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# THREE LIME BURNING PITS, CHURCH STREET, EASTBOURNE

*by Lawrence Stevens*

*This is the first of several papers relating to excavations carried out by the Eastbourne Natural History and Archaeological Society between 1977 and 1984, during which time two major sites in Old Town, Eastbourne were excavated—at Church Street and the Star Brewery site (now Safeways). The excavations were part of the Eastbourne Urban Medieval Excavation Project, carried out under the direction of the writer and initially intended to throw light on the nucleus of medieval Borne and provide a pottery sequence for that period.*

*The Church Street excavation was carried out as a rescue excavation in advance of road widening (Stevens 1978) and eventually covered 4,000 sq. metres of urban area. Under discussion here are three pits considered to have been associated with limeburning, one of which was securely dated to the 12th century.*

## LOCATION

The urban nucleus of medieval Borne (Eastbourne) is situated on a chalk spur at the eastern end of the Sussex downs, which end to the west of the town at Beachy Head (Fig. 1a). This chalk spur drops to the east to give way to the marshland of the Willingdon Levels. Medieval Borne was centred around the church on the south of the valley of the Bourne Stream and adjacent to a long established road crossing. These two old highways were the route to Willingdon from the south of the town (now blocked) and the way to Seaford, now the A259.

The excavation area (NGR TV 59799941) was situated on the south side of the A259 opposite St Mary's parish church on an area cleared for road widening and known to have been the site of the medieval vicarage and the Jesus House, the edifice of the Brotherhood of Jesus (Fig. 1b). The pits under discussion, namely features 391, 394 and 395, were situated under the northern boundary walls of what had been the street frontage of 29 and 31 Church Street, and extended both into their gardens and under the old pavement (Fig. 1c). As a result of road-widening the site is now under the new road and pavement fronting what is now Church Mews, 23, Church Street and the garages to the east.

The southern edges of pits 394 and 395 were partly overlaid by the foundations of a wall, feature 398, which was almost certainly post-medieval and was constructed of flint boulders and greensand, with some pottery sherds of medieval date in the fill.

## METHOD OF EXCAVATION

Because of the proximity of the pits to the public highway, it was impossible to excavate the pits totally and the extent of the sections exposed were controlled by the physical restrictions of excavating in a relatively deep yet small area, coupled with the friable nature of the fill.

Initially, in all cases, only a small segment of each pit was available for examination (Fig. 1c), and in the case of 394 and 395 only a part of the segments was excavated. Loose fill was encountered during the work on pit 391 to the

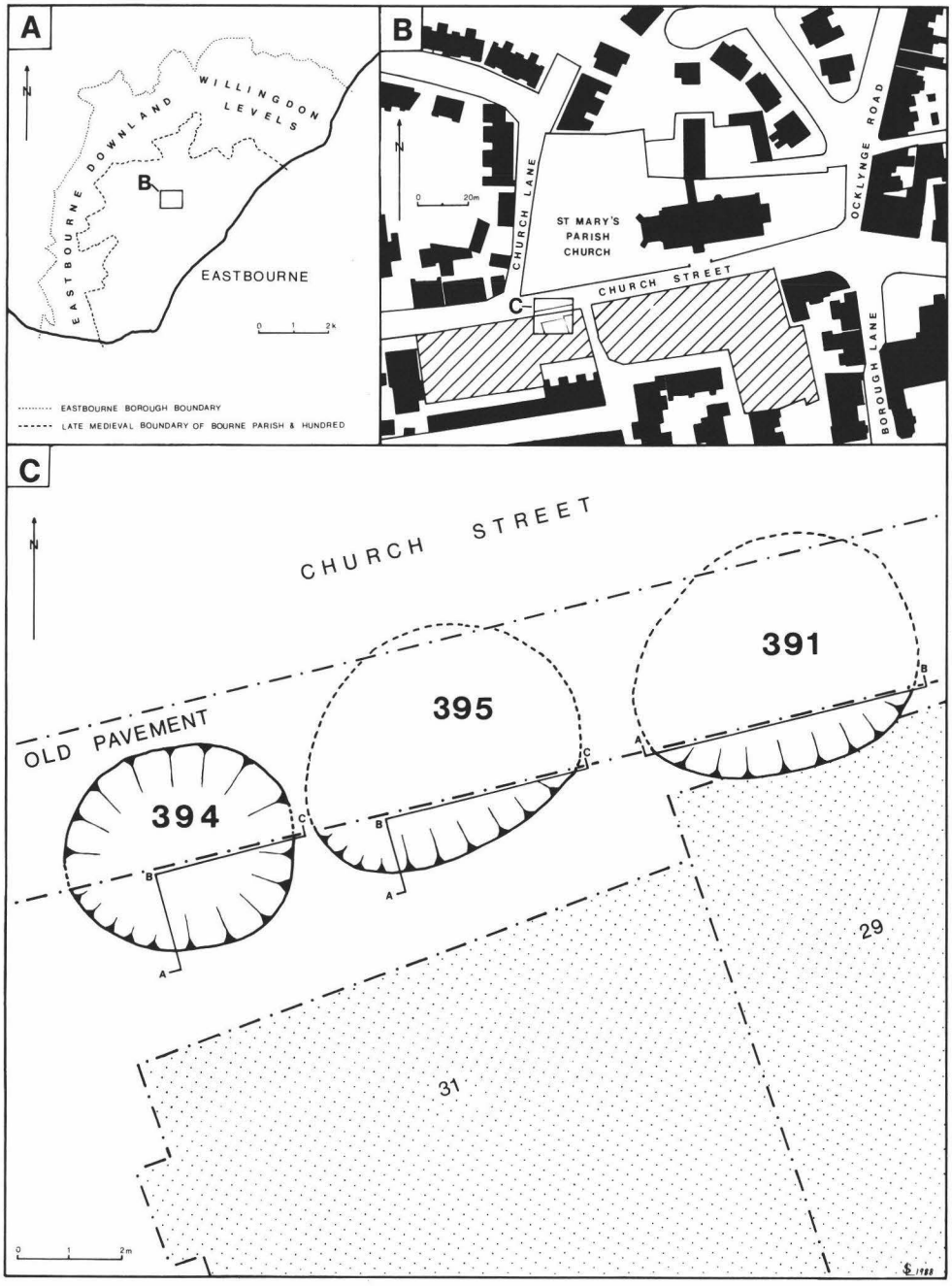


Fig. 1. Location and site plans. (a) Eastbourne area showing the excavation area B and its relation to both late-medieval and modern political boundaries. (b) Plan showing the area excavated by the Eastbourne Urban Medieval Excavation Project (shaded) and the site area under discussion marked C. (c) Plan showing the position of Pits 391, 394 and 395 and their section lines.

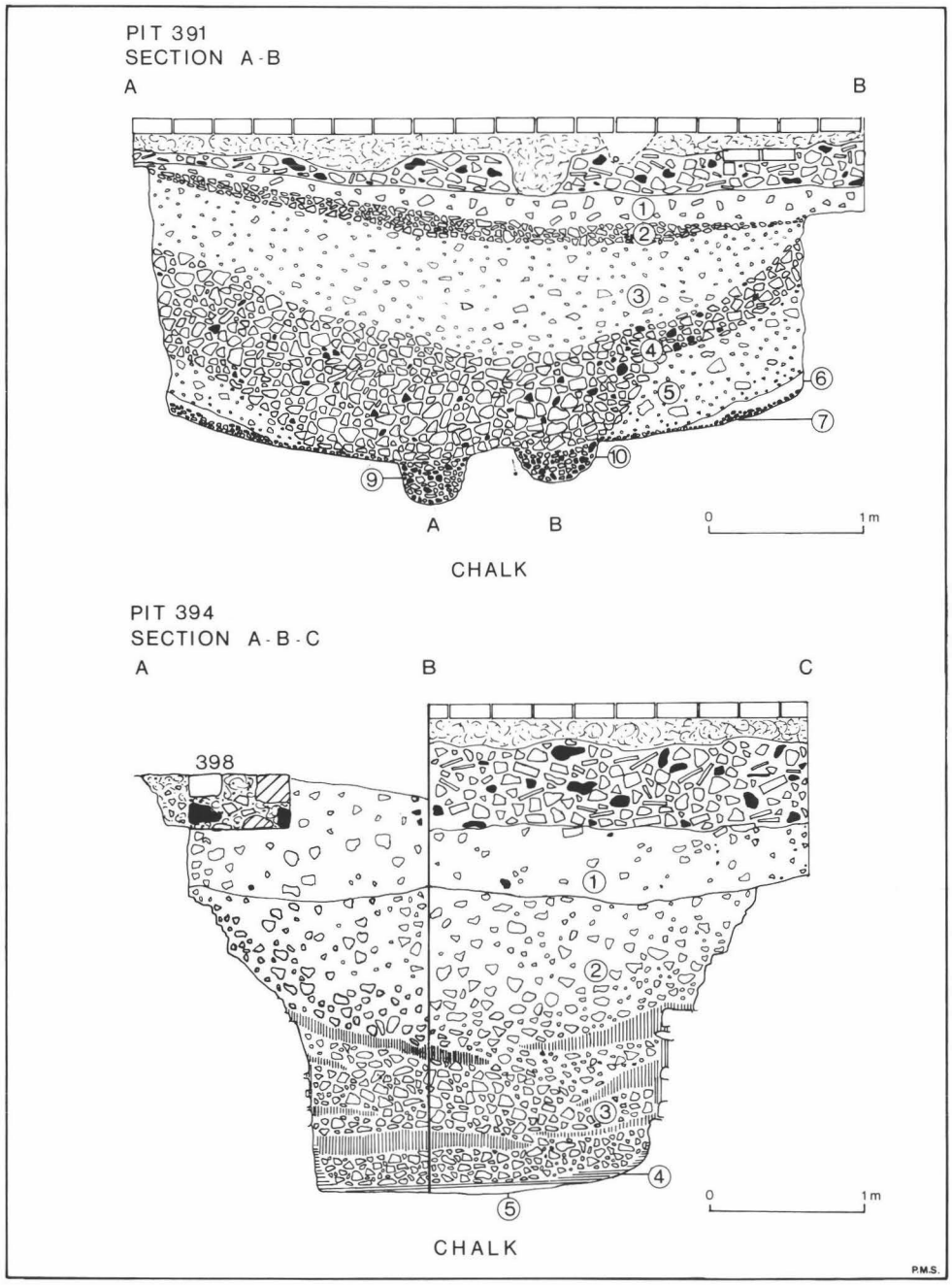


Fig. 2. Section drawing of Pits 391 and 394.

extent that the work was completed by mechanical digger and shored-up using shuttering boards and acrow props. The sections of the other two pits were also constantly being vibrated and loosened by the heavy traffic passing along the road only a metre or so away. These initial excavations were carried out during 1983 but in 1984, when the new road was being constructed, the opportunity was taken to examine the previously unexcavated position of pit 394.

## DESCRIPTIONS

### Pit 391 (Fig. 2)

*Sample sent for analysis.

Layers: 1 Dark brown soil with some chalk fragments, containing pottery and mollusca
2 Loose chalk fragments with soil from Layer 1
3 Yellow/grey silty fill with chalk and mollusca
4 Very loose layer of multi-sized chalk fragments, some of which had been burnt
5 Fine chalk layer slightly clayey and grey, with some large chalk lumps
6* (sample 9) Chalk fragments with a form of puddled chalk forming a calcareous concretion
7* (sample 10) Layer of ash with burnt chalk fragments
8* (sample 11) Floor of calcareous concretion with ash and burnt clay
9* (sample 12) Ash layer in channel A
10* (sample 13) Ash layer in channel B

The exposed portion of pit 391 which was steep sided, measured approximately 4.5 metres east-west and 2.05 metres north-south and 1.4 metres deep and had been cut into natural chalk. In the floor were what appeared to be the ends of two channels cut into the chalk and lettered A

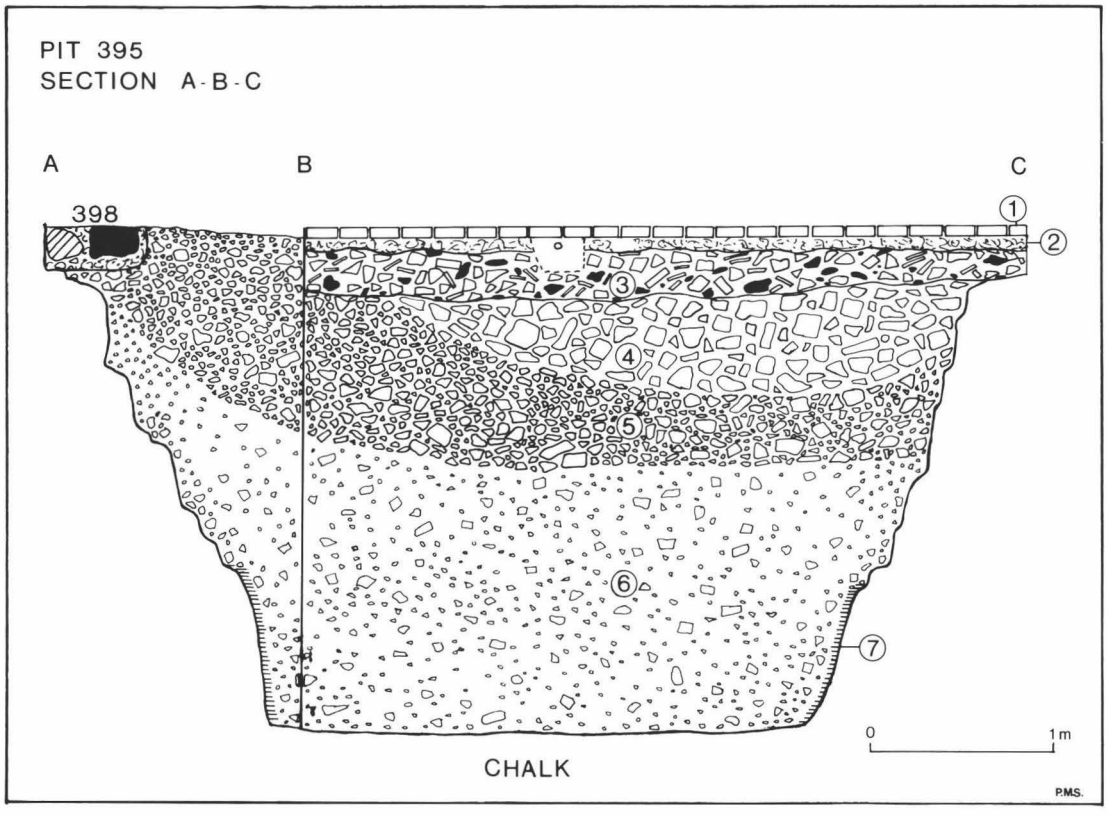


Fig. 3. Section drawing of Pit 395.

and B (Fig. 2). A measured 0.45 metre wide and 0.26 metre deep and its floor sloped downwards to the north. B measured 0.55 metre wide and 0.20 metre deep and its floor also sloped downwards to the north, but at a steeper angle. Both channels had ash on their floors and their chalk sides were grey. Above the pit floor, which was also discoloured grey, there was a layer of loose ash in which there were lumps of ash (layer 7). Overlaying this ash layer and extending as a scree for nearly a metre from the side of the pit was a deposit of calcareous concretions around small lumps of chalk (layer 6). Above these lower layers were several loosely packed layers (1–5), composed of chalk fragments, many of which appeared to have been heated.

Pit 394 (Fig. 2)

Layers: A Chalk and mortar fill associated with modern boundary wall
1 Grey/Yellow clayish fill with chalk lumps
2 Grey/chalky/clayey fill with larger and more numerous chalk lumps
2A* (sample 5) Lens of black chalky material with mollusca (in 1984 section–not shown)
3 Loosely packed chalk in grey clayey fill with lenses of red burnt clay
4 Puddled chalk type lining of the pit sides behind which there are traces of burning and blackened material
5* (sample 7) Black ash layer containing fragments of burnt wood
6* (sample 6 & 8) Burnt clay on side of pit

In 1981 the edge of the exposed portion of the pit measured 4.1 metres east-west and 1.85 metres north-south, of which only approximately half was excavated (Fig. 1c). The sides of the 2.4 metres deep pit were steep and the lower metre of its sides were almost vertical. Clay in a plastic state had been pushed into the cavities of the uneven chalk side, thus providing a smooth lining. The clay had been reddened by heat and lenses of the material showing in the section suggested that the pit may have been lined higher up, but had crumbled and fallen in. The floor was covered with a black ash layer of calcareous concretion which at first was thought to have been puddled clay, but on closer examination, the structure seemed more akin to tufa and may represent some form of product during lime burning. Layers 1–3 are similar in that they are composed of varying sizes of loosely packed chalk, much of which is of a grey colour and had probably been heated. These layers also contained zoological material and pottery.

The burnt clay on the side of the pit (layer 6) was subjected to archaeomagnetic analysis by Anthony Clark, late of the Ancient Monuments Laboratory, who reported that the material was very good and gave a date of $1170 \pm 25$ at the 68 per cent level of confidence.

Subsequently, in 1984, the pit was further examined when the new road was being built and the opportunity was taken to examine the northern side of the pit and take pottery sherd and associated soil samples for thermo-luminescence dating (samples 1–4). In the event, these were not used, but during the excavation of the trench the fill collapsed with the result that the northern extent of the pit was revealed.

Pit 395 (Fig. 3)

Layers: 1 Brick pavement
2 Concrete
3 Modern levelling rubble
4 Loosely packed large chalk fragments in grey/brown soil
5 Loosely packed medium and small chalk fragments some of which had been burnt and were pinky-grey in colour
6 Small and tiny chalk fragments in yellow/browny grey clayey soil with fragments of puddled chalk and tiny fragments of wood
7* (sample 14) Puddled chalk type material
8* (sample 15 & 16) conglomerated chalk, flint, etc.

The available area for excavation of pit 395 was limited to a segment 5 metres east-west and 1.06 metres north-south. Only a portion of this area was excavated and the floor of the pit was examined by an even smaller excavation because there was little room for shuttering and the fill was exceedingly loose and was constantly falling-in due to the traffic vibrations.

The pit was 2.6 metres deep and may have been the largest of the three. The lower 1 metre of the exposed side was covered with what appeared to have been puddled chalk and is a residue of the

lime-burning process. On the floor (layer 8), there was a mass of greyish chalk lumps and calcined flint conglomerated in a calcine matrix in which there were also fragments of oyster, animal bone and medieval pottery. Layers 4–6 consisted of variations of loose chalk fragments, some of which were grey, while others were pink, together with fragments of burnt wood. The remaining three layers consisted of modern chalk rubble, concrete and the brick pavement.

## THE FINDS

The finds are deposited at the Eastbourne Local History Museum, Towner Art Gallery, Borough Lane, Eastbourne.

*Stone*

Feature 394/1 Whetstone—fragment of dark, brownish-grey, finely bedded quartzose sandstone. The most local source being the lower cretaceous rocks of the Weald, or a waterworn pebble. I am indebted to Mr R. W. Sanderson of the Geological Museum for this identification.

395 Six small fragments of Eastbourne greensand

*Flint*

Feature 391/2 Four small flakes (? one with secondary working)

394/1 One struck flake

394/2 Eleven struck flakes

394/3 One flake (with evidence of percussion on bulbar end)

395 Eight flakes

395 Two flint pebbles

*The chalk* (R. W. Sanderson)

Samples from all three pits were examined and all were slightly brittle, fine grained pale grey limestones. None appeared to have been burnt as unaltered shell fragments were present. The material is undoubtedly chalk and the greyish colour indicating a degree of impurity–probably in the form of clay minerals. This and their general appearance suggests that this material is derived from the Lower Chalk horizons. As the pits themselves are cut into Lower Chalk, there is no reason to suggest that the material was brought from any great distance, indeed a few hundred metres to the west on East Dean hill, the Middle Chalk is easily encountered and into this there is cut a modern chalk pit.

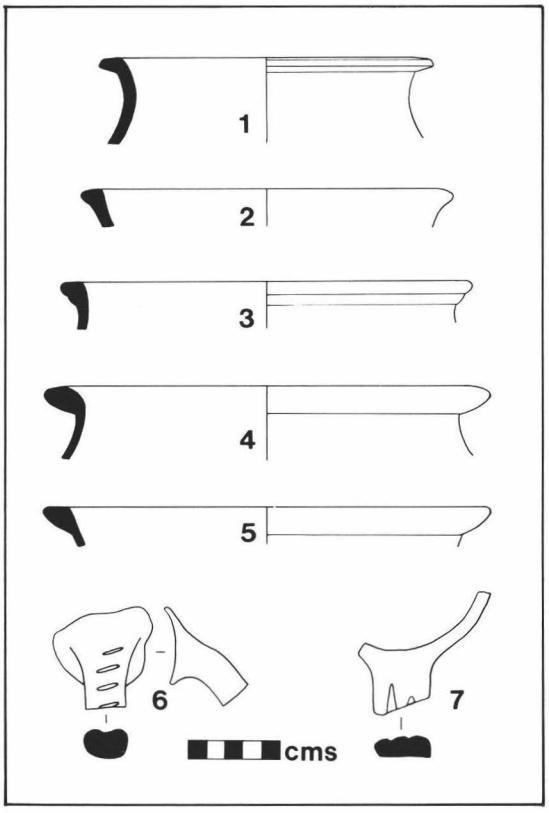


Fig. 4. Medieval pottery, nos. 1–7 (drawn by J. Dove).

*Analysis of lime residue from the pits* (J. Evans)

Each sample was initially inspected under a low power microscope and then subjected to a range of chemical tests with special reference to detect the presence of calcium carbonate and calcium hydroxide (slaked lime). This latter compound is particularly relevant to the lime production question as it represents hydrated lime. It would be highly unlikely that the initial product of lime production, namely calcium oxide (quick lime) would survive the prevailing environmental conditions.

The burning and subsequent processes can be summarised as follows:

| | | | | | |
|---|---|---|---|---|---|
| | $CaCO_3$ Calcium carbonate (chalk, limestone, shell, etc.) | – heat in kiln – | CaO Calcium oxide (quick lime) | + | $CO_2$ ↑ Carbon dioxide (a gas – escapes to atmosphere) |
| then | $CaO + H_2O$ water from environment | —— | Ca (OH) 2 Calcium hydroxide slaked lime | | |
| then | $Ca(OH)2 + CO_2$ from atmosphere | —— | $CaCO_3 + H_2O$ 're-carbonated lime' | | |

Results from the investigation are summarised in the following table:

| FEATURE | | LAYER | |
|---|---|---|---|
| 391 | (bag 9) | 6 | burnt chalk, recarbonated lime, traces of slaked lime and charcoal |
| | (bag 10) | 7 | chalk fragments, recarbonated lime, slaked lime |
| | (bag 11) | 8 | burnt clay, recarbonated material |
| | (bag 12) | Sample A | lumps of chalk, no signs of burning |
| | (bag 13) | Sample B | As sample A |
| 394 | (bag 5) | 2A | shell fragments, chalk fragments |
| | (bags 6 & 8) (2 samples) | 6 | burnt clay, recarbonated lime |
| | (bag 7) | 5 | burnt chalk fragments, carbonated lime |
| 395 | (bag 14) | 7 | chalk, burnt chalk, recarbonated lime, slaked lime |
| | (bag 15) | 8 | chalk, recarbonated lime, some charcoal |

When wood is burnt in a kiln or similar structure, the resulting ash may well contain calcium oxide and consequently the presence of burnt clay, charcoal and recarbonated lime would not be unexpected. However, in the present situation the additional presence of substantial amounts of burnt chalk and slaked lime is strongly indicative that the recarbonated material detected here is reflective of lime burning.

CALCINED FLINT

| Feature/layer | Number of fragments | Weight Kg |
|---|---|---|
| Above Wall in F.391 | 2 | 0.0585 |
| 391/1 | 4 | 0.075 |
| 391/2 | 42 | 0.920 |
| 394/1 | 2 | 0.019 |
| 394/2 | 12 | 0.1353 |
| 395 | 90 | 1.0077 |

*Brick*

| | |
|---|---|
| Feature 394/1 | Six small fragments of red brick |
| 398 | Fragments of vitrified brick |

*Tile* – Roof

| | |
|---|---|
| Feature 394/1 | Fragment of fully oxidised clay roof tile 13 mm. thick |
| 395 | Two fragments of clay roof tile 17 mm. thick |

*Tile* – Floor

| | |
|---|---|
| Feature 395 | ? Floor tile fragment 37 mm. thick |

*The pottery* (J. Dove)

A total of 94 sherds, weighing 726 gm. were recovered from the three features, F.391, F.394 and F.395. The sherds were carefully examined and the number of sherds tabulated against the most probable period of manufacture. References for Roman and Iron Age pottery were taken from Young (1977) and Hodson (1962) respectively, while the reference sources for the later fabrics were Down (1978) and Allen (1984).

| Feature | Period | | Wt.gm. | Rims | Bases | Handles | Other |
|---|---|---|---|---|---|---|---|
| 391/1 | Medieval 12/13th C | Coarse fabric tempered with numerous flint quartz | 105 | 1 | – | – | 17 |
| | Medieval 13/14th C | Medium sand tempered fabric | 5 | – | – | – | 2 |
| 391/2 | Late Bronze Age | Coarse fabric tempered with calcined flint | 30 | – | – | – | 2 |
| | Romano British | East Sussex ware | 10 | 1 | – | – | – |
| | | Oxford Parchment ware | 9 | – | – | – | 1 |
| | Medieval 12/13th C | Coarse fabric tempered with numerous flint quartz | 40 | – | 1 | – | 8 |
| 394/1 | Iron Age | Similar to pottery from Green St. E/B | 5 | – | – | – | 1 |
| | Medieval 12/13th C | Coarse fabric tempered with numerous flint quartz | 10 | – | – | – | 1 |
| | 16/17th C | Hard fine reddish fabric | 80 | 1 | – | 1 | – |
| | 16/17th C | Frechen Salt-Glazed stoneware | 10 | 1 | – | – | – |
| 394/2 | Medieval 12/13th C | Coarse fabric tempered with numerous flint quartz | 42 | 1 | – | – | 4 |
| 394/3 | Medieval 12/13th C | Coarse fabric tempered with numerous flint quartz | 18 | 1 | – | – | 1 |
| 395 | Iron Age | Similar to pottery from Green St. E/B | 9 | – | – | – | 3 |
| | Romano-British | East Sussex ware | 3 | – | – | – | 2 |
| | Medieval 12th C | Coarse fabric tempered with flint quartz and chalk | 55 | 1 | – | – | – |
| | Medieval 12/13th C | Coarse fabric tempered with numerous flint quartz | 190 | 3 | 1 | – | 33 |
| | Medieval 13/14th C | Sand tempered fabric | 20 | – | – | – | 2 |
| | | Sand tempered green glaze | 85 | – | – | 1 | 3 |

Illustrated Pottery (Fig. 4)

1. Rim from cooking pot tempered with numerous flint quartz up to 2 mm. Grey core with red surfaces.
   F.395 12/13th century
2. Rim from bowl tempered with numerous flint quartz up to 1.5 mm.
   Grey core with red surfaces
   F.394/3 12/13th century
3. Rim from cooking pot tempered with numerous flint quartz up to 1.5 mm. Grey core with black outer surfaces.
   F.391/1 12/13th century
4. Rim from cooking pot coarse fabric tempered with flint quartz up to 3 mm. and sparse chalk
   F.395 12th century
5. Rim from bowl tempered with numerous flint quartz up to 1.5 mm.
   Grey core with patchy red/black surfaces
   F.394/2 12/13th century
6. Handle from jug with deep slashings, sand tempered.
   Grey core with red surfaces and patchy green glaze
   F.395 13/14th century
7. Handle and rim from jug. Hard well fired fabric tempered with fine sand. Red core and surfaces
   F.391/1 15/16th century

The following table correlates the distribution of sherds over the three features.

| PERIOD | F.391 | | F.394 | | | F.395 |
|---|---|---|---|---|---|---|
| | Layer 1 | Layer 2 | Layer 1 | Layer 2 | Layer 3 | |
| Late Bronze Age | – | 2<br>30 gm | – | – | – | – |
| Iron Age | – | – | 1<br>5 gm | – | – | 3<br>9 gm |
| Romano British | – | 2<br>19 gm | – | – | – | 2<br>3 gm |
| Medieval 12th C | – | – | – | – | – | 1<br>55 gm |
| Medieval 12/13th C | 1'8<br>105 gm | 9<br>40 gm | 1<br>10 gm | 5<br>42 gm | 2<br>18 gm | 37<br>190 gm |
| Medieval 13/14th C | 2<br>5 gm | – | – | – | – | 6<br>105 gm |
| 16/17th C | – | – | 3<br>90 gm | – | – | – |

*Summary*

Since the Romano-British and earlier sherds were found together with medieval pottery, it must be concluded that they were residual. Most show signs of weathering, suggesting that this process had occurred before burial.

Pottery of the 12/13th century was present in all three features and of the same fabric. These sherds may be contemporary. However, this could not be proved, since none could be fitted together. The later pottery, which was present in features 391 and 394, occurred only in the upper layers. A 12th century date is therefore suggested for these two features.

The lack of stratification in feature 395 and the presence of 13/14th century pottery, tends to suggest a slightly later date for this feature.

*Wood*

| | |
|---|---|
| Feature 394/2A | (excavated 1984)<br>Fragments of charcoal identified as Quercus sp. (oak) (J. Ede) |
| 395 | Fragment of charcoal identified as Fagus sp. (beech) (C. Cartwright) |

*The animal bones* (P. M. Stevens)

Pit 391 contained three layers, viz. 391/1 and 391/2 with a layer 391/A; containing Cattle (*Bos* sp.); Sheep/Goat (*Ovicaprid*); Domestic fowl (*Gallus* sp.); and Frog (*Rana* sp.). In all a total of 24 bones was recovered.

Layer 391/1 contained five sheep/goat fragments including tibia, mandible, horn core and limb fragment, together with one single upper molar. Also two domestic fowl bones—humerus and tibiotarsus fragment.

Layer 391/2 contained nine fragments, including four cattle fragments, two longbone fragments, one ilium fragment and one complete navicular cuboid. Sheep/goat remains included one distal humerus fragment together with two longbone and two skull fragments.

Layer 391/A contained eight frog bones and fragments, probably all from the same frog.

There is little to note from these bones apart from some butchery chops and slight dog gnawing on some fragments. Apart from the remains of the frog, the bones appear to represent a small accumulation of domestic rubbish.

Construction Trench for Wall – F.398

Three bone fragments were recovered from this construction trench. Of these, one was a midshaft fragment of cattle tibia—heavily

butchered, and two sheep/goat size rib fragments.

Feature 394

The bones collected from F.394 total 62 fragments, recovered from two layers, 1 and 3. The species represented are cattle, sheep/goat, and dog (*Canis* sp.).

Layer 1.

This layer contained 16 bones, of which there were four cattle bones, four sheep/goat bones and eight dog bones. The cattle bones included scapula fragments, calcaneum and hyoid and one midshaft fragment of a juvenile tibia. The sheep/goat remains included two limb bone fragments and one rib fragment, together with one first phalange. The dog remains included four rib fragments, three scapula fragments and one lumbar vertebrae.

Layer 3.

This layer contained 36 bone fragments of which 13 were from cattle, four from sheep/goat and 19 from dog. The cattle bones included one calcaneum, four rib fragments, one juvenile ischium fragment, one limb bone fragment and six unidentifiable fragments. The sheep/goat fragments include one limb bone fragment, one vertebral fragment, one patella and one thoracic vertebrae which was dog gnawed. The dog remains form the largest group from this layer and include metapodials, a fragment of femur, seven rib fragments and six vertebral fragments including one lumbar vertebrae with ventral exotoses and lipping which would presumably have caused some fusion of the joint between two vertebrae. The broken mandible from this layer gives little indication of the age or size of the animal apart from the fact that the teeth are permanent.

Again, little can be said about this material, apart from the fact that it is most likely that it may have been collected from the immediate area when the pit was being infilled. There is no butchery evidence on any of the bones and only one shows signs of dog gnawing.

Feature 395

The bones collected from F.395, total 83 fragments and are represented by cattle; sheep/goat; pig; domestic fowl, cat (*Fellis* sp.); dog and fish (prob. *Gadus* sp.).

The cattle bones only produced six fragments (7 per cent) and included distal humerus, with butchered midshaft; two vertebral and two longbone and one skull fragment. Sheep/goat are represented by 55 fragments (66.2 per cent) and include skull, rib and vertebral fragments, scapula and metacarpal fragments, together with a butchered sacrum fragment, three upper molars, one upper pre-molar all worn, as well as a broken left jaw with M2 and M3 both well worn, with several longbone fragments and some unidentifiable fragments. Pig is represented by seven fragments (8.4 per cent), which include scapula, ulna and metatarsal fragments, two loose teeth and a jaw fragment with pm4, M1 and M2 present and worn, with M3 visible in crypt. Cat is represented by 10 (12 per cent) unfused fragments and a juvenile maxilla fragment. Those bones represented are scapula, radius and ulna, humerus, tibia and femur, together with two metapodials and vertebrae. Dog is represented by a complete

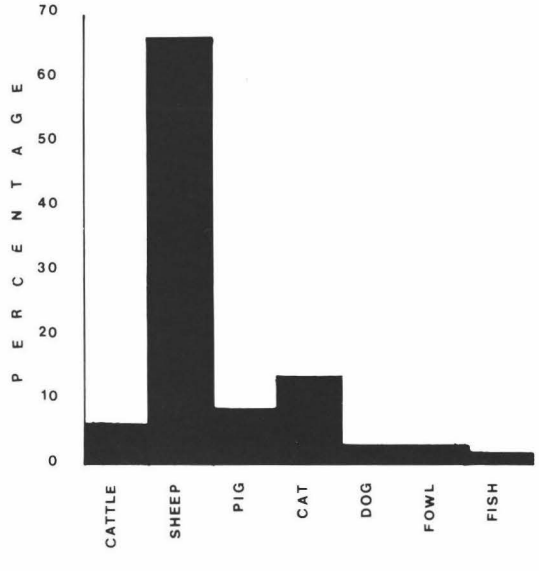


Fig. 5. Histogram showing percentage of species from Pit 395.

astragalus and calcaneum (Collie size) and represent 2.4 per cent of the total. Domestic fowl (2.4 per cent) is represented by two radius fragments and fish by (1.2 per cent) by a branchiostegal fragment (Fig. 5).

There is nothing remarkable about the bone representation from this feature. The remains would appear to be a general accumulation of domestic rubbish, with some butchery evidence—mainly chop marks and also some dog gnawing on a few fragments. Taken in isolation, it may seem odd to recover a few cat and dog bones from this pit—but if the site is looked at as a whole—it can be seen that it would be more odd if none were found. Large numbers of each have been recovered from features of all periods throughout the site.

*Mollusca* (Dr D. Adams)

With the exception of Helix aspersa, all the shells from Features 391 and 395, are marine and can be found in the intertidal zone or at the low water mark. It was noted that they probably represent the waste of a marine food source for, with the exception of Nassarius reticulatus, all are edible and are commonly eaten.

That the assemblage is consistent with the rubbish from molluscs collected for food is further supported by the total absence of juveniles, suggesting that the individuals had been harvested. There are no shells present that could not have been collected locally. It is interesting to note that two species of limpet are present, but that this may just represent two varieties of vulgata, for mixed populations of aspera and vulgata are known to occur.

| Feature | No. present | Weight |
|---|---|---|
| Feature 391/1 | | |
| Ostrea edulis | 1 fragment | 2.5 g |
| Patella vulgata | 5 fragments inc. 2 apices | 2.5 g |
| Mytilus edulis | 26 apical fragments | 14.6 g |
| | very small fragments | 11.1 g |
| Feature 391/2 | | |
| Ostrea edulis | 5 upper valves | 67.0 g |
| | 2 fragments | 7.8 g |
| Patella vulgata | 6 shells | 7.3 g |
| (rough ribbed) | 2 fragments inc. 1 apex | 0.6 g |
| Patella aspera (poss.) | 3 shells | 6.8 g |
| (smooth ribbed) | 2 fragments inc. 1 apex | 2.9 g |
| Mytilus edulis | 1 valve | 1.9 g |
| | 96 apical fragments | 63.1 g |
| | very small fragments | 43.5 g |
| Feature 394/3 | | |
| Ostrea edulis | 1 valve | 28.0 g |
| Feature 395 | | |
| Ostrea edulis | 1 valve (upper) | 3.3 g |
| | 5 fragments | 7.9 g |
| Helix aspersa | 2 shells | 6.7 g |
| | 4 fragments | 0.5 g |
| Nassarius reticulatus | 1 shell | 1.3 g |
| Buccinium undatum | 1 shell | 3.5 g |
| Littorina littorea | 4 shells | 18.3 g |
| Patella vulgata | 2 shells | 2.5 g |
| | 1 apex fragment | 1.5 g |
| | 6 fragments | 3.9 g |
| Patella aspera | 3 shells | 7.1 g |
| | 1 fragment | 1.3 g |
| Mytilus edulis | 125 apical fragments | 84.6 g |
| | fragments | 131.5 g |

## CONCLUSION

The three pits were clearly limeburning pits of the flue-less intermittent type, that is, they were not continuously fuelled and topped-up with limestone as the fire burnt upwards, but were only capable of a single firing, after which the burnt limestone would have been removed before the pit was recharged with more fuel and chalk ready for the next firing. A more detailed description of limeburning will be found in the history of the Amberley chalk pits (Aldsworth 1979).

While description of early limekilns with flues abound and include one described by Cato (234–149 BC), references to flue-less limeburning pits are scarce and no excavated examples are known to the writer. Documentary evidence is vague on account of the use of the unqualified word 'pit'. For example, at Pevensey Castle, in 1407, repair costs incurred 18*d* for making a pit to burn lime (Salzmann 1906). Unfortunately there is no way of telling if this had a flue or stoke-hole or neither.

In the absence of known British parallels of flue-less kilns, an insight into their technology and efficiency can be gained from similar contemporary pits which are being used in intermediate technology programmes in the Third World. Such small-scale limeburning are described for their areas (Wingate 1985) and afford useful comparisons.

Such primitive limeburning pits are known to be capable of producing lime in relatively small, yet viable quantities. The fill of the pit consists of two parts, the lower being filled with fuel with the limestone or calcareous material of the upper part heaped above it in the form of a dome. Built into this dome may be six or so lighting ports at ground level around the periphery of the dome, which provide much of the draught for the fire. Should the flames burn through the dome, they are stemmed and sealed by the addition of more calcareous material.

In a lime pit in Rorotongan, in the Cook Islands, (Ryan 1961) the fuel layers were laid in right angle rows with smaller kindling material layered between. The six lighting ports were ignited simultaneously and spare piles of coral were spaced around the kiln so that during firing, more coral could be thrown on the areas where the fire broke through. As the kiln burns the coral boulders disintegrate and as the wood burns, the whole mass settles slowly into the pit until only the cooling lime is left.

A similar limeburning pit called a sod kiln, constructed in a conical pit with built up sides, has been described (Gwilt 1888). In this type of kiln the limestone and fuel are loaded into the pit in alternate layers to the top and they are covered with sods. Gwilt points out that this method is tedious and far from economical, noting that the quantity of the fuel and not the quality of the stone determines the quality of the lime. Although there is evidence of the local use of sea coal for limeburning at Willingdon in 1288 (*V.C.H. Sussex*; 231) the fuel used in the pits under discussion appears to have been wood, in all probability, oak and beech. In the tropical examples the fuel is often a mixture of fast and slow burning woods to which coal and peat are sometimes added. Wood was used at the Pevensey Castle lime pits (Salzmann 1906) when 27*s* 1*d* was paid for chips and odd pieces of wood for firing three pits.

When limeburning in pits with the fill in alternate layers it is best to ignite the load from the bottom and one such method was to construct a wooden chimney through the centre of the fill down which, at the appropriate time, a burning of cotton was dropped (Searle 1935).

In all these examples, as the firing proceeds, the materials settle into the pit where the heat is sometimes retained for a week or so. On cooling the material is sorted—the lumps are picked out and the unburnt stone is sorted from the good quicklime by its heavier feel. A vivid picture of firing one of these primitive kilns (Dr Stephan Cramer, pers. comm.) describes the work entailed in their construction, firing and emptying. There is no method by which additional fuel can be introduced and it is therefore essential that during the firing the top

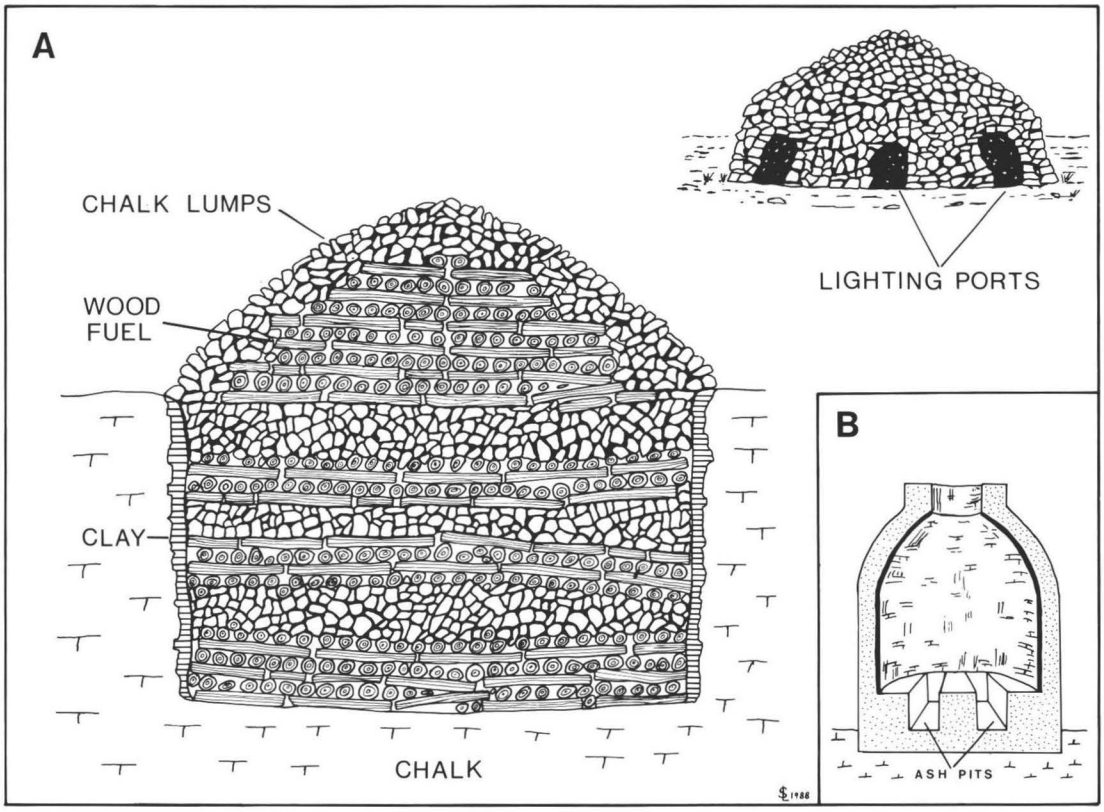


Fig. 6. (a) Conjectural reconstruction of a pit kiln. (b) Section of a flare kiln showing ash pits. (After Wingate, Searle and others).

must inhibit the fire burning through. Inadequate temperature will result in worthless firing which in economic terms is a tragedy.

The product of each firing varies and the fuel consumption is high and may be as much as three times greater than the cubic capacity of the quicklime. Neville Hill (pers. comm.) considers that as much as 18 $m^3$ of palm wood is necessary for the production of 5 $m^3$ of lime. If we take this ratio it would seem that the Eastbourne pits could each be expected to produce approximately 6.5 $m^3$ of lime.

That we have here three pits in a row may not just be a coincidence for such arrangements have been recorded in more recent times. A similar row of intermittent flue kilns set on the side of a valley at Nebeur, Tunisia were used for processing coral (Eeckhoudt 1979) and a series of three similar pits is described at Rorotonga (Ryan 1961). In the latter example the three pits provided a form of continuous burning for while one pit is burning, another is being prepared and the third is being drawn off. There is therefore the possibility that the pits at Eastbourne might have been run on the same lines. In this connection it is worth noting, again at Pevensey Castle in 1407, '30s was paid for burning 3 pits of lime' (Salzmann 1906).

Burnt clay was present in all the excavated pits and its use in limeburning kilns is well attested. Searle describes the plastering of the kiln sides with clay paste except those near the

ground where the holes are left to admit air. In pit 394 considerable quantities were still in situ on the side of the pit where it had been used as a lining and it is this stable burnt clay from which the archaeomagnetic sample was taken. Clay was present as a lining at both Old Erringham (Holden 1980) and Bramber Castle (Barton and Holden 1977). In all probability the lining of the chalk sides of the pit with clay was also an attempt to reduce the loss of heat through the pit side and also to stabilise them.

The evidence for channels in the floor of pit 391 can be compared with the parallel grates found in the floors of flare kilns (Fig. 6b). Although there is no possibility that this pit belonged to such a kiln type, no doubt the channels were intended to improve the draught.

It is not possible to say when the use of the flue-less pit kiln ceased use but the recently excavated flue kiln at Guildford (Arthur 1986), produced a 12th-century archaeomagnetic date that predates the Eastbourne example.

Although it is possible that the limeburning pits were put to an agricultural use, it would seem most likely that in the urban area of medieval Borne, adjacent to the parish church, they were used for building lime. In this connection, the late Mr Eric Holden has pointed out that the grey Lower Chalk is best for the production of lime for mortar for laying masonry as it possesses a clay-fraction. The archaeomagnetic date of 1175 and their close proximity to the church leads one to postulate on their having been used to build the church, which took place around this date, between 1160 and 1190 (Budgen 1912).

The absence of long-term silting in the stratigraphy of all the pits suggests that after the pits had ceased production they were filled quite rapidly, but not before the clay on the sides had begun to fall into the rising fill. Domestic rubbish may be seen either as the rubbish from the builders or merely nearby habitation, which will be discussed in a later paper.

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