A medieval saltern mound at Millfields Caravan Park, Bramber, West Sussex

by Victoria Ridgeway

Archaeological evaluation and excavation work in advance of redevelopment at the former Millfields Caravan Park, Bramber, West Sussex in 1997, revealed evidence of sporadic occupation dating from the medieval period to the present. The site was located adjacent to the strongly tidal, and originally estuarine, River Adur, approximately 6.4 kilometres inland from Shoreham-by-Sea.

Although residual prehistoric flintwork was recovered, the earliest excavated feature was a ditch of probable early medieval date which suggests attempts to drain the open marshland of the estuarine floodplain. Subsequently, washed silts and sands deriving from medieval salt manufacture were deposited, forming a saltern mound used intermittently from the 13th into the 16th century. The mound showed evidence of sporadic flooding until the mid-16th century, by which time the River Adur had been fully embanked and the land was used as pasture. A saw-pit was in operation by the early 19th century, possibly in connection with a wharf known from documentary sources.

This paper is primarily concerned with the evidence for salt manufacture. The saltern mound, buried beneath alluvium and previously undocumented, joins the many examples known to have been in operation in the valley during the late Saxon and medieval periods, but is the first to be extensively excavated and the first to produce evidence of buildings.

INTRODUCTION

The site occupies a roughly triangular patch of land (centred on National Grid Reference TQ 1915 1065) at the eastern limit of the settlement of Bramber in West Sussex, close to Beeding Bridge (Fig. 1). The River Adur forms the north-eastern boundary of the site, with a drainage ditch to the north-west, 'The Street' (the main road through Bramber) to the south and domestic residences to east and west. Plans for building twelve new houses threatened to destroy potential archaeological remains and the developer, Crest Homes (Southern) Ltd commissioned Pre-Construct Archaeology ('PCA') to conduct a trial investigation. This was undertaken from 19 June 1997 to 4 July 1997 and revealed important remains. The developer funded a second phase of work from 24 September 1997 to 29 October 1997, again carried out by PCA. The extent of the excavation was determined by the planned development, both in terms of extent and the proposed depth of building foundations.

Bramber is situated on the west bank of the strongly tidal River Adur which, to the north, runs through a gap in the South Downs, created by post-glacial scouring of the chalk. The mouth of the estuary would probably once have been at Shoreham-by-Sea approximately 6^1/$_2$ kilometres to the south, but the river now turns and runs east-wards for about 1.6 km, entering the sea at Kingston Buci (Brookfield 1952).

The site occupies a low-lying area of alluvial floodplain, now protected from episodic flooding by embankments. Prior to the embankment and reclamation of the marshes the river was a tidal estuary with at least two deep streams at this point, one of which is the minor tributary assumed to have run roughly on the course of the present river. Further west, running close to St. Mary's (an extant 15th-century house), was a wider channel and its course is now preserved in a minor brook (Holden 1975a, 104).

The excavation area was generally level at 3.5 m OD, rising in the north and east to form the embankments of the River Adur. The surface geology as revealed in the excavations and engineers' test pits comprised alluvial silts and clays to at least 3.0 m below present ground level, except in the

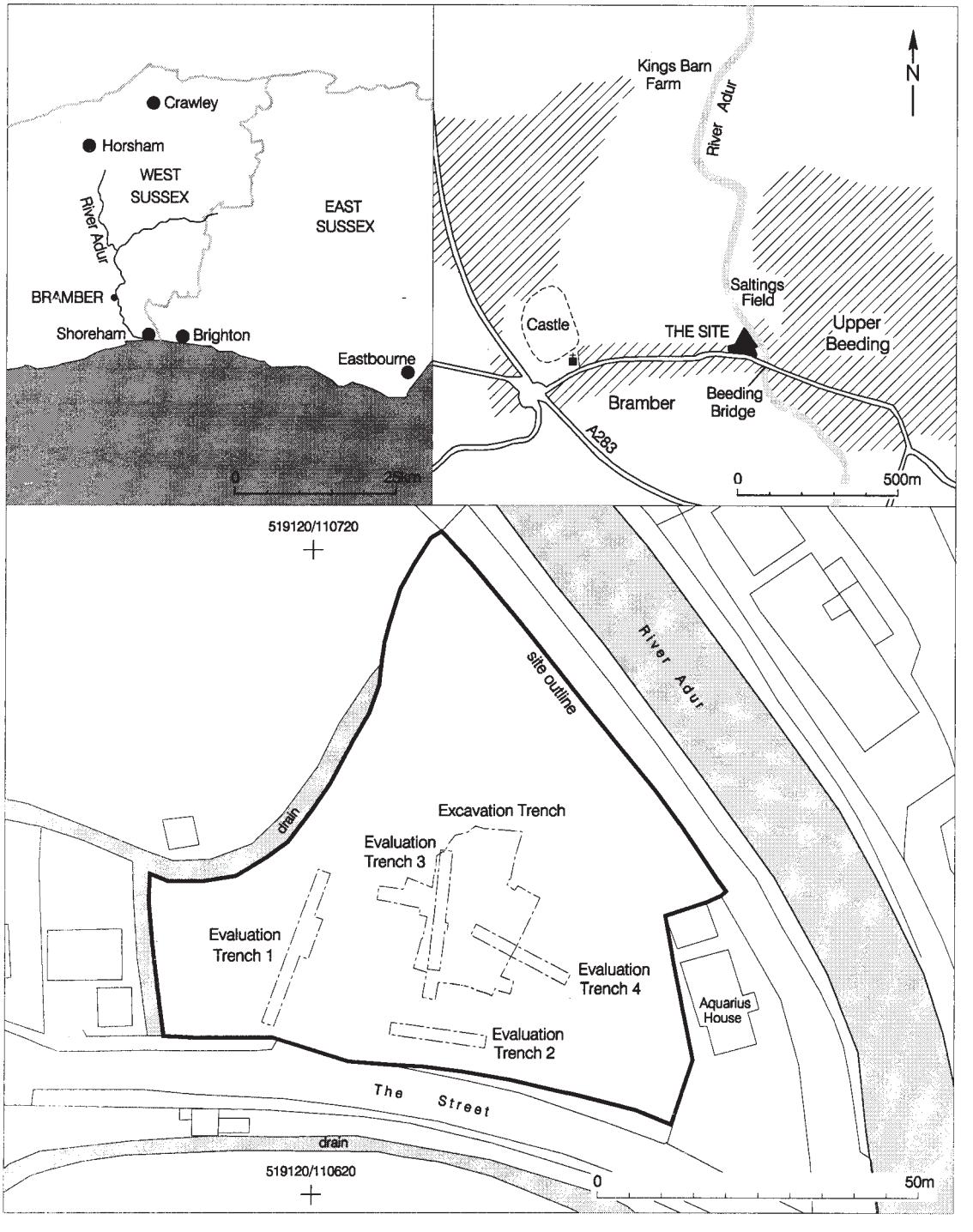

Fig. 1. Site and trench locations.

extreme south-east where 1.6 m of alluvial silts overlying a completely weathered chalk marl survived (LBH Wembley 1997). East of the river, in Upper Beeding, excavation of a sewer trench exposed 1.22 m of alluvial silts over an unknown thickness of gravel (Holden & Hudson 1981, 120–21). The solid geology in the vicinity of the site is chalk, at an undetermined depth below floodplain alluvium.

In the first phase of investigation four trenches were excavated (Fig. 1) at a width of 1.8 m and varying in length between 15.0 m and 25.0 m. Trenches 1 and 2 revealed a sequence of alluvial deposits, consistent with marshland within the alluvial floodplain of the River Adur, overlain by deposits suggesting a 20th-century levelling operation and topsoil. Towards the centre of the site, in Trenches 3 and 4, 13th- to 16th-century features consistent with the form of a saltern, or salt-production mound, were revealed; these were a common sight in the Adur valley in the medieval period (Holden & Hudson 1981). The second phase of the project involved excavation of a large, open area centred on the concentration of these features.

HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

Although chance finds and excavations in the vicinity of the site have revealed a few artefacts dating from Palaeolithic to Saxon times, nothing suggests a pre-Conquest settlement at Bramber. The medieval town developed alongside the Norman castle and its church which were built on natural high ground overlooking the floodplain at the western end of the present settlement. The name 'Bramber' probably stems from the name *Bremre*; the earliest reference to the name 'Adur' for the river dates to the 17th century. Upper Beeding, to the east of the Adur, had a substantial Domesday population and Sele Priory was established there *c.* 1080, by William de Braose, Lord of Bramber Rape and founder of the castle and church (Holden 1975a, 112).

An 11th-century timber causeway was revealed during the excavation of sewer trenches in 1957, 1960 and 1974 (Holden 1975a). It traversed the marshy ground and river west of the site, and probably continued eastwards to ford the estuary close to the point where the present Beeding Bridge now crosses the River Adur, immediately south-east of the site. The 1974 excavations also revealed piles which were interpreted as the foundations of a timber quay associated with this causeway (Holden 1975a). There are documentary references from 1086 and 1103 to a single bridge built by William de Braose, but it was not until *c.* 1230 that two bridges are recorded (Holden 1975a, 113), namely a 'lesser bridge towards the east', built of timber and presumed to have been situated close to the present Beeding Bridge, and a 'greater bridge of Bramber', built of stone, to the west. The causeway between the two bridges is referred to in 13th-century charters from Sele Priory (Holden 1975a, 113).

The river had been embanked by the late 16th century and the reclaimed marshes used for grazing. The Yeakell and Gardner (1780) survey map of 1780 shows the site area as pasture. The name 'Millfields' probably originates from 19th-century ownership; the 1839 Tithe Map describes the area as 'Mill Green', being pasture land with a wharf belonging to a Mr William Mills.

SALT MANUFACTURE IN THE ADUR VALLEY

Salt was manufactured in Sussex from pre-Roman to medieval times. The industry was important in the Adur Valley in the late Saxon and medieval periods, as is demonstrated by the density of saltern mounds over a wide area. Many of these were extant until being destroyed by ploughing as recently as the early 1970s. A thorough survey of these mounds has been published (Holden & Hudson 1981) and has been useful in putting the excavated Bramber mound into context (Fig. 2). In Bramber, alone, a group of at least 14 mounds was recorded to the south of the site, with a further nine to the north. Although there has been little opportunity for controlled excavation, several sections through mounds were examined, including a machine-cut through one of the group south of Upper Beeding and two excavation trenches across mounds approximately 200 m north of the site at Saltings Field, Upper Beeding (Holden & Hudson 1981, 138; Gardiner 1995). These identified some defining characteristics of a saltern mound in the Adur valley including tip lines revealing mound formation, deposits containing quantities of charcoal and burnt clay, finds of lead, and medieval pottery.

Salt extraction and processing methods are described in detail below, but a brief summary of practice posited for the Adur Valley is provided here.

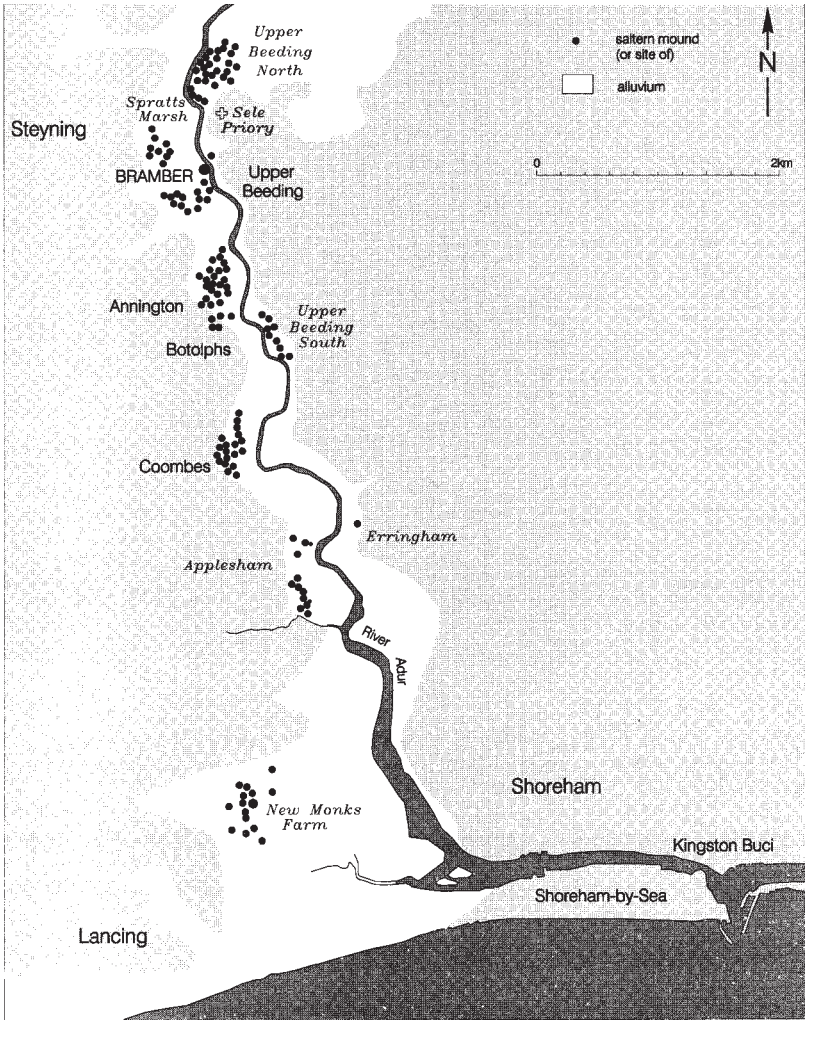

Fig. 2. Location of known saltern mounds in the Adur Valley. (After Holden & Hudson 1981, fig. 1.)

Following particularly high tides, salt-impregnated silt was gathered from estuarine shores and scraped into heaps which were then transferred to troughs which acted as filters, so that water poured over the salty material further concentrated the brine. The resulting concentrate was then heated (commonly in lead pans) to evaporate the water, producing salt crystals, and water saturated with salt (the 'bittern'). The leached out sands and silts were then dumped nearby, gradually forming substantial mounds which were subsequently used as places of salt manufacture.

THE ARCHAEOLOGICAL EVIDENCE

METHODOLOGY OF THE EXCAVATION

Trial investigations showed that saltern material was concentrated on a central area, hence determining the resultant trench location. Two narrow baulks, running north–south and east–west across the site, were left unexcavated to provide access and to allow spoil to be removed (Fig. 3). The excavation trench covered an area 28.5 m north–south by 24 m east–west with activity concentrated towards a central area roughly 10 m to 15 m across. A large 19th-century saw-pit (measuring 6.50 m north–south by 3.20 m east–west and over 1.20 m deep) was found to occupy an area towards the centre of the mound, thus probably destroying archaeological evidence relating to earlier features (Fig. 3).

EVIDENCE FOR PREHISTORIC OCCUPATION

The earliest anthropic features excavated on site may have been as late as the 13th century and are unlikely to have been earlier than the 11th century. However, a small assemblage of 15 struck flints, including various cores, core rejuvenation flakes and retouched implements, was recovered from excavated deposits. Some of the pieces were compatible with a Mesolithic or Early Neolithic industry but most of them were flake-based and the technology and reduction strategy employed were more characteristic of later Neolithic and Bronze Age industries (Bishop 1998). Although prehistoric horizons may exist in the alluvium, it is thought that they would have been beneath the proposed building foundation depth and, therefore, remain

unexcavated. Thus, the worked flint assemblage is probably residual, derived from the gathering of salt-impregnated sands and silts.

PHASE 1: NATURAL MARSH DEPOSITS

The earliest deposits encountered were blue and mottled blue and brown silt-clays, thought to be alluvial deposits. Column samples taken through a section at the southern end of the site indicate that the earliest observed alluvial sedimentation occurred when the river was tidal; that the latter was prior to occupation of the site and probably continued into earlier phases of occupation. The area supported plants common to salt marsh and freshwater riverbank environments (Branch & Fairbairn 1998) and the upper surface of this marsh was at a level of approximately 2.2 m OD. Variations in the level and nature of overlying deposits indicate that it was traversed by rivulets. These deposits were undatable, relatively clean (with an occasional fine charcoal flecks) and probably accumulated over time. They may correspond to deposits observed at Bramber Bridge, to the west, where a 0.6 m accumulation of alluvial clay sealed a possible causeway and quay built in the 11th century and was cut by a stone bridge thought to have been constructed towards the end of the 12th or early 13th century (Holden 1975a).

PHASE 2: MARSH DRAINAGE

The earliest identified anthropic feature cutting the alluvium was a drainage ditch, running east–west across the north of the site, which produced no dating evidence. This may represent drainage works associated with the construction of Bramber Castle (Holden 1975b) or a marsh drainage programme necessary to the construction of the 11th-century timber causeway to the south of the site. It seems likely, therefore, that this ditch was originally dug between the late 11th and early 13th century, although the possibility of an earlier date cannot be ruled out, and a *terminus ante quem* of the 13th century has been assigned on the basis of subsequent occupation.

PHASE 3: FORMATION OF A SALTERN MOUND

Overlying the marsh clay were deposits of light, greyish-blue silt-clay with fine charcoal flecks. The upper surface of these sloped from a maximum height of 2.62 m OD to a minimum of 2.11 m OD, being thicker towards the centre of the area of excavation and becoming thinner towards the edges.

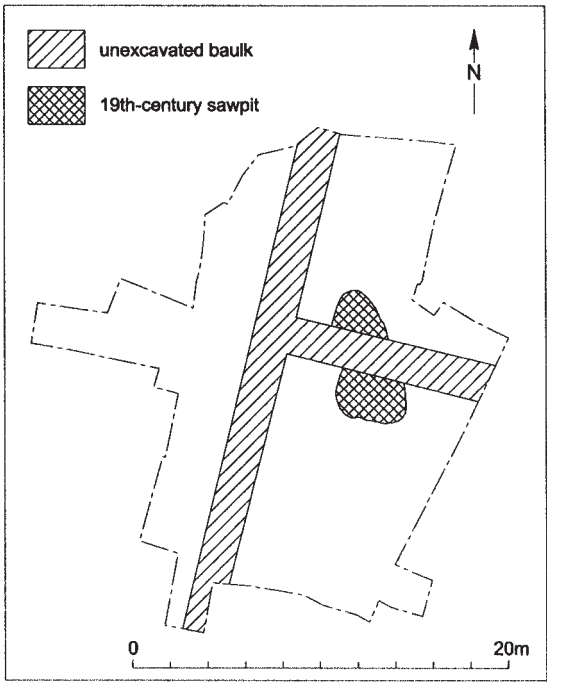

Fig. 3. Area of excavation showing truncation by 19th-century saw-pit and unexcavated baulks.

The mounded nature of these deposits suggests deliberate dumping, probably of washed silts deriving from the salting industry. In places the dumped deposits were interleaved with very finely laminated silts and sands, probably as a result of the dumped deposits being alluvially reworked and subjected to flooding episodes.

The mound thus formed was roughly ovoid in plan, standing up to 0.50 m high and measuring 20 m east–west by at least 25 m north–south (though its northern extent was not fully determined). The mound would have been surrounded by freshwater marshland (Branch & Fairbairn 1998) and was probably higher, having been eroded subsequently.

PHASE 4: 13TH-CENTURY SALT-MANUFACTURING ACTIVITY (Fig. 4)

The highest, central, area of the mound thus created was then used for activity related to salt manufacture. Occupation evidence comprised a ditch encircling its base in the south, with a gravel surface, hearth, well, tank and midden at the centre, partially enclosed by a substantial bank.

The ditch is indicated by a wide, shallow, feature curving around the southern side of the base of

the mound (Contexts 51, 118 & 124), and was up to 3.20 m wide, 0.50 m deep and at least 15 m in length. Its prime function may have been drainage, perhaps collecting water run-off from the top of the mound, but it may also have acted as a defining boundary feature. Immediately north of the ditch were dumps of silty clay (0.42 m thick and 5.23 m wide, becoming thinner towards the edges) which had been formed an upcast bank, eroded since deposition and thus flattened and widened.

In the higher, central area was a deliberately consolidated pebble surface (Contexts 249 & 340), covering an area at least 3.7 m north–south by 7.4 m east–west. As pebbles do not occur naturally in the site environs, it is presumed that they were deliberately imported, albeit that they may have come from nearby (as natural gravels were observed in deep excavations at Upper Beeding: Holden & Hudson 1981, 120–21). A bank surrounded this surface to the north and east. It was approximately 0.6 m high and up to 2.0 m wide (Contexts 321 & 329), and was composed of heavily compacted, mottled, sandy clay, and contained the remains of a timber stake in its northern part. This feature may have provided shelter from inclement weather as well as protection against periodic flooding. Set inside the area enclosed by this bank was a hearth (Context 341) with evidence of repeated re-use comprising fire horizons interleaved with sand dumps. The hearth structure took the form of an ovoid scoop (3.10 m east–west by 1.34 m north–south and 0.40 m deep), with shallow sides and a concave base lined with clay. At the south-eastern end of the bank, to the south-east of the hearth, was a small tank (1.08 m long and 0.90 m wide: Context 62) with a decayed timber or organic lining, together with a shallow gully draining into it from the north-east. The latter indicate that it may have been used in the salt filtration process. Approximately one metre west of the hearth was a large sub-circular cut (over 2 m across and 0.93 m deep) with near vertical sides and a concave base (Context 284) which is thought to have been a well. To the north of the hearth, overlying the cobbled surface, were laminated sands and silts containing a range and quantity of dumped domestic waste (including animal bone) which is interpreted as a midden. To the north of the bank were laminated dumps of fine silty sand which are probably accumulated flood deposits, suggesting that the bank may have been at least partially successful in preventing flooding of the occupation area.

The pottery recovered from Phase 4 was predominantly medieval Binstead ware, with some Orchard Street, Chichester, and Streat wares, indicating a late 13th- to early 14th-century date for this period of occupation (Jarrett 1998).

PHASE 5: CONTINUATION OF SALT-MANUFACTURE IN THE LATE 14TH TO EARLY 15TH CENTURY (Fig. 5)

The well (Context 284) associated with the previous phase of activity went out of use in this phase, probably due to collapse. Worked timber in a very fragmentary condition was recovered from its back-fill, including five fragments of planking (some of which were oak). Additionally, two fragments of radially-cleft beech board were found, one with a skewed lap joint and peg-hole and one with a tapered end (Goodburn 1998). These probably represent collapse of either a lining to the feature, or a superstructure protecting the well, or another associated building. Further finds included a mallet head (Fig. 9), some possible stakes and some fragments of firewood.

Following the collapse episode, the well was re-used for waste disposal and associated pottery included a large part of a late 14th- or early 15th-century Binsted ware cistern base with a bung hole (Fig. 7:2). Subsequently, it was partly filled in with finely laminated silts and sands. This is thought to have been a result of flooding, particularly as similar deposits covered the hearth, bank, tank and gully to the south and east.

The flooding was followed by a reorganization of the workings on the mound, including the construction of a building with associated wells, tanks and large pits. The building remains took the form of three post-holes (Contexts 264, 255 & 194) and a partially robbed-out wall foundation (Context 261) (Building 1, Fig. 5). The structure was approximately 5 m by 5 m in plan and appears to have been a simple timber-framed hut or shelter which may have had wattle-and-daub or mud-brick walls built on foundations of beach cobbles and chalk. A later dump of medieval tiles slightly to the north is interpreted as part of a collapsed roof from that building. To the south of the wall foundation, the remains of horizontal timber planking were overlain by occupation deposits, suggesting a timber floor. Two large pits were associated with the building and these may have been storage tanks or wells. The first (Context 338) was circular in plan

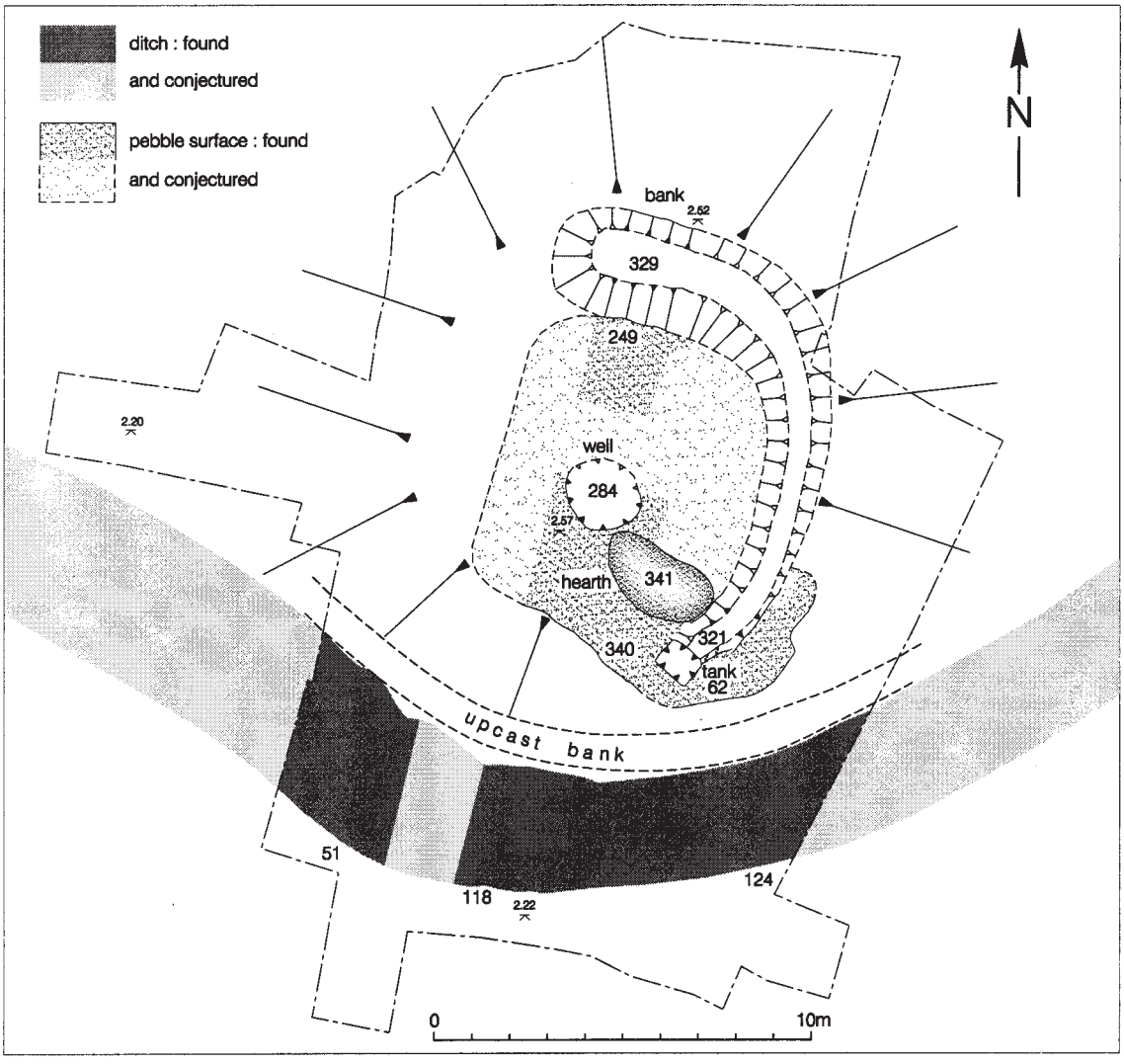

Fig. 4. Phase 4: 13th-century salt-manufacturing activity.

(1.30 m in diameter and 0.90 m deep) with a substantial clay lining. The second, to the north-west, was a large, sub-rectangular cut with stepped sides (2.76 m across and 1.30 m deep) and with a central ovoid element (1.70 m north–south by 1.10 m east–west: context 247). The presence of quantities of charcoal and briquetage suggest a hearth nearby, indicating a continuation of salt-manufacturing activity, although no actual hearth remains were identified (probably due to later truncation).

The pottery assemblage from this phase of occupation was dominated by Binsted wares with Ringmer and medieval Graffham wares also present, indicating a late 14th- to early 15th-century dating for this phase (Jarrett 1998). Part of a rounded jar in an unglazed, oxidized, sand-tempered fabric was recovered from occupation deposits in Building 1 (Fig. 7:1).

A large rectangular pit (at least 2 m across and over 0.55 m deep) was identified to the east of the excavated area (Context 272) but its proximity to the limit of excavation precluded further investigation. It had stepped sides, the steps running roughly parallel with the southern edge of the

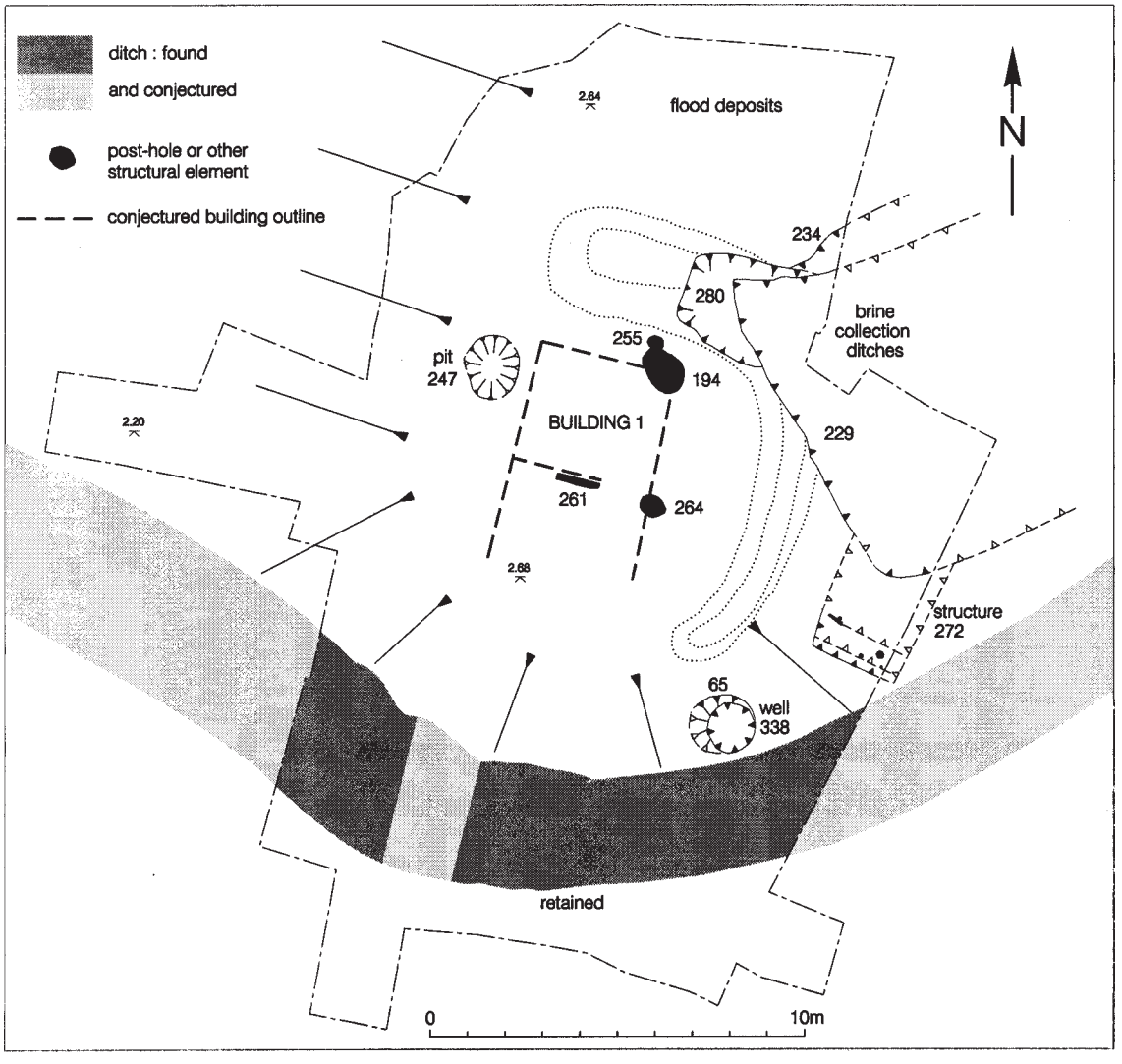

Fig. 5. Phase 5: continuation of salt-manufacture in the late 14th to early 15th century.

feature with the upper step 0.30 m deep, stepping out a further 0.20 m at 0.30 m down. The base of the pit was roughly level as revealed, but excavation was truncated to the north. The stepped side appeared to be a deliberate feature of the pit and the remains of heavily decayed, driven timber posts along the edge of the second step probably held retaining timbers. Remains of further driven stakes and an up-ended plank were identified approximately 0.80 m further north, possibly indicating a further step.

To the north of this and north-east of the mound was a series of large pits, repeatedly recut, and possibly continuing a process which began in the preceding phase of site use (Contexts 234, 280 & 229) (Fig. 5). The earliest cut was sub-circular (1.28 m by 1.10 m by 0.58 m deep: Context 234). It was truncated by a larger sub-rectangular cut (at least 3.0 m long by 2.80 m wide and 0.90 m deep: Context 280), with slumped sides. This was truncated by an even larger feature (at least 7.60 m by 4.80 m and over one metre deep: Context 229).

The relatively clean and laminated fills of the pits were mixed with large lumps of material similar

to the surrounding clay. These suggest that the in-fill processes were natural, arising from a combination of water-carried deposits and slumping of the pit sides; the pits were recut several times. Although not lined, the pits were dug into clay and were observed retaining water after excavation, so it is suggested that they were used for collection, storage or settling of saline water as part of the salt-manufacturing process. These pits cut the clay bank, implying that it must have become redundant, though it remained undisturbed in the northern part.

PHASE 6: COLLAPSE AND FLOODING

Several factors indicate a hiatus which may have been due to flooding. The ditch silted up and was filled in. The building collapsed and the entire site was covered with a layer of alluvium up to 0.75 m thick at the edges of the mound, thinning towards the centre. The silting of the ditch and accumulation of finely laminated bands of sand and silt towards the edges of the mound was probably gradual, and pollen assessment of column samples taken through a section at the southern limit of site supports the idea of several flooding phases (Branch & Fairbairn 1998).

The associated pottery dates the flooding event(s) to the early 15th century, and includes fragments of a rounded jar in Binstead-type ware with glaze dribbles (Fig. 7:3) and a second rounded jar in High Lankhurst fabric with white slip decoration and green glaze drips (Fig. 7:4). The alluvial deposits also contained residual material, including an abraded sherd of Roman oxidized grog-tempered ware and some 13th-century material (Jarrett 1998). It is postulated that water levels had been slowly rising, resulting in alluvium accumulating around the lower slopes, and eventually overwhelming the top of the mound.

PHASE 7: LATE 15TH- TO EARLY 16TH-CENTURY OCCUPATION (Fig. 6)

As the climate became drier in the later 15th and early 16th centuries, site use was resumed (albeit possibly aided by improved drainage systems). The habitation evidence included a substantial, semi-sunken structure and associated well and pits.

The structure, Building 2, took the form of a sub-rectangular shallow-sided cut (Contexts 232, 233, 186 & 330) *c.* 6.5 m across and 0.30 m deep, with post-holes and linear beam slots around its edges (Contexts 237, 245, 201, 199, 188, 60 & 243) (Fig. 6). Occupation deposits within the building contained frequent flecks of charcoal, pot fragments and shell (oyster, cockle and mussel). Associated demolition deposits contained burnt daub, iron nails and pieces of roofing stone. The building was probably semi-sunken, supported by earthfast timber posts, walls resting on timber base plates and with a stone roof. As with the previous structure, the walls may have been of mud-brick or wattle-and-daub. An abundance of nails may derive from a roof supported by timber planks.

To the north-west was a circular well or pit (Context 69) (0.88 m deep and overall 2 m across) containing a central wicker lining (0.70 m across, its impression preserved by iron panning), with a clay back-fill between the lining and the cut. A further small pit was excavated to the east (Context 149).

The building was set almost directly above the earlier one on the erstwhile slightly higher area at the centre of the mound; between the two building episodes, the site had been mostly levelled by flooding. Continued salt production during this phase can only be postulated, though it seems that the top of the mound was still being exploited, since it provided a dry area in the surrounding marsh. The pottery recovered from this phase was sparse, but suggests a late 15th- or early 16th-century date (Jarrett 1998) on the basis of an unglazed bowl in Binstead-type ware (Fig. 7:5).

PHASE 8: DISUSE OF BUILDING AND LATER 16TH-CENTURY ACTIVITY

A large pit was dug into the central area of the earlier structure and it seems likely that it would have provided a ready supply of building materials although small Horsham stone slabs, commonly used in the area as roofing material, were left *in situ*. The pit was later used for opportunistic waste disposal.

One large post-hole was found in association with several other features, which may have formed less substantial elements of a structure, but no cohesive plan was evident. A series of further pits, gullies, possible tanks and land drains indicate continued activity in the vicinity and attempts to keep the area well-drained. The ditches or drains may reflect field boundaries and it is likely that they were associated with agricultural use of the land, indicated by the development of a subsoil horizon across the site. There was no evidence of any

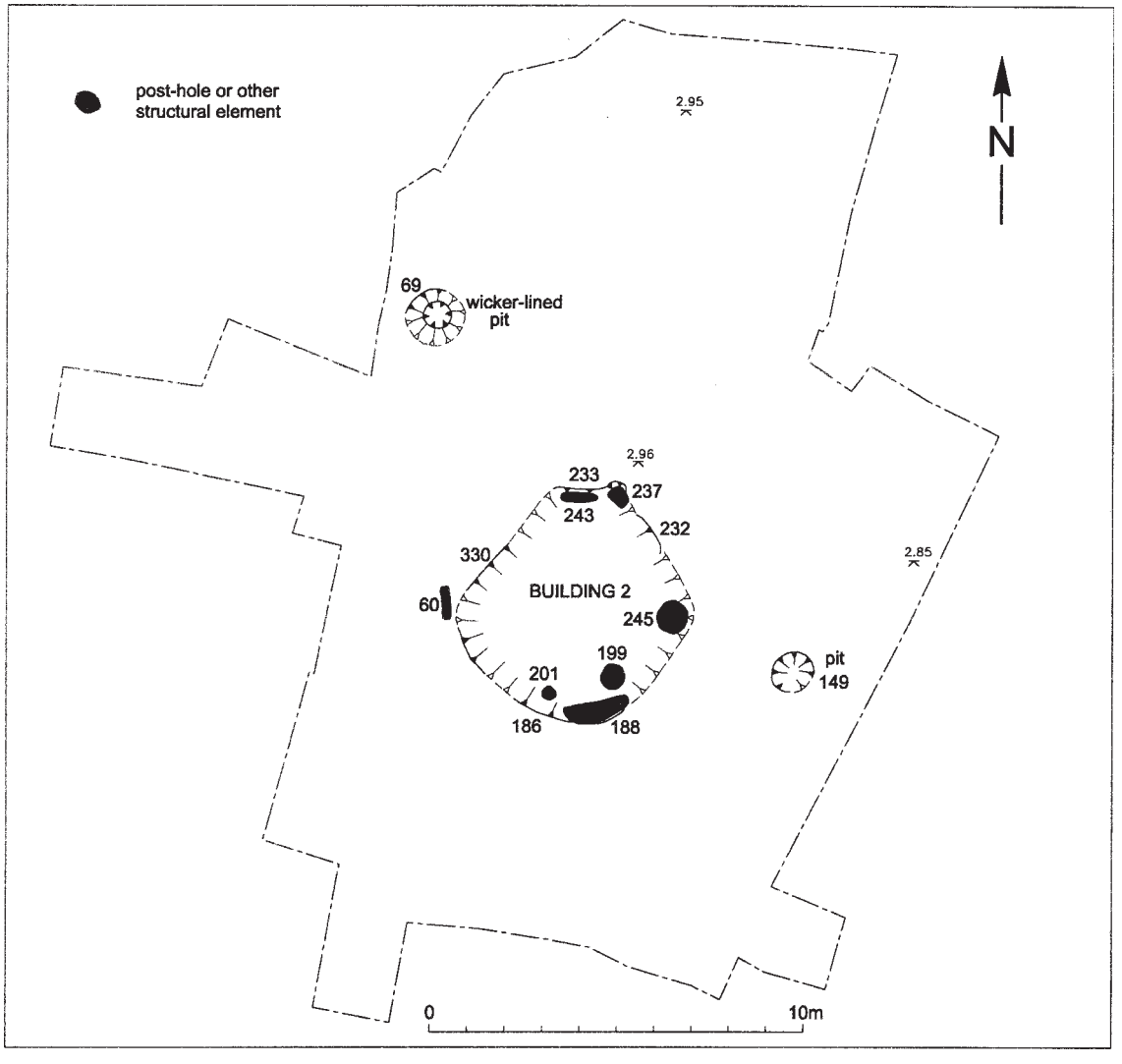

Fig. 6. Phase 7: late 15th- to early 16th-century occupation.

connection with salt-making and the pottery evidence suggests that the industry had ceased by the mid-16th century.

The pottery included some residual material, probably due to the intercutting nature of the features, but a 16th-century date is indicated by Graffham wares (including a rounded jar with internal olive green glaze: Fig. 7:6), Langerwehe, Raeren and Frechen stoneware and a French Martincamp flask (Fig. 7:7) (Jarrett 1998). Vessels recovered from Phase 8 include fragments of a pipkin, a colander, a frying pan, pancheons (large flared bowls) and jugs. These items are generally associated with the preparation and serving of food and drink, and indicate domestic occupation in the vicinity. A bone skate recovered from one of the gullies was apparently early medieval and therefore probably re-deposited (Riddler 1998) (Fig. 8).

PHASE 9: 17TH- TO 19TH-CENTURY ACTIVITY

Cartographic sources indicate that the land continued to be used as pasture from the 17th to the 19th centuries, but no cultural material dating

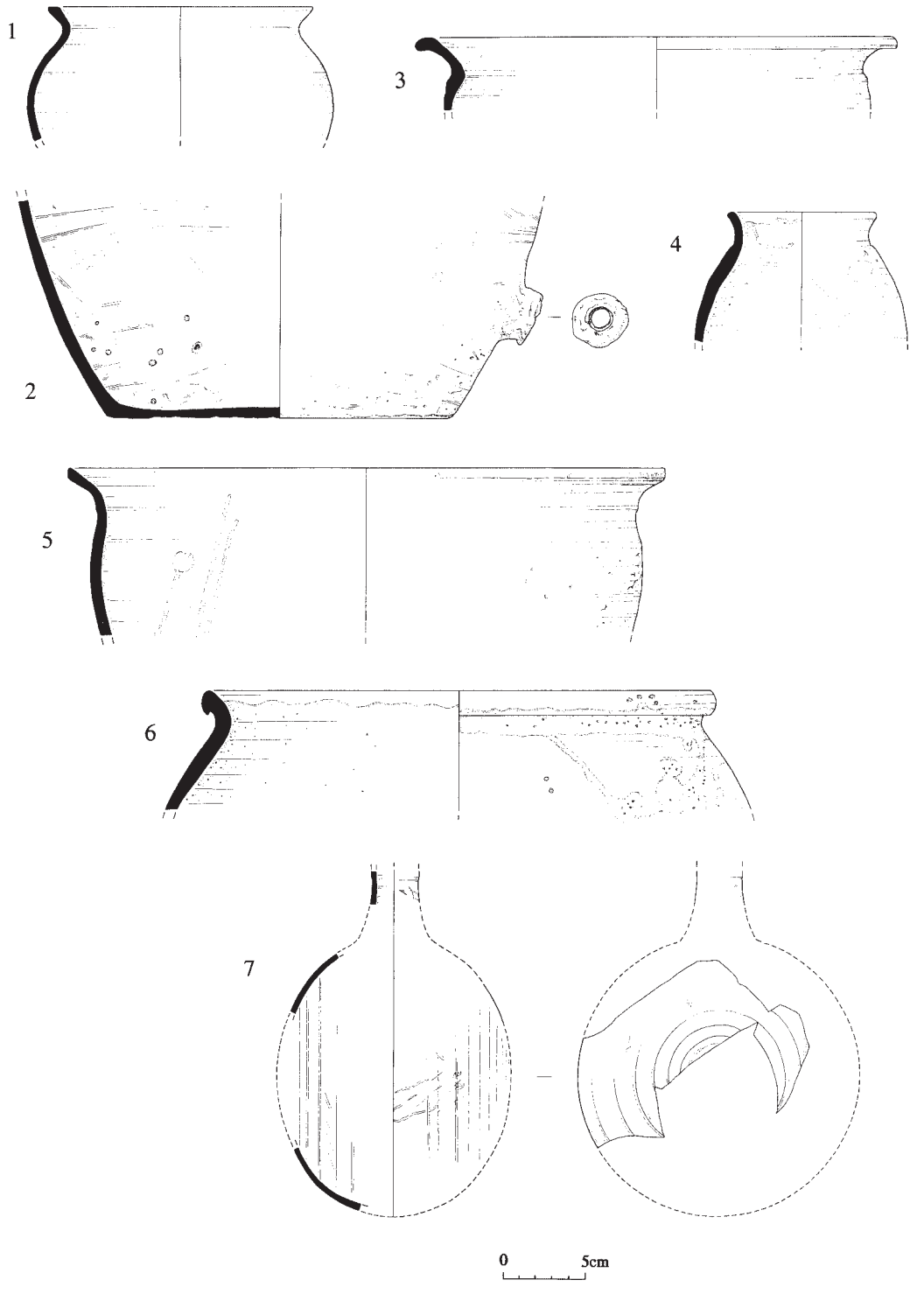

Fig. 7. Medieval and post-medieval pottery.

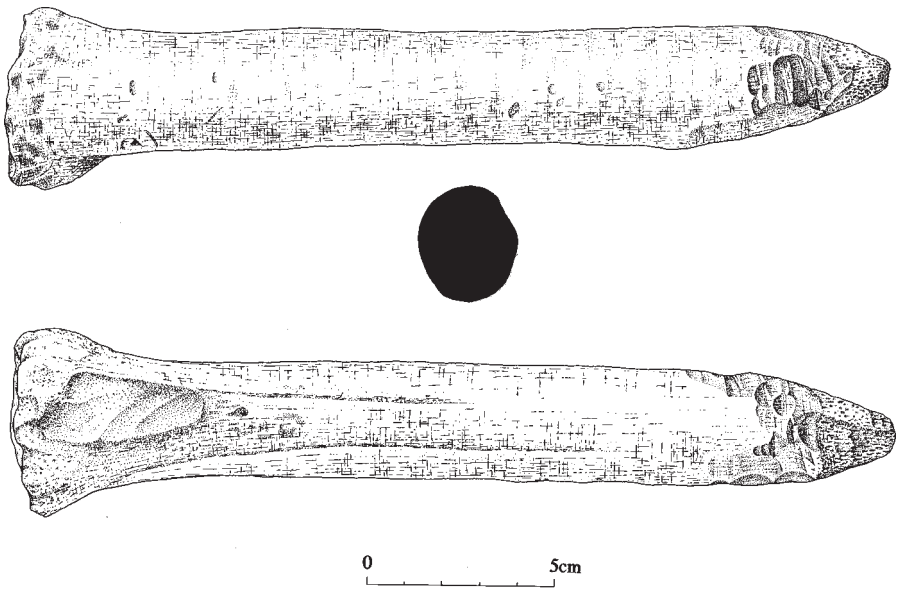

Fig. 8. Medieval bone skate.

to this period was recovered. Resumption of occupation activity on the site in the 19th century was indicated by a variety of features, including small pits or post-holes, a land drain, a drainage ditch, a goat burial and a large pit. The pit measured 6.50 m north–south by 3.20 m east–west, with a timber platform (indicated by well-preserved timber planking resting on beams) set at approximately 1.20 m below the top of the cut, and is interpreted as a saw-pit. The pit's backfill included a piece of commemorative, transfer-printed, refined, white earthenware bearing the date 1862 (Jarrett 1998, fig. 8) and, therefore, the pit is assumed to be of late 18th- or early 19th-century origin. It may have been used for preparing timbers for house construction in Bramber, for boat construction, or a combination of both. The proximity of the river to the saw-pit would have facilitated transportation of wealden timber to the site and it may have been unloaded at William Mills' wharf (*see* above).

PHASE 10: 20TH-CENTURY ACTIVITY

Levelling deposits and topsoil were observed across the site, as were the foundations of a Second World War gun emplacement. The most recent activity was represented by hard standing for caravans, access roads and the house 'Aquarius', and associated drainage features and services.

DISCUSSION

THE TECHNOLOGY OF SALT MANUFACTURE AND PROCESSES IDENTIFIED ON SITE

The method by which salt was extracted from saline water, processed and distributed can be summarized as: a) gathering of raw material; b) extraction of brine, and settling and disposal of waste; c) condensing the resulting concentrate; d) drying the salt and distributing the finished product. These processes are discussed in relation to the excavated evidence from Bramber.

The basic approach to salt-making changed little until the 20th-century introduction of the vacuum pan; such variations as were apparent were due to differing sources of raw material (for example open sea or estuarine water, brine wells, rock salt), local geographical and topographical conditions, and the availability of materials (such as fuel). The major technological change which occurred through time was the early use of briquetage boiling pans, then lead pans in the medieval period, and iron in post-medieval times.

The techniques are likely to have differed through time and from area to area. Therefore, the excavated evidence from Bramber has been compared with historical accounts and archaeological material, concentrating in particular on contemporary

sites and those in geographically-similar locations.

GATHERING OF RAW MATERIAL

There are various documented methods of collecting brine for salt manufacture. These include solar evaporation in 'salt pans', commonly practised at coastal locations with warmer climates than that of Britain (although it has been suggested that salterns at Winchelsea were used this way: Holden & Hudson 1981, 123), and by separation from salt-impregnated sand. In Britain, the latter was favoured at the coastline and on tidal estuaries and was probably the method used in the Adur Valley in the medieval period (Holden & Hudson 1981). Although the term 'sand' is frequently used, silts, sands and clays occurring either as beach deposits or as estuarine mud were all exploited. Modes of collection differ in minor detail but most are variations on the idea of scraping off the upper surface of the sand that was overflowed by sea water at times of particularly high tides. A receding tide leaves behind salty silts and sands, in the upper surface of which salt is further concentrated by natural evaporation. This surface material was collected, washed and filtered (a process known as 'sand-washing', 'sleeching' or sometimes 'salt-upon-salt'). Estuaries and creeks may have been preferred to open sea sites both because the water is more saline and also because the sheltered nature of estuaries renders salterns easier to work. An 18th-century account describes the process thus:

> The sand from which they prepare the brine . . . is collected on flat sandy shores on those parts which are only covered in the high tides . . . before and after the full and new moon. This sand they collect . . . when the sea has been exhaled from it by the sun . . . and they rake it into heaps to the depth of two or three inches . . . (Brownrigg 1748)

Unfortunately, the 'sandy shores' of the estuary were beyond the limits of excavation at the development site, so this was not tested archaeologically at Bramber.

Brownrigg (1748) also describes sea water being poured on to sand lying in a pond or sump at spring tides. At Chidham, on the shores of Chichester Harbour, to the west of the Adur Valley, excavation of a Roman salt-production site revealed the butt-end of a ditch at least 1.45 m deep and 6 m wide (Bradley 1992). It appeared to have been filled with sea water intermittently and led out onto the mudflats. It would have collected sea water at high tides and then acted as a reservoir, storing the brine for evaporation.

The large cuts revealed to the north-east of the Bramber mound (Fig. 5, Contexts 234, 280 & 229) may have performed a similar function to the ditch in Chidham. Though Bramber is later in date, this method might have been used there, given that similar geographical and tidal conditions were at work. At times when the estuary was wide and the tide strong it may have been desirable to bring the

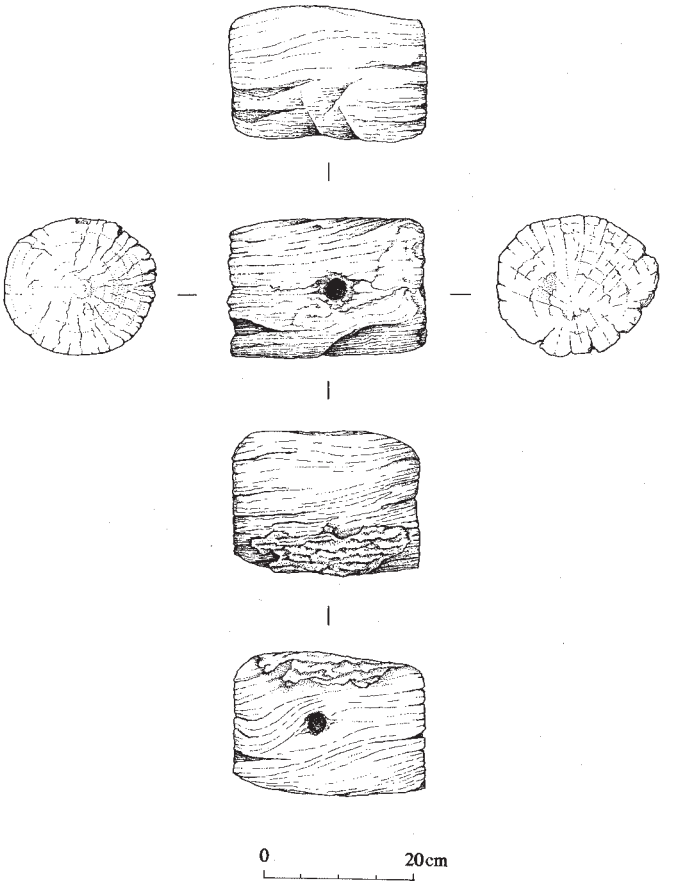

Fig. 9. Wooden mallet head.

saline water close to the centre of production, then leave it to evaporate prior to gathering, mounding up and further processing. The location of the ditches, on the north-eastern edge of the mound between it and the present river, makes such an explanation plausible. The smaller feature to the south (Context 272) may have functioned as steps leading down to the ditch (Context 229).

EXTRACTION OF BRINE AND DISPOSAL OF WASTE

In the sand-washing method of manufacture, the salt-impregnated sands and silts were gathered and mounded up close to the working site. They were then washed, with either fresh or saline water, to concentrate the brine further. The process of sand-washing required a tank or trough to act as a filtration unit and there is both archaeological and documentary evidence from elsewhere to indicate the forms they took. Excavations at Wainfleet St Mary, Lincolnshire, revealed rectangular trenches lined with turf, and with timber frames set above; interpreted as filtration tanks, they would have been filled with concentrated salty silts or sand. The salt- or fresh-water would have then been poured over, to filter through the turf, down the slightly sloping base of the trenches, and along channels and into clay-lined pits (McAvoy 1994, 140–41). More locally, evaluation work at Church Farm, Coombes, West Sussex may have identified a filtration tank over 5 m long (Gardiner 1992). Turning to documentary sources, Brownrigg (1748, 136) describes the filtration process as practised in Cumbria as using rushes or straw. In Normandy, France, filter beds had wooden bases and were lined with straw; an 18th-century illustration shows a raised filter bed with a barrel placed beneath it (Sturman 1984, 51).

The small 'tank' found in Phase 4 (Context 62) had a wooden base with organic material placed in it and may have been used for filtering. The associated gully utilized the slope of the bank, allowing water to be fed down and through the tank. However, there was no indication of filtration units on the scale found in Lincolnshire. Peat may have been used as a filtration material and was available about 2 km north of the site. In Britain, filtration units were commonly set within pits but it is possible that raised timber structures were used, as in Normandy (Sturman 1984, 51). Timber was readily available from the Weald and may have been employed to make free-standing filtration units at Bramber, but such structures would leave little or no trace in the archaeological record. Brine collection also may have taken place in pits or free-standing vessels. As described by Brownrigg (1748), the same water was repeatedly poured over the sand, with fresh sand being added as required, until an egg placed in the brine collecting cistern began to float (Martin 1975, 75); interestingly, eggshell was recovered from a Phase 5 pit or well (Context 65/338).

Large pits, interpreted as wells, were associated with all salt-manufacturing phases at Bramber. With the exception of the timber-lined well (Phase 4) (which had a secondary phase of use as a cesspit), all had relatively clean back-fills suggesting that they were not rubbish pits. All had central, sub-circular, straight-sided elements, which would have aided water-drawing with a bucket. They had lined sides but open bases, which would have allowed fresh water to enter whilst preventing saline estuarine water from seeping in. Either fresh or sea water could be used in the sand-washing process (Holden & Hudson 1981, 124) but freshwater was preferable, producing better quality, fine, white salt (Sturman 1984, 51) which is less likely to deliquesce. Large pits may also have been used for collecting filtered, washed brine, and the water-retaining, unlined, step-sided pit (Context 247) may have fulfilled this function in Phase 5.

The dumping of washed sand led to mound formation. Approximately 133 standing mounds of varied shape and size have been identified in the Adur Valley, though many of these have been levelled by ploughing (Holden & Hudson 1981). An early 20th-century survey of saltern mounds at Botolphs reported that 21 of the 27 mounds had shallow ditches round them (Catt 1908) and these were thought more likely to have been caused by water run-off from the mounds rather than being artificially made (Holden & Hudson 1981, 129). Medieval saltern mounds along the Lincolnshire coastline often had a 'narrow trench' around them (Rudkin 1975, 37). The mound ditch observed at Bramber had been deliberately dug and would have helped to keep the top of the mound dry.

CONDENSING THE RESULTING CONCENTRATE

The collected, concentrated brine was further condensed by evaporation in open vessels over hearths, using whatever fuel was available; in the Adur Valley that would have been both wood and peat. Holden and Hudson (1981, 126) suggest that

timber would have been floated down the river from the Weald for use as fuel at the Adur Valley salterns. Among the timber fragments recovered from the backfill of a Phase 4 well or pit (Context 284) were a few pieces of probable firewood, including a quartered roundwood fragment, and part of a cleft-quartered, small, oak log which had been partially charred at one end (Goodburn 1998). Wood charcoal was also recovered from sampled deposits throughout the postulated salt-making phases.

All documentary sources suggest that lead vessels would have been used for condensing the concentrate, and excavations at salterns of medieval date have frequently recovered lead fragments. A small fragment was recovered from the backfill of a well or pit in use in Phase 5 (Context 284), and this may have been part of a condensing pan, or an off-cut of lead from pan manufacture. The temperatures reached in the hearths need not have been high and, indeed, lead pans would not withstand great temperatures. Many authors refer to 'boiling' of the brine, though this is not necessarily an appropriate term. It has been argued that boiling would be both unnecessary and impractical (de Brisay 1975, 5) though Martin (1975, 75) suggests that whilst slow heating produced the best large-crystal salt, fast boiling produced fine-grained salt; overheating, however, would result in the bittern (the lye) crystallizing into the salt.

Duncan (1812) describes the lead pans used in Dumfriesshire as being about four feet long, three feet broad and five inches deep (approximately 1.22 m by 0.91 m by 0.12 m). Agricola's contemporary account describes boiling pans almost twice this size at eight feet long, seven feet wide, and half a foot high (2.43 m by 2.13 m by 0.15 m) (Hoover & Hoover 1950, 548–50). An illustration of 1631 by Farkson, in Cumbria (as reproduced in Martin 1975, 74), describes pans nine feet long by eight feet wide (2.77 m by 2.46 m). The excavated hearth at Bramber measured 3.10 m east–west by 1.34 m north–south by 0.4 m deep and its size probably reflects the dimensions of the lead boiling pans used. A 15th-century hearth at Wainfleet St Mary, Lincolnshire was comparable at 2.6 m long, 1.1 m wide and 0.2 m deep (McAvoy 1994). Although there was clear variation in hearth and pan size, pans were always shallow, maximizing the surface area in order to facilitate evaporation and collection of salt.

Though it is conceivable that 'boiling' was only carried out at times of good weather, the vagaries of the British climate make it seem likely that a successful hearth would have been protected from the elements. It is possible that mud-brick walls were constructed around the fire, or a less archaeologically-visible shelter or windbreak such as that postulated around Saxon boiling hearths at Upwich (Hurst & Hemingway 1997, 25). At Bramber the curving bank against which the hearth was set probably provided this protection and the recovery of the base of a timber stake from the bank suggests that it may also have supported a fence or windbreak, increasing the effect. The Phase 4 midden deposits close to the hearth may have derived in part from dumped waste from floating off the scum during boiling (Holden & Hudson 1981; Hoover & Hoover 1950, 552).

DRYING THE SALT AND DISTRIBUTING THE FINISHED PRODUCT

Following condensing, salt must be dried and the most widespread practice in Britain was the use of conical wicker baskets ('barrows') (Brownrigg 1748), often hung in the building in which the boiling took place ('saltcote') (Bridbury 1955, 3–6) to allow bittern to drip out of the salt.

Salt was likely to have been transported in sacks (by distributors known as 'salters') (Sturman 1984, 53) and/or in briquetage containers of which there are examples from this site (*see* below). Interpretation of briquetage function is inconclusive here.

EVIDENCE FOR BUILDINGS

Structural evidence recovered from Phase 5, in the form of a robbed-out wall foundation and post-holes, possibly represents a saltcote (Building 1, Fig. 5). This appears to have had a timber framework and mud-brick or wattle-and-daub walls resting on shallow chalk and flint cobble foundations, with a tiled roof and timber floor. Prior to this excavation no structural evidence for saltcotes had been found on any of the Adur Valley mounds. A saltcote (*cotagium salinum*) in Bramber is referred to in a deed of 1403 and at least 70 saltcotes (*dom' salinaru'*) were apparently destroyed by the sea at Lancing between 1291 and 1341 (Holden & Hudson 1981, 125, 130). Saltcotes are known from elsewhere in Britain and in Lincolnshire a typical saltcote would have had mud walls, wooden doors and windows and a timbered and thatched roof (Hallam 1960).

Further structural evidence was recovered from

Phase 7, in the form of a sub-rectangular semi-sunken building (Fig. 6) which was probably a simple timber-framed hut or shelter. No evidence directly associates this building with salt-manufacture but its setting on top of the mound in the midst of marshland does make it likely. No hearth remains were found and so it is unlikely to have been a boiling house, though it may have been used for drying the salt, or as a store or shelter.

Building techniques subsequently employed in the area were suggested by the recovery of worked flint from Phases 8 and 9, which is interpreted as deriving from cobble-dressing (Bishop 1998) which is in keeping with local traditions of masonry using flint cobbles (dressed and undressed).

BRIQUETAGE

Briquetage is the name commonly given to moulded and fired clay used for a variety of purposes in the salt-making process and has been discussed in detail elsewhere (e.g. Fawn *et al.* 1989). A total of 35 fragments of briquetage, weighing 1273 g, were identified from the site, retrieved from deposits assigned to Phases 4, 5, 6, 8 and 9 (Sabel 1998). All briquetage identified was of a very fine, sandy (0.1 mm), orangey-brown fabric with occasional-moderate inclusions of fine iron oxide (<0.01 mm). The larger examples were of varying thickness and dished in shape, with characteristic yellow discoloration on the upper/inner face where the fabric came into contact with the salt. One sherd had a possible base angle.

Sources suggest that briquetage was not commonly used for boiling pans in the medieval salt industry and pans would generally be of lead (for example Duncan 1812; Hoover & Hoover 1950; Brownrigg 1748; Sturman 1984, 52–3). Therefore, the briquetage recovered is more likely to be the remains of hearth furniture (in the form of props, bars or bricks on which to support the lead pans) and from pans or vessels for storing and transporting the finished product. McAvoy (1994, 142) describes a rectangular 'brick' of fired, silty clay found within the hearth excavated at Wainfleet St Mary, which may have been an *in situ* stand for a lead pan.

SEA-LEVEL CHANGES, ALLUVIATION AND THE END OF SALT-MAKING AT BRAMBER

It has been suggested (Holden & Hudson 1981, 120) that inning of the marshes in the Adur Valley, especially in the 13th century, caused the deposition of much sand, silt and clay. The mound was formed on top of this alluvium at Bramber. Later flooding episodes buried the earliest occupation features which have been dated to the early 15th century (Phase 6 deposits). These flood deposits were composed of finely laminated, yellow-brown silts and sands, the laminations being indicative of relatively slow development in a frequently waterlogged environment (Branch & Fairburn 1998). The evidence indicates that this flooding did not lead to long-term abandonment of the site and that activity had resumed by the later 15th century (Phase 7). The mound by this time was almost entirely buried by alluvium and occupation contracted to the very top of the mound.

Holden and Hudson (1981, 128) postulate that salt-making elsewhere in the Adur Valley had almost ceased by the 14th century due to a combination of factors. At Bramber, excavated evidence suggests a continuation, or at least a resumption, of salt-making in the later 15th or early 16th centuries, probably as a result of an amelioration of conditions combined with improved land drainage and further reclamation of the marshes. Excavations across the river at Upper Beeding revealed evidence for salt-making of probable 14th-century date (Gardiner 1995).

Embankment of the estuary was piecemeal but completed by the late 16th century. This would have precluded further salt-making and it appears that from the 16th to the 19th century the meadows formed were used as pasture land.

CERAMICS, DATING, STATUS AND TRADE

Analysis of pottery types recovered suggests that the early phases of activity (4 and 5) were associated with locally-produced wares and that this trend continued through to the latter half of the 16th century (Phase 8) when more imported wares appear, possibly reflecting a rise in status (Jarrett 1998). However, inferring status from the pottery assemblage recovered here should be treated with caution because the mound was a working site and unlikely to be a focus of full-time occupation; whether used for food consumption or in the manufacturing process, the ceramics would not be representative of the range and quality of those used in the home. The subsequent apparent rise in the status of the ceramics in the later 16th century may reflect the fact that, following embankment of the river and subsequent reclamation of the marshes, the area became more suitable for domestic habitation. The

assemblage recovered from Phase 8 suggests domestic habitation in the vicinity rather than a direct association with the salt-making industry.

FAUNAL AND PLANT REMAINS AS INDICATORS OF DIET AND ENVIRONMENT

Remains of sheep, cattle and pig indicate domesticates consumed at the site, with pig being the least well represented, and goose possibly also formed part of the diet (Bendrey 1998). Additionally, the midden (Phase 4) contained quantities of sea shells and the remains of what may have been a shell fish meal (mostly mussel with some oyster) were found at the edge of the hearth, suggesting exploitation of the river as a food source. Horse remains (mostly whole bones of mature animals) imply the use of working animals at the site. Charred cereal grains were recovered from Phase 4 and 5 deposits, probably indicating that bread wheat was consumed (a common staple of the medieval diet) though they may have derived simply from straw used to set fires (Branch & Fairburn 1998). Several charred soft fruit fragments were also recovered (but the fruit types were unidentifiable). Taken together with the other evidence they suggest sporadic exploitation of unprocessed foods (Branch & Fairburn 1998).

The waterlogged assemblages from alluvial samples contained few identifiable plant remains, comprising mainly rootlets, including those of the rush and sedge families. Taken together, they indicate local open marshland and disturbed conditions during sediment accumulation.

CONCLUSIONS

The excavations at the former Millfields Caravan Park in Bramber demonstrated that salt was being manufactured on an artificially-created mound, formed from the waste of the industry, from at least the late 13th century and probably continuing until the early 16th. In the early 15th century the mound was flooded on one or more occasions as a direct result of rises in water levels which probably began in the later 14th century, causing a temporary period of abandonment.

Though the existence of late Saxon and medieval saltern mounds in the Adur valley has long been acknowledged and some investigation has been carried out, this was the first opportunity for extensive open area excavation of such a site. The excavation provided the first archaeological evidence for structures on a saltern mound in the valley and the evidence confirms Holden and Hudson's (1981, 128) hypothesis of a late tradition of salt-making at Bramber.

Many Adur valley salterns have been destroyed over the years by ploughing and by the effects of land drainage in the western alluvial floodplain of the Adur between 1967 and 1972 which rendered this erstwhile grazing land suitable for arable farming. As a result, many more standing mounds (notably those south of Bramber village and at Annington, Botolphs, Coombes and Applesham farm (Fig. 2)) were levelled through ploughing. More recently, the importance of the mounds has been recognized and in the mid-1970s a group of saltern mounds surrounded by ditches, to the north-west of the development site in Bramber, were scheduled as an Ancient Monument (Holden 1975b). Indeed, as excavation progressed on the development site in October 1997, a further group of extant mounds across the river (at Saltings Field in Upper Beeding) was being scheduled.

Interestingly, although many saltern mounds have been identified as standing monuments within the Adur Valley (Fig. 2), this one has not previously been recorded and had been totally buried beneath alluvial silts, as were the mounds discovered by fieldwalking at New Monks Farm, Lancing (Holden & Hudson 1981, 129). Many more may be hidden beneath the alluvial deposits of the river valley.

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The site archive including written, drawn and photographic records is deposited in Worthing Museum and Art Gallery, accession number 1997/139.

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