.

The group 4001 ditches were sealed by a layer of clay, up to 0.1 m thick. A similar layer was observed more widely across Area A (e.g. layer 213, Fig. 6), and also in Area B and was provisionally interpreted as a pre-saltern flood deposit, as it was cut by the saltern ditches and overlain by mound 3010 (but see Discussion below). It was covered by a thin smear of black silt identical to the material filling the later ditches.

Ditch blocks

The most noticeable feature revealed by the fieldwork in Areas A and B was an array of sub-square blocks of connected ditches, each block comprising a number of parallel cross ditches connected at one end to a 'feeder' ditch that bounded two or more sides of the block. Some of these ditches were faintly visible as earthworks, and recorded in the topographic surveys. Their form was most clearly discernible in Area A.

The blocks varied in size from *c.* 50–80 m square, and while those in Area A were all aligned approximately north-south, many of those in Area B had different orientations, giving the impression that the latter in particular had developed piecemeal over a period of time, possibly filling in the intervening spaces between existing blocks. While many of the blocks showed signs of modification, with ditches being recut, in only one, at the north-east corner of Area B, had this apparently involved the complete realignment of the ditches – at right-angles to their previous orientation. Particularly in Area A, it was possible to establish some relative phasing between blocks where adjacent blocks overlapped.

There was little difference between the profiles of the blocks' feeder ditches and the cross ditches running off them, although in some blocks the feeder ditches were wider and deeper. The ditches averaged *c.* 2 m wide and where excavated proved to be 0.3–0.4 m deep with shallow, generally V-shaped profiles. Most were filled with very dark, almost black, sandy silt, some with orange and grey mottling, the lower fills often being finely laminated, as would be expected of water-lain deposits. However, despite the black, apparently charcoal-rich nature of these fills only small quantities of charcoal were recovered from the samples taken.

In some blocks the feeder ditches bounded three sides, with the cross ditches extending from opposite sides towards a central mound (see below). The feeder ditches must have been connected to channels running either directly from the sea or, more likely from seawater holding ponds fed by the high tides, but no such features were identified on the site. The spacing of the cross ditches within each block was relatively uniform across the site – generally *c.* 7–9 m between the inner edges of adjacent ditches, although this was often narrowed where ditches had been recut on slightly different lines. The relatively few features recorded within the rectangular strips between the ditches, mostly pits, appear not to have been located with reference to the ditches and therefore seem not to be directly associated with them.

Banks

A number of the ditch blocks were clearly bounded by low earth banks, and although these had suffered from levelling, their disposition, particularly in Area A, was highlighted by the topographic survey. The block at the south-west corner of the site, for example, was

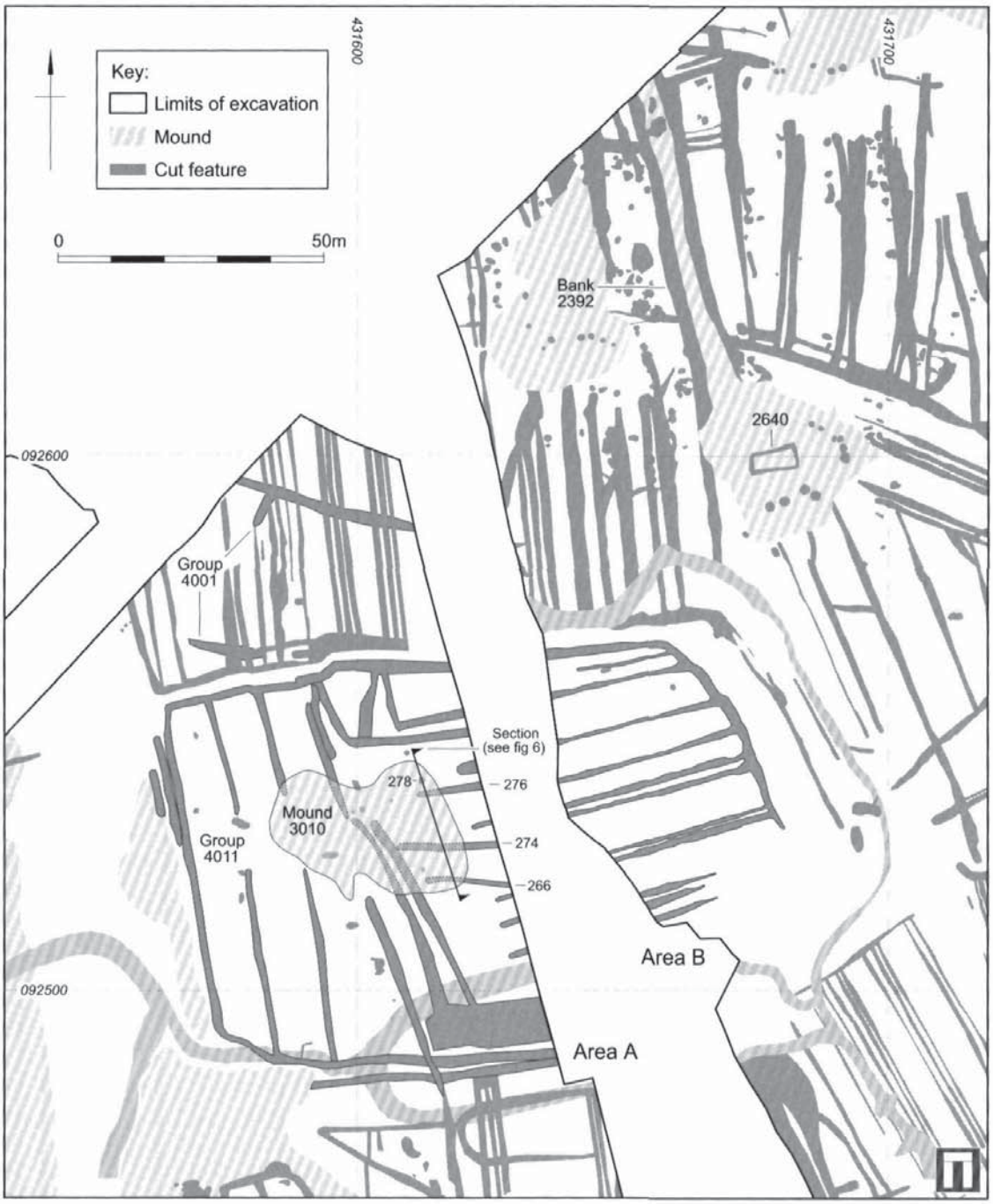

Fig. 5 Detail of Areas A and B including Mound 3010 and adjacent ditch blocks

bounded by banks to the east, north and west (the bund to the south concealed the block's southern extent). While the feeder ditch would have passed through a break in the bank, with water flow possibly controlled by a sluice gate, the breaks identified in these banks during the topographic survey all post-date the abandonment of the salt works.

Such banks may have had a range of functions – defending each ditch block against river flooding or inundation from the sea, providing dry access routes across the salt working area and to the central mounds within the blocks, and also possibly defining the boundaries of individual saltern properties, identifying the block as the basic unit of salt production.

Bank 2392, which ran north from a large earthwork mound in the centre of Area B, was flanked on either side by probable feeder ditches supplying water to the blocks to the east and west, the ditch to the east apparently recut on two occasions. A section excavated close to the mound showed that the bank was built up over a palaeosol cut by the ditches, and comprised varied layers of dumped material surviving to a height of *c.* 0.4 m, including redeposited sandy clay (possibly from the ditch construction) and dark brown silty clay, with small patches of orange heat-affected soil/clay.

Mounds

The mounds were irregular in shape, located either between ditch blocks or in their centres and reached by banks from one side. While some survived as low earthworks, others appear to have been completely levelled during the 19th century conversion of the site to grazing land, although their positions may be deduced from the empty spaces between blocks of ditches, as for instance towards the south-west of Area B (Fig. 2).

The structure of one mound (3010) in the centre of ditch block 4011 was revealed in section (Figs 5–6). This mound may have comprised two phases of construction, since its eastern edge overlay the terminals of cross ditches possibly belonging to a ditch block underlying the bentonite dam. The position of these ditch terminals suggests that the eastern edge of the original mound had lain further west. When the later phase mound was constructed or extended eastwards, these ditches had silted up with black sandy silt to a depth of no more than 0.1 m; they had then been backfilled with grey brown sandy clay containing some gravel, occasional charcoal and flecks of burnt/fired soil/clay. A small pit (278), sealed by a spread of burnt material (342), was also overlain by the later phase mound (Fig. 6).

The later phase mound, as revealed in section, appears initially to have been bounded by a bank or 'kerb' of redeposited sandy clay (337 and 343), possibly derived from the excavation of the group 4011 ditches. This enclosed an area 17 m wide. A further redeposited layer (336) had been dumped against the inner edge of the kerb on the south side of the mound, but across the rest of the base there was a layer, up to 0.3 m thick, of red burnt soil (272), in some places apparently burnt *in situ*, containing frequent burnt pebbles and fragments of charcoal. A concave hollow, 0.5 m in diameter and 0.3 m deep, in the top of this layer was filled with a dump of grey-green clay (341). Overlying the burnt soil was up to 0.6 m of black sandy silt (271), containing charcoal, ash, burnt clay and vitrified soil. This extended over the clay bank and 2–3 m beyond it, giving the mound an overall width of *c.* 25 m; while its edge covered some of the terminals of the block 4011's cross ditches, this may be due to the subsequent levelling and spreading of the mound material.

The three large mounds in the central and northern parts of Area B had been cut into by numerous pits, of varying form and content, some laid out in lines. The investigation of one approximately east-west line of pits, at the western end of the northernmost mound, showed that all were subcircular, between 0.9 m and 1.2 m wide, most having similar profiles with steep sides and a slightly concave base. All had linings of yellow/orange clay, on average 50 mm thick, in most cases extending across the base and up the sides, and they had clearly been used to contain water. Although they ranged from 0.2 m to 0.5 m deep, given

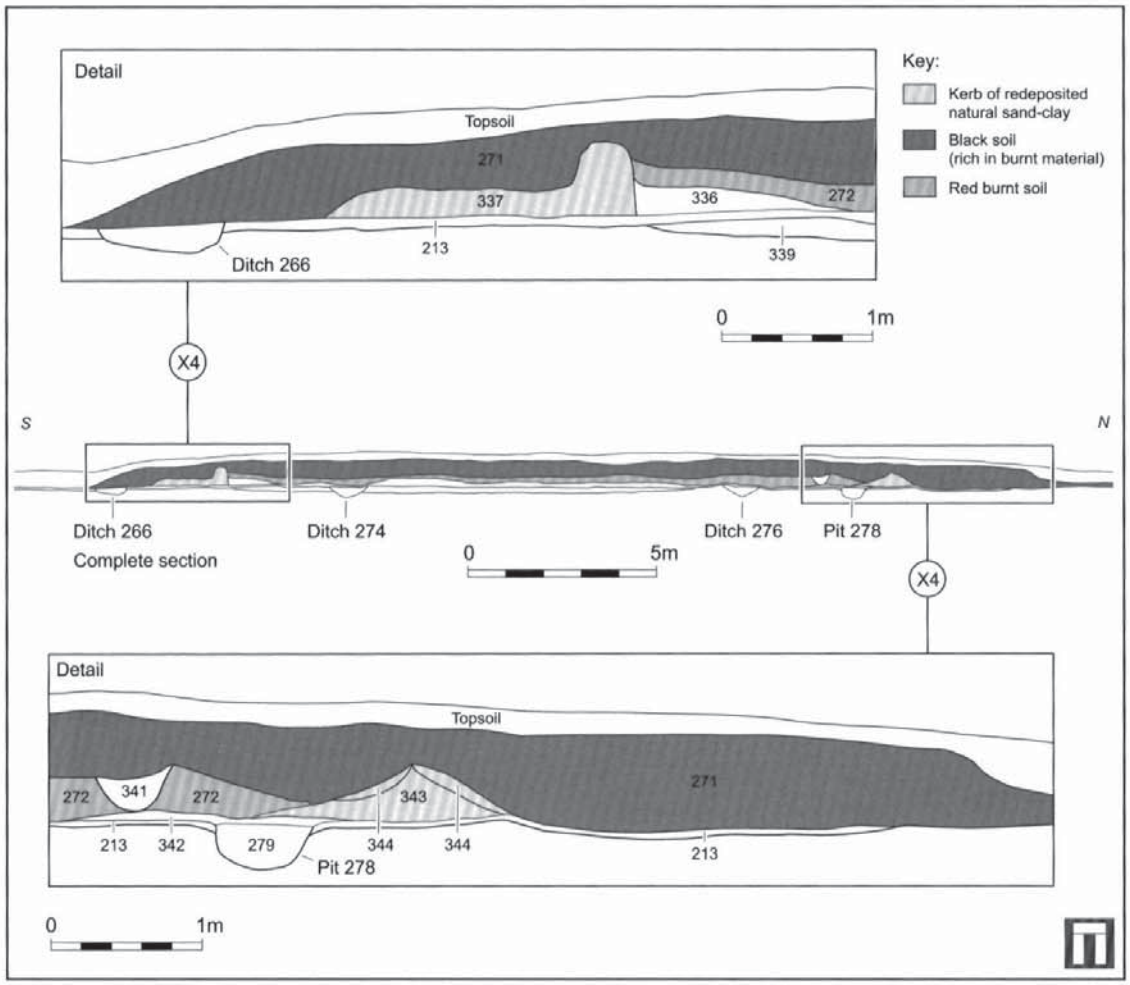

Fig. 6 Section across mound 3010, Area A

the later levelling of the mounds, they may originally have been significantly deeper, and therefore capable of holding a larger volume than their recorded depths would suggest. Some had a thin layer of compact silt on the base, but the main fills in each pit comprised finely laminated dark grey-black silty clay, with occasional inclusions of burnt clay.

These clay-lined pits, possibly used for holding brine, clearly contrast with the groups of undated and unlined pits sited off the mounds (as described above), whose groupings had less linear arrangements.

Rectangular clay-walled structure

A rectangular structure (2640) with an internal floor area of over 20 m² was recorded in the centre of the central mound in Area B, and was the only feature of its kind recorded on the site. It was 9.4 m long and 4.9 m wide externally, with clay walls up to 1m thick surviving to a height of 0.3 m. It was filled with layers of material probably dumped after the feature had gone out of use.

The underlying mound material had been capped by a 60 mm thick layer of grey clay that extended out beyond the walls of the structure.

In the section at the west of the feature this was overlain by a thicker layer of clay that appeared to form a foundation layer for the walls, suggesting that the clay capping may have formed a watertight floor. In the opposite section, however, there were several intervening layers of apparently dumped material, interpreted as part of the mound, between the clay capping layer and the walls, suggesting that there was no functional relationship between them. The nature of this feature is unclear, therefore, although almost certainly associated in some way with the salt making process.

FINDS

Pottery by Grace Perpetua Jones *(medieval pottery identified* by Lorraine Mepham*)*

A total of 327 sherds (3912 gr) of prehistoric, Roman and medieval pottery was recovered. Analysis of fabric and form has followed the standard Wessex Archaeology recording system for pottery (Morris 1994). The assemblage derives from 52 contexts, although only two (context 7143 in ditch 2812 and context 7286 in the gully of roundhouse 7) contained more than 25 sherds, the minimum number considered reliable for an estimation of phase (PCRG 1997, 21). The condition of the material is poor to fair, with post-depositional concretions present on some sherds, particularly those from context 7286. The mean sherd weight is 12 gr. The assemblage has been quantified by period in Table 3.

Table 3 Quantification of pottery by period (number and weight of sherds)

Period	*Number*	*Weight (g)*
?Late Bronze Age	1	15
Late Iron Age	298	3323
Roman	2	104
Medieval	26	470
Totals	327	3912

Fabrics

The late Iron Age fabrics are dominated by sandy wares, which account for 60% of the Iron Age pottery by count and 72% by weight. Sandy ware Q4 is probably a Durotrigian product from the Dorset industries of the Wareham-Poole Harbour region (Cunliffe and Brown 1987, 319), as may Q3. Fabrics dominated by vesicles, presumably from leached out shell, account for a further 19% of the number and 14% of the weight. Some of these additionally contained flint and quartz inclusions. Fabrics occurring less commonly comprise grog-tempered wares (11% by number, 9% by weight), flint-tempered fabrics (9%/5%) and shell-tempered wares (<1%). With the exception of the Q3 and Q4 fabrics, most vessels were probably manufactured locally. The flint-tempered sherds include one of probable late Bronze Age date, but as a group were not chronologically distinctive.

The Roman fabrics comprise single sherds of Oxfordshire mortarium and New Forest parchment ware mortarium. The medieval fabrics are predominantly coarsewares, including south-east Wiltshire/East Dorset Laverstock-type coarseware (some scratched-marked), four sherds of sand/flint-tempered and two sandy ware sherds. All fabrics are quantified by fabric code in Table 4, and detailed in Appendix 1.

Forms

Sixteen rim forms were identified, most represented by single examples, with the exception of the R5, R7, R8 and R11 forms, each with two vessels.

Out-turned or everted rim jars

R2: Jar with high, rounded shoulder and out-turned rim (Fig. 7.1).

R3: Everted rim jar (Fig. 7.2).

Bead-rimmed jars

R1: Bead-rimmed jar (Fig. 7.3).

R4: Necked jar with bead-rim (slightly triangular), broken at neck.

R6: Bead-rimmed jar with high, carinated shoulder (Fig. 7.4).

Table 4 Quantification of pottery fabrics, by number and weight

Fabric	*Number*	*Weight (g)*
Prehistoric fabrics		
F1	26	159
G1	20	168
G2	13	138
Q1	54	219
Q2	34	220
Q3	10	320
Q4	10	137
Q5	69	1499
S99	2	2
V1	37	209
VF1	12	49
VQ1	8	171
VQ2	4	47
Romano-British wares		
E211	1	9
E212	1	95
Medieval wares		
E422	7	168
Q400	13	129
Q401	6	173
Total	327	3912

R14: Small bead-rimmed jar or beaker (Fig. 7.5).

Undifferentiated rim, from barrel-shaped to round-bodied jars

R5: Undifferentiated rim, probably from barrel-shaped/'baggy' jar (Fig. 7.6).

R7: Undifferentiated rim on round-bodied/ovoid jar (Fig. 7.7).

R11: Undifferentiated rim, orientation uncertain.

R15: Possible jar with very slight bead rim, orientation uncertain as too little is present. Alternatively may be a lid.

Jars with flattened beaded rim

R12: Jar with internally-bevelled rim and small bead (Fig. 7.8).

R16: Bead-rimmed jar, flat-topped and channelled rim, internally expanded (Fig. 7.9).

Handled jar

R13: Barrel-shaped jar with slightly out-turned rim and two opposing applied handles (Fig. 7.10).

Miscellaneous jars

R8: Upright-necked jar with everted rim, broken at neck.

R9: Upright-rimmed jar (Fig. 7.11).

R10: Shouldered jar with flat-topped rim. Hint of fingertip impression on rim top (Fig. 7.12).

Two jars with out-turned or everted rims were recorded, one in a sandy fabric (R2, Q4) and one grog-tempered example (R3, G1). Both are of late Iron Age date, although the R3 may extend into the post-conquest period of the 1st century AD. The closest parallels from Hengistbury Head are the JD4.11 jars. Six vessels are characterised by undifferentiated rims, two are barrel-shaped (R5) and two are more round-bodied (R7), however the orientation of two (R11) could not be ascertained due to the small size of the sherds. Three are in vesicular fabric V1, two are made from a sandy ware and one is in a grog-tempered fabric. The form is paralleled in the Hengistbury Head series, JC2.0, which were particularly common in vesicular and grog-tempered fabrics (Cunliffe and Brown 1987, 208).

Four bead-rimmed jars are present, but all representing quite different forms. The R1 is a typical late Iron Age large jar, possibly a storage jar, with a rim diameter of approximately 400 mm. It is paralleled by Hengistbury Head form JC 3.1 and had been made from a fabric now characterised by vesicles and quartz. The form of the R4 could not be ascertained as too little is present, but it has a slightly triangular terminal and is of late Iron Age date, potentially from either side of the conquest. The R6 has a high, carinated shoulder, with well-defined bead and point of carination. Both the R4 and R6 are in sandy fabrics. The R14 is a small jar or beaker form.

The R12 and R16 are both round-bodied

jars with flattened beaded rims, in Durotrigian type fabrics (Q3 and Q4). These are paralleled at Hengistbury Head by form JC4.1, described as a Dorset product, part of the Durotrigian assemblage, dated 50 BC-AD 50 (Cunliffe and Brown 1987, 209). Also typical of the Durotrigian ceramics are jars of rounded profile and elongated, lipped rim, sometimes handled (Cunliffe and Brown 1987, JD4.41, 50 BC-AD 50), one example of which was present at Efford (R13, Fig. 7.10), although the fabric is not a Durotrigian one.

The miscellaneous jars (R8, R9 and R10) were too incomplete or undiagnostic to identify parallels, however a hint of a fingertip impression on the top of the flint-tempered R10 suggests a possible late Bronze Age date. This vessel was recovered from tree-throw 7281 which was cut by the gully of roundhouse 7 and therefore this date is entirely possible.

Discussion

The earliest pottery from the site is a single flint-tempered rim, probably of late Bronze Age date, from tree-throw 7281, however most of the prehistoric assemblage is of late Iron Age date. It derives predominantly, but not exclusively, from excavation Area C where the Iron Age features and buildings were recorded. Diagnostic forms and fabrics suggest either local manufacture or Durotrigian products brought in from the Wareham to Poole Harbour region of Dorset. Typical forms include the jars with flattened beaded rims (Efford R12, R16) which probably derive from middle Iron Age types (Cunliffe and Brown 1987, 319) and the handled jar (Efford R13), although the fabric of the Efford example appears to be slightly earlier in date, possibly dating from the 2nd to 1st century BC. The jar was recovered from the gully terminal of roundhouse 7.

With the exception of the deposition of much of this handled jar in the terminal of the gully of roundhouse 7, the remaining Iron Age pottery was spread across the site in small groups. Assemblages of 29 sherds or less were recovered from the gullies of roundhouses 2, 3, 7 and 9. Assemblages of a similar size were present in clay-lined pits 2102, 2999, 7301, 2798 and 2732, located in and around roundhouses 6, 7 and 8.

Only two sherds of Roman pottery were recovered, both from late Roman mortaria. The medieval material is of 12th to 13th century date and derives from most of the areas investigated. Most of the sherds are in sandy/flint-tempered coarsewares, although slightly finer, sandy variants include two jug rims. The coarsewares include Laverstock-type ware from south-east Wiltshire/East Dorset.

List of illustrated late Iron Age sherds (Fig. 7)

1 Round-shouldered jar with out-turned rim (R2), Q4 (fabric), PRN (Pottery Record Number) 3, context 2812, ditch 2812
2 Everted rim jar (R3), G1, PRN 20, context 2961, ditch 2757
3 Large bead-rimmed jar (R1), VQ1, PRN 2, context 2812, ditch 2812
4 Bead-rimmed jar with high, carinated shoulder (R6), Q1, PRN 37, context 7143, ditch 2812
5 Small bead-rimmed jar or beaker (R14), G2, PRN 81, context 800, gully of roundhouse 3
6 Small barrel-shaped jar with undifferentiated rim (R5), V1, PRN 31, context 7042, gully 2777, roundhouse 6
7 Round-bodied/ovoid jar with undifferentiated rim (R7), Q2, PRN 38, context 7159, gully 7252, roundhouse 9
8 Jar with internally-bevelled rim and small bead (R12), Q3, PRN 62, context 7324, gully of roundhouse 9
9 Bead-rimmed jar with flat-topped and channelled rim, internally expanded (R16), Q4, PRN 84, context 808, gully of roundhouse 4
10 Barrel-shaped jar with slightly out-turned rim and two opposing applied handles (R13), Q5, PRN 69, context 7286, gully of roundhouse 7
11 Upright-rimmed jar (R9), VQ1, PRN 42, context 7196, gully 7253, roundhouse 9
12 Shouldered jar with flat-topped rim and possible fingertip impression (R10), F1, PRN 52, context 7282, tree-throw 7281

Fired clay by Grace Perpetua Jones and Kayt Brown

A total of 997 fragments of fired clay, weighing 11761 gr, was recovered from 105 contexts

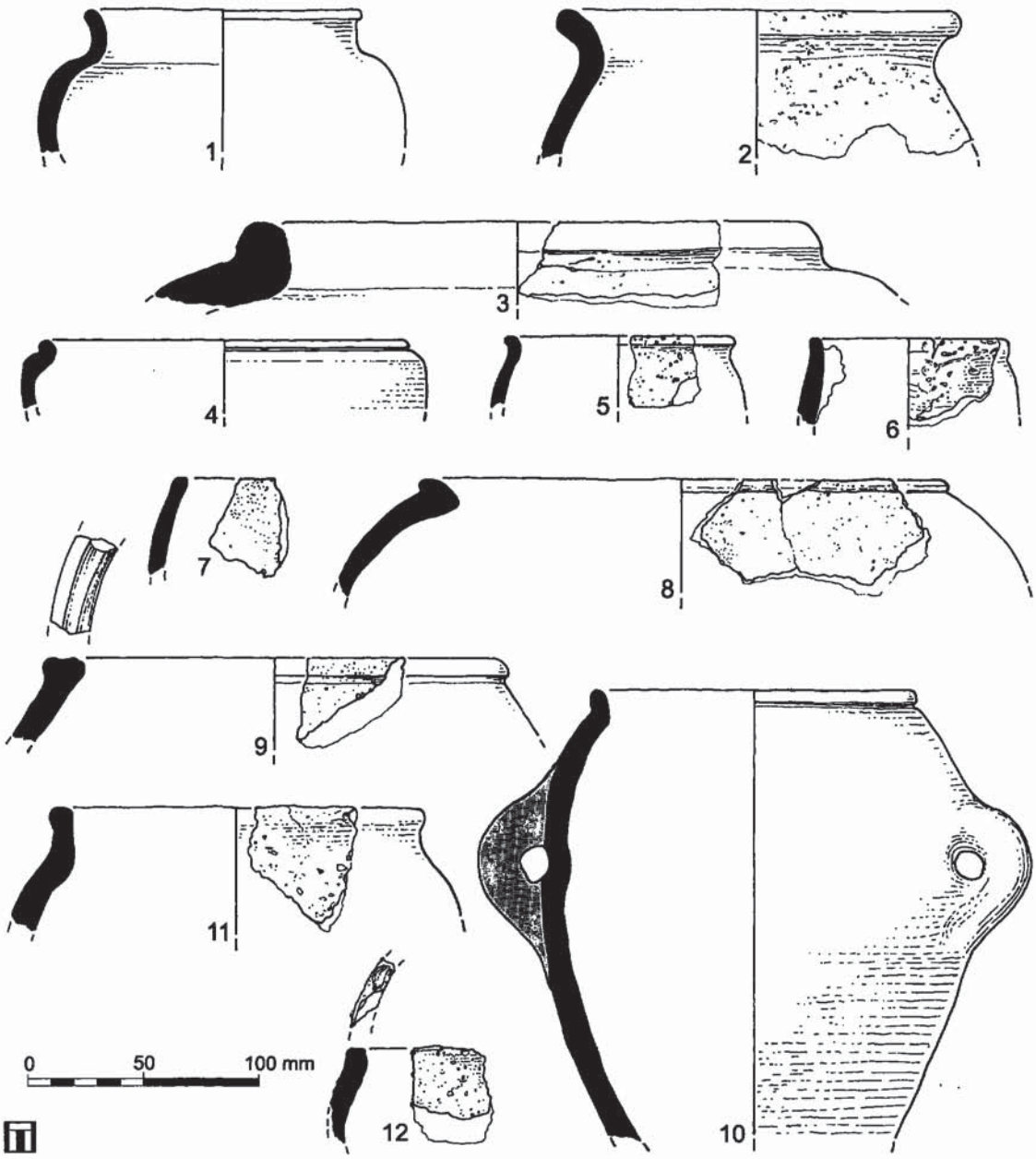

Fig. 7 Iron Age pottery

across the site, all but 65 fragments (370 gr) deriving from features in Area C. A further 1562 gr of burnt loam identified from environmental samples represents evidence for heating, presumably during salt production, creating light-weight, vesicular nodules.

Approximately one third of the fired clay assemblage, by weight, could not be identified, consisting of amorphous lumps, usually devoid of surfaces or any diagnostic traits. Another third consists of fragments from fired clay slabs. These were usually constructed from poorly wedged fabric FC V1 (Appendix 1). The upper surface of these objects is usually buff, orange or yellowish brown, often with a relatively smooth surface, almost a slurry finish. The underside is more rough and less oxidised, usually grey with areas of buff or brown. Most are around 35 mm in thickness, however no complete slabs were present and the length and width of these objects is unknown. They are usually uneven, often appearing slightly warped. One slab, from context 800 (gully of roundhouse 3), is unique in that 13 circular impressions were present on the upper surface, penetrating it by 5 mm (Fig. 8.11). They had been made prior to firing, probably with a stick. At 115 mm x 100 mm x 43 mm it was the largest slab present in the assemblage, although three fragments from ditch 2727 (context 7326) joined to form a piece 155 mm x 165 mm x 35 mm. It is unclear whether or not these clay slabs were used in salt production or utilised in a domestic context.

A small assemblage of briquetage, characterised by its organic tempering and discoloured surfaces (resulting from contact with salt), included rim fragments which are often irregular in shape, the size and orientation of which could not easily be ascertained (Fig. 8.1–5). The rims measured between 8 mm and 11 mm in thickness and all occurred in organic-tempered fabric FC V2. Two rim sherds, shouldered vessels with upright rims, both from context 7286, are quite distinct forms; although the late Iron Age assemblage from Wytch Farm includes illustrated vessels which hint at possible similar rounded forms (Cleal 1991, fig. 64, nos 13 and 18), none are directly comparable. The larger of these Efford rims (Fig. 8.2) may be a more exaggerated version of a trough form with moulded rim as identified at Danebury (Poole 1991 fig. 7.68.31), whilst the smaller version may represent a small container, perhaps for the transport of the finished product (Fig. 8.3). The use of domestic vessels as drying moulds has been proposed at the middle Iron Age site at Mill Hill, Sussex (Bradley 1992, 43) so perhaps it is not implausible that a similar practice could have occurred at Efford. Two other briquetage rims (contexts 7229 and 2923, Fig. 8.5 and 8.4 respectively) are again comparable to fragments from Wytch Farm (Cleal 1991, fig. 64.4) and Danebury (Poole 1991 fig. 7.68.31).

Briquetage container body fragments were generally flat, approximately 6–8 mm thick, with buff or orange/yellow brown surfaces, sometimes with unoxidised interiors, and some with pink/grey/white colours associated with salt contact. A number of fragments from context 7250 could be re-joined (Fig. 8.10), comprising the base of a thin walled vessel with flaring base. Two wedge-shaped fragments (context 7321, 7285) may also be associated with salt production (Riehm 1961, 188).

The use of triangular loomweights was indicated by the presence of three fragments, each with a perforation across the corner measuring approximately 15 mm in diameter (Fig. 8.7–9). Two other clay objects, of unknown function, comprised rounded fragments with an incomplete central perforation (contexts 2917 and 7261).

List of illustrated fired clay (Fig. 8)

1 Briquetage rim, context 2991, gully 7252, roundhouse 9
2 Briquetage rim, context 7286, gully of roundhouse 7
3 Briquetage rim, context 7286, gully of roundhouse 7
4 Briquetage rim, context 2923, gully 7252, roundhouse 9
5 Briquetage rim, context 7229, gully of roundhouse 9
6 Fired clay object, context 2861, ditch 2727
7 Loomweight fragment, context 7286, gully of roundhouse 7
8 Loomweight fragment, context 2969, gully 7253, roundhouse 9

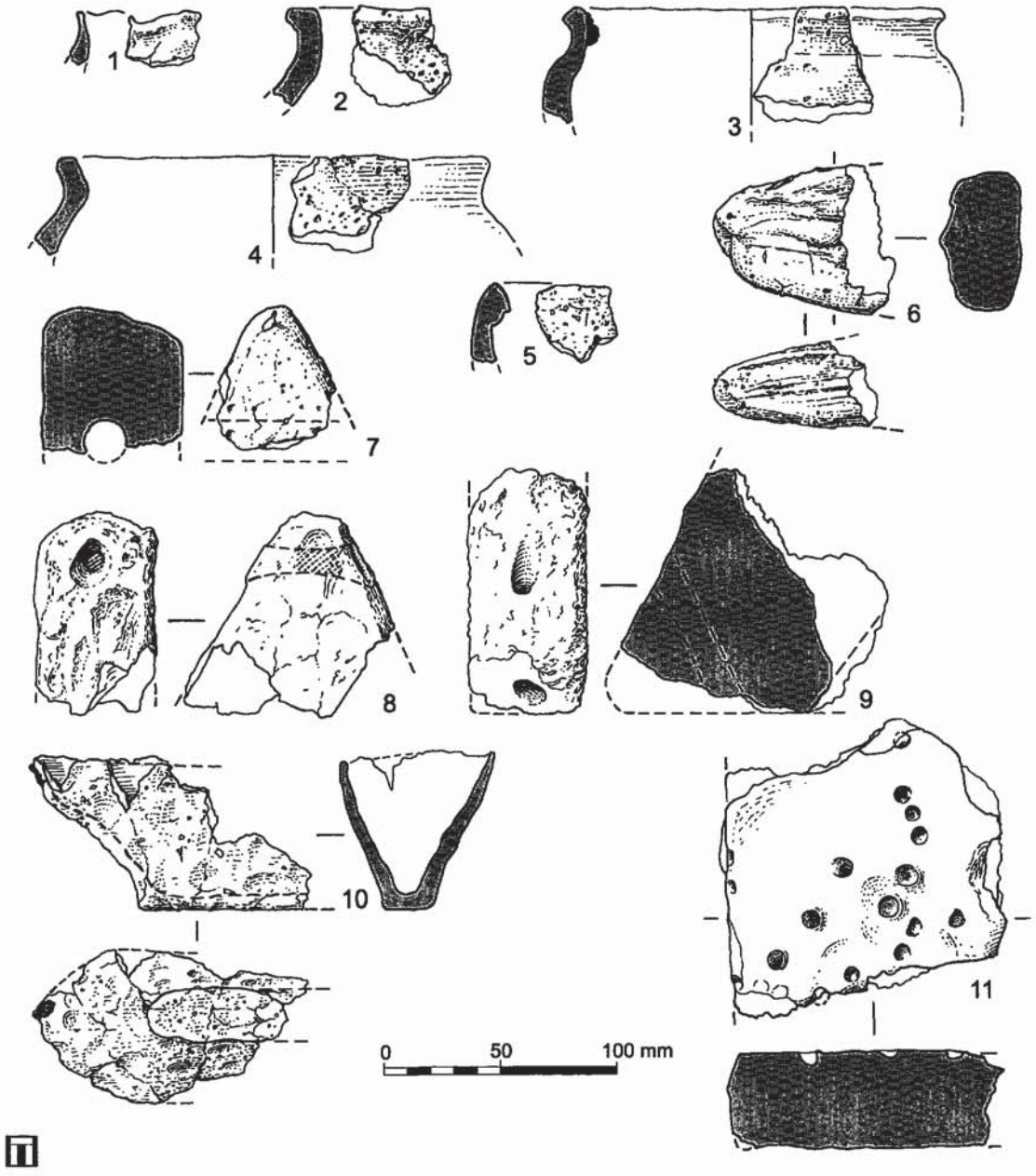

Fig. 8 Fired clay and briquetage

9 Loomweight fragment, context 7285, gully of roundhouse 10

10 Salt container body, context 7250, pit 7249

11 Fired clay slab, context 800, gully of roundhouse 3

Table 5 Plant remains and charcoal from pit 7313

	Context	*7311*	*7312*
	Sample	*63*	*64*
	Sample volume (l)	*10*	*10*
Charred plant remains			
Atriplex sp.	Orache	–	1
Chenopodiaceae		–	2
Stellaria media (L.) Vill.	Chickweed	–	1
Rumex sp.	Docks	–	1
Fallopia convolvulus (L.) A. Love	Black bindweed	–	1
Corylus avellana	Hazel nut shell fragment	1	–
Calluna vulgaris (L.) Hull	Heather seed capsule	–	2
Galium aparine L.	Goosegrass/cleavers	1	1
Rubus fruticosus L. agg.	Bramble/blackberry	–	–
Eleocharis palustris (L.) Roem. & Schult.	Common spikerush	–	1
Carex sp. 3 sided	Sedges	–	5
Carex sp. 2 sided	Sedges	–	2
Unidentified seed		–	2
Cyperaceae rhizome		1	–
Monocotyledon rhizomes		–	7
Poaceae culm node		–	1
Culm lengths		–	+
Roots/stem lengths		+++	++
Charcoal			
Volume of charcoal >2mm (ml)		16	20
Cf. *Ulmus* sp.	Elm	1	–
Quercus sp.	Oak	35	90
Quercus sp. Heartwood	Oak	7	–
cf *Quercus* sp.	cf. oak	2	–
Pomoideae	Apple/Pear/whitebeams	–	9
Prunus spinosa L.	Sloe/blackthorn	2	–
Prunus spinosa L. heartwood	Sloe/blackthorn	–	1
Indet		3	–
Total no. identified fragments		50	100
% of assemblage identified by volume		50	59
?Waterlogged			
Ranunculus acris/repens/bulbosus L.	Buttercup	–	1
Atriplex sp.	Orache	–	3
Chenopodium album L.	Fat hen	–	6
Rumex acetosella L. agg	Sheep's sorrel	–	1
cf. *Rumex* sp.	Docks	–	2
Rubus fruticosus L. agg.	Bramble/blackberry etc	–	2
Anthemis cotula L.	Stinking mayweed	–	4
Potamogeton sp.	Pondweed	–	2
Carex sp.	Sedges	–	1

Other finds by Lorraine Mepham

Almost all the burnt, unworked flint (over 99 kg) came from Area C, where the associated pottery suggests a late Iron Age date. The bulk of it came from a single feature – 76 kg from ditch 2727, and only two other contexts produced more than 1 kg (7143 in ditch 2812 and 2998 in pear-shaped feature 2997). Its association with briquetage in ditch 2727 and feature 2997 suggests it was used in salt production.

Other material types were represented in much smaller quantities. They include seven pieces of undiagnostic worked flint, a Roman silver coin (republican denarius, unstratified); 13 fragments (3 gr) of unidentifiable animal bone, a post-medieval iron horseshoe, three fragments of lead (unstratified) and modern brick.

ENVIRONMENTAL EVIDENCE

By Ruth Pelling with Chris J. Stevens

The changing pattern of settlement and industrial activity at Efford must be closely related to the local patterns of coastal change, with the expansion of salt marshes as the coastline moved southwards. Likewise the long tradition of salt making, which became increasingly industrialised over time, may have had a significant impact on the local vegetation, particularly in relation to fuel usage. The aim of the sampling was to attempt to retrieve evidence for the arable economy at the site as well as other evidence for plant use and in particular changing fuel patterns over time. Changes in fuel use may be related to changing industrial or semi-industrial activities or may be related to changing vegetation and fuel availability. This evidence was supplemented by sediment descriptions.

Environmental samples were taken from a range of feature types and processed for the recovery and assessment of charred plant remains and charcoal. These included 40 bulk samples of generally 10 litres; one sample of 140 litres from ditch 2727 was artefact sieved (4 mm) for charcoal. Siliceous material was noted in all the samples suggesting some sort of industrial residue, and flots were therefore tested for the presence of iron working residues and hammerscale with a magnet. The bulk samples were supplemented by two monoliths, two soil samples and one kubiena taken for the analysis of sediments.

Methods

The bulk samples were processed by standard flotation methods; the flot retained on a 0.5/0.25 mm mesh and the residues fractionated into 5.6 mm, 2 mm and 1 mm and 0.5 mm fractions and dried. The coarse fractions (>5.6 mm) were sorted, weighed and discarded. The flots were scanned under a x10 – x30 stereo-binocular microscope and presence of charred remains quantified (assessment table, in archive), to record the preservation and nature of the charred plant and charcoal remains. In the majority of samples charred plant remains other than charcoal were found to be limited and sufficient detail was recorded during the assessment to characterise the flots, forming the basis of the following discussion.

Two samples from pit 7313 (initially interpreted as of possible late Iron Age date) were selected for detailed analysis of charcoal and any other macrofossils present (Table 5). This feature was within one of the groups of otherwise undated pits within the later ditch system in Area B, which were problematic in terms of their interpretation. All charcoal fragments retained in the 2 mm and larger sieves were extracted from the flots. Up to 100 fragments of charcoal were then selected from each sample for identification. The extracted charcoal fragments were prepared for identification according to the standard methodology of Leney and Casteel (1975, see also Gale and Cutler 2000). Identification was undertaken according to the anatomical characteristics described by Schweingruber (1990). Identification was to the highest taxonomic level possible, usually that of genus, and nomenclature is according to Stace (1997).

Results

The flots were generally small to moderate in

size (up to 60 ml from a 10 litre sample). Many consisted almost entirely of rooty material (80–90%) and low numbers of weed seeds which were not charred and may therefore be indicative of stratigraphic movement. Silicaceous material and small lumps of burnt fine grained mineral material were present in all samples.

Evidence for cereals was recovered from two Iron Age samples: pit 7301 (pit group 2) produced a single glume base of probable emmer wheat (*Triticum dicoccum*), and the gully of roundhouse 2 (section 7283, context 7286) produced a single rachis of barley (*Hordeum vulgare*). A small number of weed seeds was also recovered from the pit, including sedges (*Carex* sp.), common spikerush (*Eleocharis palustris* type) and knotgrass (*Polygonum aviculare*). Charred cereal remains are most frequently a product of the regular processing of cereals as they are taken from storage and the waste thrown upon hearths or fires. The absence of such remains probably indicates that the inhabitants of the site did not process grain upon the site or that any cereals brought to the site may have arrived already processed as flour, bread or beer. Alternatively, processing waste may have been used for other purposes, or the occupation of the site may have been of such short duration that few remains were produced or survived.

Several of the samples did produce remains of grass or sedge stems, as well as a few seeds, mainly of wetland species such as sedge (*Carex* sp.), spikerush (*Eleocharis palustris*) and blinks (*Montia fontana* ssp. *chondrosperma*). Other species were also occasionally present such as knotgrass (*Polygonum aviculare*), black bindweed (*Fallopia convolvulus*), cleavers (*Galium aparine*) and docks (*Rumex* sp.). These were commonest from the samples in pit 7313 (see below).

While generally scarce, charcoal occurred in high quantities in occasional samples. Round wood and stems were present in several samples, for example possible Iron Age ditch 2812, undated pit 7313 and two probable post-medieval pits (2522 and 2524) in the group south of rectangular structure 2640. The samples from ditch 2727 conversely contained charcoal but little round wood; that from context 2861 produced some 800 mls of material sieved through a 4 mm mesh from 140 litres.

Pit 7313

Two samples from pit 7313 (contexts 7311 and 7312), which was initially considered to be of possible Iron Age date, were examined in more detail (Table 5). Each flot was generated from 10 litres of deposit, producing 500 ml and 350 ml of material respectively. The flots consisted of charcoal, stem or root material and large quantities of both silicaceous material and lumps of apparently burnt, fine sediment with occasional larger sand inclusions. The charcoal in both samples was dominated by *Quercus* sp. (oak) including fragments containing tyloses indicative of heartwood. Fragments of Pomoideae (apple/pear/whitebeam etc) and *Prunus spinosa* (blackthorn/sloe) were also present and a single fragment tentatively identified as *Ulmus* sp. (elm). This range of mixed tree taxa is likely to reflect local mixed vegetation rather than any deliberate targeting of species.

Of more interest was a number of convoluted roots or stems, and the rhizomes and tubers of monocotyledons such as grasses or sedges. While the species of these items were not determined, they are indicative of uprooted grasses and shrubs. Two seed capsules identified as *Calluna vulgaris* (heather) in context 7312 provide some indication of possible species for the woody root and stem material. This context also produced a number of trigonus seeds of *Carex* sp. (sedges) including two preserved as silica skeletons, as well as seeds of *Eleocharis palustris* (common spikerush), *Rubus fruticosus* (bramble/blackberry), *Rumex* sp. (docks), *Fallopia convolvulus* (black bindweed), *Atriplex* sp. (orache) and indeterminate Chenopodiaceae.

This assemblage also includes seeds of wet ground or marshy conditions (*Carex* sp. and *Eleocharis*) as well as species more characteristic of disturbed ruderal habitats. A fragment of *Corylus avellana* (hazel) nut shell was present in context 7311. A small number of possible waterlogged seeds present in context 7312 included a range of possible wet or marshy

ground species such as *Ranunculus acris/repens/bulbosus* (buttercup) and *Carex* sp. (sedges), or species of disturbed ground such as *Atriplex* so. (orache), *Rumex acetosella* (sheep's sorrel) and *Rubus fruticosus* (bramble). A seed of *Potamogeton* (pondweed) suggests open water.

Context 7312 also contained four seeds of *Anthemis cotula* (stinking mayweed) which are slightly anomalous within the assemblage in that this species is closely associated with arable fields and cereal cultivation of the Romano-British and medieval periods. While its occurrence in a late Iron Age context is possible this would be more likely to occur on a site with better evidence for arable agriculture. Given the absence of Romano-British deposits on this site the presence of this species therefore hints at a medieval rather than Iron Age date for this feature.

Conclusions

Despite the archaeological evidence for Iron Age activity at the site, the bulk samples produced little evidence for cereal remains beyond rare individual items of glume bases, rachis or arable weed seeds. The fact that these remains are present at all suggests some cereal-related activity although clearly on a small scale, with cereals possibly brought onto the site as flour or even bread. This may reflect the predominantly industrial, rather than domestic, nature of the site.

The charred remains from the pit 7313 are interpreted as being related to fuel use rather than burnt domestic refuse, including charcoal but also possibly peat or heather burning suggested by seed capsules of heather. If mature heather was uprooted rather than cut it is likely that it would include sedges and/or grasses or other heathland species growing around it. The roots and thick stem fragments have not been positively identified but are thought to include more than one species, which may include heather (*Calluna vulgaris*). The silicaeous material and burnt amorphous material may represent silty peat deposits uprooted with the heather. While heather is relatively frequently identified from archaeological sites (e.g. Murphy 1995) the association of the thicker roots or stems and amorphous burnt and silicaceaous material is more unusual. Similar deposits were recovered from excavations on the Isle of Barra (Wessex Archaeology 2008) consisting of burnt soil, stems and seeds of sedges which were interpreted as burnt turves. The mix of fuel types (wood charcoal and peat/heather) may be indicative of secondary refuse rather than primary fuel, or it may represent a low grade industrial process involving whatever fuel was easily available.

The paucity of charred remains and charcoal probably reflects the nature of activity on the site rather than poor preservation. On a salt working site of this kind, the dark colours in the samples may indicate the use of materials other than wood for heating seawater. For instance, peat would leave few large fragments, and coal (imported for the post-medieval saltworks) would not be recorded in the flots. The 'slag'-like concretions recorded during the assessment (in archive), which are the same as the burnt amorphous material present in pit 7131, are a by-product of heating and burning but do not represent coal or the burning of peat, or industrial processing of metals (i.e. slag). Nor has it been determined whether they represent the burning of elements occurring naturally in the local highly oxidised and gleyed soil, in the soils uprooted with the heath, or from salt making.

DISCUSSION

Salt making

British coastal seawater consists of *c.* 3.5% by weight of salt, and in order to extract that salt the water has to be evaporated off. The history of coastal salt making in Britain, from prehistory through to the modern period, reveals the different means by which salt was extracted from sea water with ever greater efficiency, by harnessing a combination of natural and industrial processes.

Two main methods have been used to concentrate brine (Gilman 1998). One is to 'wash'

the salt from sand (and/or silt) collected from the shore; the salt becomes impregnated in the sand during the high tides, and dried and concentrated by the sun and wind. This method of sand washing, sometimes referred to in the medieval period as 'sleeching' or 'muldefang', involved skimming off a thin layer of sand, and trickling water through it in a trench filled with turfs, straw or reeds to act as a filter (Sturman 1984). The filter retains the sand, while the brine passes through and is collected. A characteristic feature of this process are large mounds consisting mainly of the discarded, washed sand.

The other method of producing brine is to use solar evaporation in 'salt pans', some times called 'sun works', a method described by Georgius Agricola in the 16th century and represented in rather idealised illustrations (Agricola 1556). Seawater, collected in ponds at the spring tides, is fed into a series of wide shallow basins in which the salt content gradually increases as the water evaporates. Archaeological evidence for salterns using this method may include the remains of the holding ponds, the ditches or channels that fed the seawater to the pans, and the pans themselves, although their shallow constructions makes the latter vulnerable to subsequent ploughing. While such methods were common in warmer climates from antiquity, there is no clear evidence that they were used in Britain until the post-medieval period.

Once the brine had been produced, by whatever method, the concentrate needed to be further condensed and dried in vessels over hearths, fuelled by wood or peat, and latterly coal. This was a process common to both prehistoric and historic salt production, indicated by the evidence of burning in the form of charcoal and burnt soil, although the nature of the vessels and the form of the hearths changed over time.

Iron Age

The Iron Age settlement occupied relatively dry land on the edge of the salt marsh which consisted of fine silts and mud supporting stands of grasses and reeds and bisected by deeper flowing channels – an environment similar to that in the present Keyhaven Harbour. However, its low-lying and exposed position is likely to have made it unsuitable for year-round settlement and it is possible that it was occupied only on a seasonal basis, as part of a cycle of agricultural and other economic activities. Evidence for seasonal coastal settlement in the Iron Age has been found on the Avon Levels in Somerset, based on the transhumant exploitation of coastal grazing, and characterised in part by the repeated renovation of roundhouses (Gardiner *et al.* 2002). Certainly the summer months would have offered the best time for both making salt and for grazing livestock on the coastal marshes (Bradley 1975), and there is considerable evidence for Iron Age salt making along the Hampshire coast, such as in Langstone and Chichester Harbours (Fox 1933; Bradley 1992; Allen and Gardiner 2000).

Although the roundhouses on the site were close together, none of them overlapped and it is possible that they represent a single substantial contemporary settlement, with evidence of the rebuilding indicating their reoccupation over a number of years. Whether they were all domestic structures is unclear, however; while some had entrances facing between east and south, two (roundhouses 2 and 10) had opposed entrances, and roundhouse 5 faced north-west – unusual for a domestic structure.

Despite the density of roundhouses, however, the site produced very low levels of domestic refuse, the finds consisting mainly of pottery, either locally produced or imported from the Wareham to Poole Harbour region of Dorset, fired clay and burnt flint. While the presence of a number of loomweight fragments within the fired clay assemblage points to a domestic craft activity of the type normally associated with Iron Age settlements, the almost total absence of animal bones (one context) and crop remains (two contexts) makes it difficult to determine the wider economic basis of the settlement.

As discussed above, there is doubt as to the identification of clay-lined pits in the Iron Age

settlement. Even if some were genuinely clay-lined, their possible role within the salt making process is unclear, although they may have been used for holding water, possibly brine. There are no indications, however, as to how brine might have been concentrated. Much of the fired clay from the site was fragmentary in nature, although the identification of some pieces from flattish briquetage blocks/slabs and rods indicates that water was boiled off the brine in fired clay containers. However, no hearths, either domestic or salt making, were identified, and while the burnt flint may have been a product of the brine boiling process, only four contexts produced more than 1 kg; the 76 kg recovered from the upper fill of ditch 2727 was clearly redeposited. The production of salt, therefore, may have been undertaken away from the settlement focus with distinct areas of industrial and settlement activity shifting over time. Although the pits were found close to the roundhouses they need not have been directly associated with them, the different pit groups being found both inside, outside and cut by the roundhouse gullies.

Late Iron Age salt making at Lymington is likely to have been combined with other economic and agricultural activities, the number of roundhouses alone suggesting that the seasonal occupation of this coastal landscape for possibly varied activities was one that made sound economic sense. Salt making was a potentially lucrative industry, and as briquetage is found on sites far inland from the coast, the identification of briquetage vessels used for transporting salt may indicate this site's involvement in long distant exchange and trade. The recovery, albeit unstratified, of a Roman republican silver *denarius* is a hint at the potential wealth that this trade may have generated.

A likely social context for such activity is the multivallate fort at Buckland Rings 4km north to the north, which dates from the 4th century BC to the 1st century AD (Hawkes 1936). There was another, smaller earthwork, also possibly Iron Age, at Ampress Hole, just east of the fort beside the junction of Passford Water and Lymington River (Thames Valley Archaeological Services 2001), while to the north-east at Exbury there was a promontory fort on the Beaulieu River (Sumner 1917, 119). The univallate fort at Tournerbury on Hayling Island is in a similar location (Bradley and Fulford 1975), and although such fortified sites are relatively rare in lowland areas they may have been established to control the exploitation of the rich coastal and estuarine resources in the area, including salt.

Medieval and post-medieval

There are references in the Domesday Book of 1086 to salterns at 12 manors in Hampshire, including six at Hordle, just west of Lymington. The earliest reference to salt making at Lymington, however, concerned the grant of a tithe of Lymington salt to Quarr Abbey on the Isle of Wight in 1132, which fits well with the 12th–13th century date range for the pottery from the site. It is suggested that the Lymington industry may already have been well established by that date (Lloyd 1967).

Such early references, however, give few clues as the method of salt production in the medieval period, although there are indications from both Sussex and Dorset (and further afield) that sand washing (as described above) was the standard method (Holden and Hudson 1981, 123; Keen 1987). Moreover, early maps of Hampshire, such as Norden's map of 1595, show the Lymington coastline dotted with substantial mounds, which may be a representation of the characteristic feature of this method (Fig. 9). Although Rudkin (1975, 39) refers to sun works having been used at Lymington since the 13th century, references to medieval 'salt-pans' (the normal translation of medieval Latin *salina*) may denote salt works in general, rather than specifically the use of floor pans. (Some confusion can be caused by the fact that the term 'pan' is used, variously, to refer not only to salt works in general, but also, more specifically, to salterns using floor pans to concentrate the brine; it is also used to denote the individual shallow ponds within such salterns, as well as the lead, and later iron, vessels used for boiling the

Fig. 9 Detail of John Norden's 1595 map of Hampshire (reproduced with permission of Hampshire County Council Museum Service)

brine). Although a tentative medieval date has been suggested for pit 7313 on the basis of the environmental evidence, the function of such features is unclear.

Following a decline in the 14th century, salt production at Lymington was boosted at the beginning of the 17th century by the granting of a patent by James I 'for the new invention of making white and bay salt', and in 1625 all the mudlands on the coast at Lymington were granted to the salt trade. However, these new methods required major structural alterations (VCHH, 470), and there were protests by 14 Lymington saltern owners against an order requiring them to replace their mounds with floor pans. This, too, implies that sand washing, a process resulting in the creation of mounds, had been the main method employed up to that date. Maps dating to the end of the 17th century, however, indicate the new form of the salterns, that of 1698 by Dummer and Wiltshaw (Lloyd 1967, plate 4), for example, showing an array of large rectangular 'salt panns' stretching along the shore west from the Lymington River, interspersed with wind pumps and buildings – probably boiling houses.

The central questions to be answered about the features identified in Areas A and B, therefore, are: what was their function and where do they fit within the development of the Lymington salt industry? The medieval pottery (the only datable finds from these features) and the presence of low earth mounds might suggest an early date, but the grid-like arrangement of ditches within larger blocks appear closer in form to the descriptions of the 17th century and later salt works. However, there have been no excavations of this type of site within Hampshire, and none of the few saltern sites excavated elsewhere in the country display

this layout (e.g. Hall and Coles 1994; Healey 1975; Holden and Hudson 1981; Barford 1988, McAvoy 1994; Gilman 1998; Ridgeway 2000).

In 1879, Edward King reported that the marshes, by degrees, had been more or less levelled and the salt making ponds filled up, so as to render land useful for grazing (King 1879), and the 1846 Sheringham chart shows the whole site, and the land between it and the shore as rough grazing land drained by a wide ditch running from the north of the site to the sea. However, as any early sand washing mounds may already have been largely levelled as a requirement of the early 17th century developments, the low mounds recorded during the excavation may be the remains not of medieval mounds but of raised areas (possibly reusing material from the earlier mounds) constructed for the siting either of the hearths used for boiling the brine, or of the wind pumps used for pumping the brine to the boiling houses. The windmill mounds are reported as being 30 feet across (*c.* 9 m) across and 5 feet high (*c.* 1.5 m); the windmills were demolished in 1873 (Lloyd 1967, 97).

The bank or kerb underlying the mound in Area A, which was built (or at least extended) after a period of use of one of the ditch blocks, may have been designed to keep water out of a central dry area, and the thick layer of red burnt soil inside the bank, in places burnt *in situ*, indicates that this space was probably the site of hearths. The overlying mound material, comprising a thick layer of black sandy silt containing charcoal, ash and burnt clay, may represent a mix of hearth debris and material intermittently cleared out of the surrounding ditches, with whose fills it was similar in appearance.

A detailed account of the Lymington salterns around 1700 was provided by Celia Fiennes in *Through England on a Side Saddle in the Time of William and Mary* (Morris 1949), in which she described how 'Ye seawater they draw into the trenches and so into severall ponds, yt are secured in ye bottom to retain it and it standeth for ye sun to exhale ye watry fresh part of it and if it prove a dry summer they make the best and most salt for ye raine spoyles ye ponds by weakening ye salt. When they think its fit to boyle they draw off water from ye ponds by pipes ... '. A 1784 drawing by Thomas Rowlandson shows a regular patchwork of square floor pans, each bounded by low banks, the wider area dotted with the windmills (Wark 1963).

Unfortunately, the cartographic evidence for the extent of the post-medieval salterns at Lymington, which has a bearing on the date of excavated features, is ambiguous. A 1781 chart by Lt. Murdoch MacKenzie places most of the site outside (northwest of) the salterns, although the precise location of the salterns' landward boundary would not have been important in a naval chart focussing on the navigation of the Solent. In contrast, the 1st Series Ordnance Survey map of 1811 (Fig. 10), which shows the salterns as a regular grid pattern that appears to cover almost all of the site, contains clear inaccuracies and surveying errors.

There are a number of contemporary descriptions of the final phase of the Lymington salt works. In 1813, when there were 68 'pans' in the Lymington and Pennington salterns (Lloyd 1965), Charles St. Barbe, the principal owner of the Lymington salterns, wrote 'The sea water is first admitted into feeding ponds, from whence it flows into levels, in which there are partitions, forming pans, as they are called .... these receive the sea water from the feeding ponds to a depth of about 3 inches (*c.* 8 cm), and from which it passes from the higher to the lower pans, exposed to the action of the sun and the wind, until the brine becomes of a sufficient strength to be pumped up by small wind engines into a cistern, whence it is conveyed by troughs into respective iron pans for boiling' (Vancouver 1813, 420).

Further details were provided by Loudon (1825, 562–3): 'At Lymington, in Hampshire, sea water is evaporated to one sixth of the whole by the action of sun and air. The works in which the sea water is heightened into brine are called sun-works or out-works. These are constructed on a flat down or oozy beach, within a mole which is raised if necessary to keep out the sea; there is a large reservoir, or

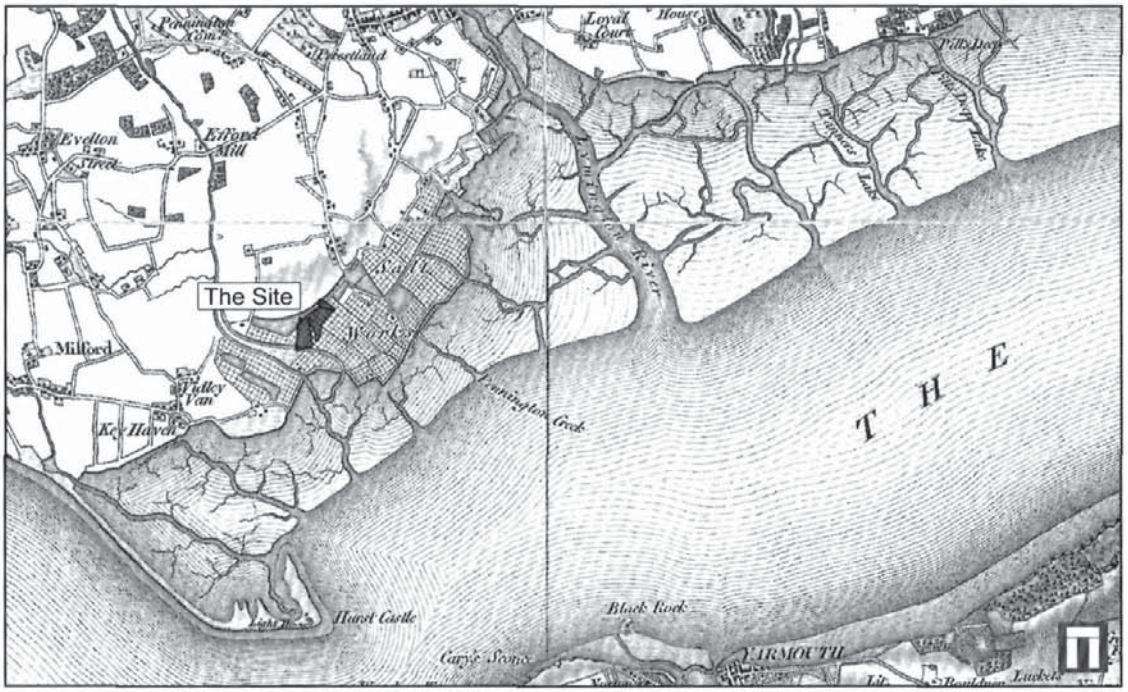

Fig. 10 Detail of the 1811 Ordnance Survey Old Series map of Hampshire (reproduced with permission of Hampshire County Council Museum Service)

feeding pond, communicating with the sea by a sluice, and adjoining to this reservoir a long trench parallel to which there are several square ponds, called brine pots, in which the water is evaporated to a strong brine, and afterwards it undergoes and artificial evaporation and purification in boilers'.

From these varied sources of information the most likely interpretation of the features recorded in Areas A and B is that they represent 17th century or later floor pans and ditches, and associated low mounds for the siting of hearths and/or windmills. However, none of the above descriptions, or other studies of the salterns at Lymington (e.g. Ravenscroft 1914; Cross 1965), exactly match the arrangements of ditches uncovered on this site. Apart from the obvious function of feeding seawater into the salterns, their precise function remains unclear and the following interpretation is necessarily tentative. Furthermore, a post-medieval date appears to be at odds with the (admittedly small) finds assemblage, as it requires the 26 sherds of medieval pottery all to be residual, deriving from an earlier phase of salt working of which no clear structural evidence was found. In turn, the interpretation offered would be stronger had post-medieval finds been recovered from the site, but their absence could be explained if the main foci of activity – the boiling houses (of which, again, no structural evidence was found) – were located outside the boundaries of the site.

Each ditch block appears to represent a single saltern unit, possibly bounded by an earthen bank. St. Barbe recorded that 'the extent of ground required for evaporation, exclusive of the feeding ponds and cistern, is about 3 roods, or 120 perches to each pan'. This is equivalent to an area *c.* 55 m square, consistent with the sizes of the ditch blocks (as described above) of

50–80 m square. At spring tides, seawater would have passed through sluices to fill the reservoirs or feeding ponds behind the sea wall. Such ponds are clearly shown on the 1781 Mackenzie chart flanking the shoreline, the nearest to the site being some 150 m to the south. From there the sea water was fed by trenches into the feeder ditches which in turn fed the cross ditches in each saltern.

No internal earthworks associated with the cross ditches were noted within each saltern. However, the 1879 edition of 'Old Times Revisited' says that salterns were 'divided into shallow ponds about 20 feet *(c.* 6 m*)* square by low mud banks about 6 inches *(*15 cm*)* high, just wide enough for a man to walk upon with caution'. It is possible that such features did not survive the 19th century levelling of the salterns or were not archaeologically visible. An 1828 account (quoted by Lloyd 1967, 97) describes such ponds (referred to as 'pans') as measuring 25–120 square yards (5–10 m square), therefore potentially lying between the cross ditches, and says that the liquor was moved six times from pan to pan. If this was this case, then each saltern may have comprised in the region of 50 interconnected ponds, with the increasingly concentrated brine possibly being fed inwards towards the mounds from where it was pumped to the boiling hearths. A 1693 map of Lymington by Captain Greenville Collins shows what may be a stylised representation of such a saltern, the 'Salt Pitts' comprising an approximately square block of six parallel ditches, with perpendicular 'cross-bars' between them creating smaller divisions.

According to Celia Fiennes (Morris 1949), the ponds were lined with clay in order to retain the brine: 'They are very careful to keep their ponds well secured and mended by good clay and gravel in the bottom and sides'. The traces of a clay layer recorded extensively across the site, sealing the pre-saltern features, were initially interpreted as a flood deposit, and indeed there is a record of a great storm in 1703 in which some salterns were flooded (Lloyd 1967, 90). However, it is possible that this clay layer was deliberately laid as part of the saltern construction. The excavation records describe the clay layer (213) below the mound in Area A as possibly 'deliberately spread', while the clay layer recorded below the central mound in Area B (2518) was also described as 'laid' and compared to the clay used to line the clay-lined pits; the same context record also refers to probable repairs to the clay layer with a slightly grey clay.

Conclusions

The programme of fieldwork has added valuable new information about salt working on the Lymington coastline, but leaves many important questions unanswered. While the Iron Age remains provided clear circumstantial evidence of salt working, they offered little insight into the actual operation of the industrial process. The presence, however, of a substantial, if seasonal, settlement, capable of exploiting the varied economic resources of the coastal marsh and saltmarsh environment, of which salt was probably an important element, helps provide an economic context for the hillfort at Buckland Rings and other possibly late Iron Age enclosures along the coast and estuaries.

The complex of features associated with the later salt works are also, in some respects, difficult to interpret. The interpretation offered above requires, for instance, that the few datable finds (medieval pottery) were residual, and that the later activity left no artefactual remains (or at least no archaeologically recovered finds) within the features excavated. However, in contrast to the little that we know about medieval coastal salt making in Britain, there are clear formal similarities between the features uncovered and the descriptions, illustrations and cartographic representations of the post-medieval and later sun works at Lymington. While there would seem to be little doubt that the arrays of ditches were used in some way to feed floor pans, the precise operation of those floor pans is not clear, as no internal earth ridges were noted that would separate individual ponds. Moreover, as the descriptions refer to the brine

being passed through a series of ponds, which could in theory be fed from the outer, feeder ditch, the purpose of the cross ditches is also not clear.

The reported levelling of the salterns in the 19th century to create coastal pastures clearly impacted on the upstanding earthworks, as well as features cut into them. While the clay-lined pits may have been used to hold brine, there was no direct evidence for the latter part of the salt making process – converting the brine to salt. There was clear evidence of burning associated with salt making, but no hearths were identified; two unstratified fragments of lead were the only possible evidence of the boiling pans. Apart from the large, rectangular, clay-walled feature of uncertain function, no buildings, wind pumps or other structures were recorded.

Many of the descriptions of the Lymington salterns date from late in their history, and it is possible that the precise operation of such sun works may have changed significantly from the time of their initial introduction. The documentary references to the replacement of mounds with floor pans suggests that they were first constructed in the early 17th century, although the possibility of an earlier, even medieval date, cannot be entirely ruled out.

As the saltmarsh and mudflats were reclaimed for salt production, the earliest floor pans may have ended up being sited furthest from the shore, and therefore the earliest to be turned back into grazing land, and this site, although not far from the 18th century sea wall, lies on the north-western (inland) edge of the salterns as they are depicted both on the 1781 MacKenzie chart and the 1811 OS map (Fig. 10). The bund which defines the southern edge of the site may mark a boundary between an area of early floor pans, and those closer to the coast which may correspond closer to the late post-medieval descriptions. It is certainly evident from the remains of adjacent salterns, visible in aerial photographs, that there is considerable variation in their layout, and a survey of a small area near Iley Dock in Keyhaven Marsh, for example, revealed a regular grid pattern of ditches spaced 5–7 m apart (Stone 2003, fig. 9), significantly different to the salterns recorded on this site.

It is clear that many questions raised by this programme of fieldwork – about the layout, development and operation of the Lymington salterns through the medieval and post-medieval periods, as well as in the Iron Age – remain to be answered. However, there is a high potential for further targeted investigation of this important archaeological resource to help resolve these issues.

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APPENDIX 1. FABRIC DESCRIPTIONS

Pottery fabrics

Iron Age fabrics

F1: A soft fabric containing a common amount (20–25%) of flint, mostly calcined, angular, up to 4 mm, poorly sorted; rare (1%) iron oxides, 3mm, sub-rounded.

G1: A soft, soapy fabric containing a common amount of grog (20%), sub-angular to angular, up to 3 mm, poorly sorted. In section the grog appears as voids.

G2: A soft, soapy and slightly silty fabric containing a moderate to common amount (15–20%) of grog, angular, up to 1mm, well sorted, and a moderate amount (15%) of voids, up to 5 mm, possibly from grog, poorly sorted, in a silty micaceous fabric.

Q1: A soft, sandy fabric containing an abundance of sub-angular to angular quartz, medium-grained, well sorted, with rare (2%) angular coarse to very coarse (up to 1.5 mm) grains. Iron staining visible in break.

Q2: A soft, harsh fabric containing a common amount (25%) of quartz, clear and opaque fragments including milky and rose-coloured, rounded to sub-angular, coarse to very coarse-grained, well sorted, and occasional detrital flint fragments, up to 2 mm, angular.

Q3: A coarse, sandy fabric containing abundant (40%) quartz, sub-angular to angular, coarse-grained, well sorted. 1st century AD, could be either side of conquest. Very similar to Q4 but grey in colour.

Q4: A coarse, sandy fabric containing abundant (40%) quartz, sub-angular to angular, coarse-grained, well sorted. Very similar to Q3 but this is generally black in colour, similar to Black Burnished ware 1.

Q5: A soft, sandy fabric containing abundant (40%) quartz, sub-rounded, medium to coarse-grained, well sorted, and common (20%) red iron oxides, rounded, up to 1 mm, moderately sorted and sparse (5–7%) voids from organic inclusions.

S99: Small sherds of shell-tempered ware.

V1: A soft and very soapy fabric containing an abundant amount (40%) of voids, up to 4 mm, platy, poorly sorted, possibly from shell.

VF1: A soft, harsh fabric containing a common amount (20%) of voids, up to 11 mm on surface, probably from shell, and a moderate to common amount (15–20%) of flint, some calcined some not, angular, up to 3 mm, moderately sorted.

VQ1: A soft, soapy fabric with a common to very common amount (25–30%) of voids, possibly from leached shell fragments, 1–2 mm, moderately sorted; and a common amount (20%) of quartz, coarse-grained, sub-rounded to sub-angular, well sorted.

VQ2: A soft, sandy fabric containing a common amount (20%) of voids, up to 5 mm where visible, in a fine sandy clay matrix with rare (1%) red iron inclusions, up to 1mm and detrital flint, up to 8 mm.

Roman fabrics

E211: Oxfordshire mortaria.

E212: New Forest parchment ware mortaria.

Medieval fabrics

E422: Laverstock-type coarsewares.

Q400: Sandy/flint-tempered medieval fabric.

Q401: Medieval sandy ware.

Fired clay fabrics

FC V1: A soft, slightly silty textured fabric with a moderate to common amount (15–20%) of linear voids, up to 6mm, and a sparse amount (5–7%) of rounded red iron oxides, up to 1 mm. No actual quartz grains are visible. The fabric is quite marly.

FC V2: A soft, slightly silty textured fabric with an abundant amount (40%) of linear voids, up to 6 mm, and sparse monocotyledon stems.

FC Q1: A soft, but harsh sandy fabric, containing a common amount (20–25%) of coarse-sized quartz grains, rounded, well sorted, and sparse (3%) iron oxides, rounded, 1 mm. On the surface, larger (up to 2 mm), more angular milky quartz fragments can be seen.

FC I1: A soft, soapy fabric containing a moderate amount (15%) of rounded iron inclusions, up to 3 mm, well sorted, in a silty clay matrix.