

Excavation at Borelli Yard, Farnham: the tile kiln

NICHOLAS RIALL

with contributions by
A J CLARK and ROBERT FOOT

This report describes the excavation of a roof tile kiln built with great brick, voussoirs and tile which is dated on archaeological and documentary grounds to 1200–20. Products from this kiln have been identified in Farnham Castle and Bishop's Waltham Palace. The connections between the Borelli Yard kiln and those in Farnham Park and at Guildford Castle and Palace are explored. Important documentary evidence for tile production at Highclere (Hampshire) is examined to illustrate the organization and running of the roof tile industry.

Background

This paper provides the second, and last, part of the report on the excavation at Borelli Yard, Farnham. The first part dealt with the town ditch (Riall 1998), while this part concentrates solely on the roof tile kiln. Details of the later history and use of the site are given in an interim report on the excavation (Riall & Shelton-Bunn 1989).

Location and land use

The site is located on the southern edge of Farnham and less than 100m from the river Wey (fig 1). The 1985–6 excavation showed that the town of medieval Farnham was here bounded on the south by a substantial ditch. The land between the ditch and the river was mainly used for agricultural purposes until the late medieval period when land south of the town ditch began to be taken up for habitation. The tilerly lying alongside the southern edge of the town ditch was apparently the only medieval industry in this area apart from agriculture.

Documentary evidence

Any study of medieval Farnham depends, in part, on material contained in the pipe rolls of the bishops of Winchester. These documents, which survive with the occasional gap from the year 1208–9 until late in the medieval period, record in detail expenditure by the bishops and their servants on their castle and manor at Farnham alongside the manorial income from agricultural produce, rents, fines and so on. It is important to make a distinction between the castle and manor, both of which belonged to the bishop, and the borough, which lay within the town ditch (fig 1), details of which do not feature in the pipe rolls.

From the earliest of these pipe rolls it is clear that ceramic roof tile was in use at the castle. It should also be noted that wooden shingles, thatch and lead were also in use as roofing material and, further, that ceramic roof tile was not restricted to use solely as a roofing material – it was also used in fireplaces and ovens. The 1210–11 pipe roll records the sum of 8s 9½d being spent on repairs to the stable with tile. Thereafter roof tile, or the work of the tiler himself, occurs in most years. While brick and tile still *in situ* at the castle can be shown to be the products of the Borelli Yard kiln, it is impossible to make a positive connection between individual pipe rolls, the physical material and Borelli Yard (Riall 1995).

It is possible that an entry in the 1223–4 pipe roll for a John the tiler, who paid a fine of 6d for a piece of land, may be the tiler who operated the Borelli Yard tile kiln and carried

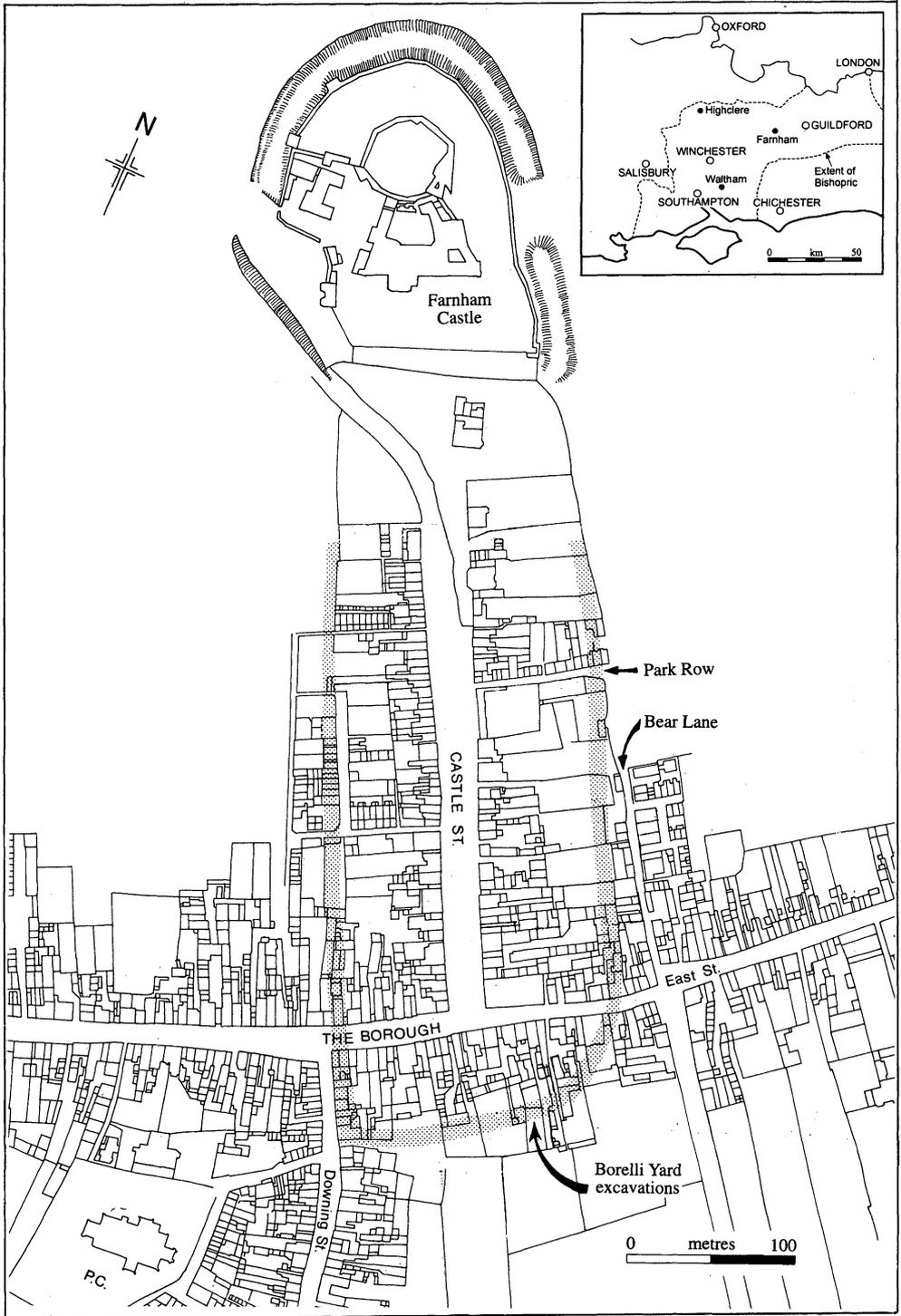


Fig 1 Borelli Yard, Farnham. Location map showing the setting of Borelli Yard and (tone) the possible course of the town ditch (northern section uncertain).

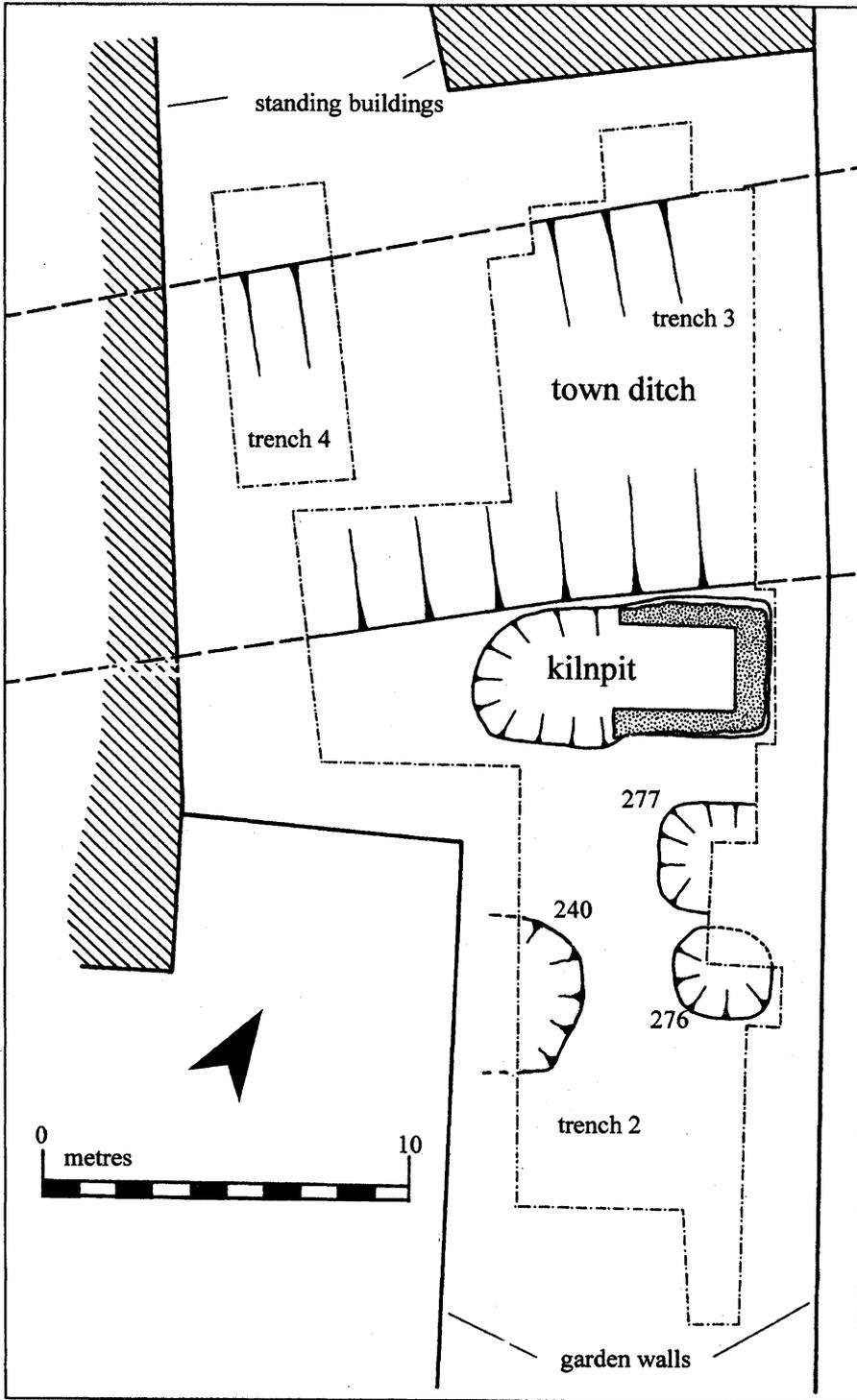


Fig 2 Borelli Yard, Farnham. Site plan showing trenches 2-4 and the main excavated features.

out roofing work in the castle (Riall 1995). He may have been a floor tiler but, at this period, there seems no reason to suppose this craft was being plied at Farnham as there is no documentary reference to clay floor tiles being laid at this date and certainly nothing in the archaeological record to suggest they were being manufactured in the Farnham area. Earlier pipe rolls record, in 1215–16, the payment of a fine of 2s for land by the daughter of the tiler and, in 1217–18, a payment of 12d, for the same reason, by the son of the tiler. These may all relate to the same family, and it may well be that by this date John the tiler had been in business producing tile and, perhaps occasionally, brick from before 1208–9 (the date of the first episcopal pipe roll) and, furthermore, that this same man ran his business from the tilery at Borelli Yard.

The original grant of land for the tilery is not recorded in the pipe rolls and it is presumed that this occurred before 1208–9, a supposition that fits well enough with the archaeological evidence that implies a start date for the Borelli kiln in the period 1190–1208. This accords with the documentary evidence for the castle and from material found built into the castle structure that certainly pre-dates the first pipe roll (Riall forthcoming b).

There is no documentary evidence for the closure of the tilery. The archaeological evidence is ambiguous. A large number of snail shells found in the brick and tile rubble of the kiln along with silt and humus indicate a period of dereliction and abandonment, lasting anything from eighteen months to as much as three or four years, before a phase of demolition when the kiln structure was demolished and the kilnpit filled in. The pipe rolls do however offer an explanation – war.

The years from May 1215 through to the autumn of 1217 were marked by a civil war which saw King John opposed by many of his barons supported by the French led by the Dauphin. King John's principal ally and justiciar was Peter des Roches, the bishop of Winchester who, in late 1214, initiated a widespread programme of military preparations for a war that evidently was seen as becoming inevitable. Among the military works ordered by des Roches was the creation of substantial new urban defences at his town of Taunton, Somerset. The pipe rolls reveal the cost of the excavation of the ditch alone came to £66 17s 19½d (Leach 1984, 11). It is possible that the town ditch at Farnham was recut at the same time although there is no equivalent record in the pipe rolls for this. Even had the Farnham defences been refurbished it would have been in vain for, by the mid-summer of 1216, Farnham, together with much of south-eastern England was in the hands of the rebels (Vincent 1996, 114–49). The war ebbed and flowed, King John died, and des Roches recovered Farnham in March 1217 only to lose it again as the Dauphin counter-attacked until the war was brought to a close by the autumn of 1217. This one-and-a-half-year hiatus provides a potential period during which the Borelli Yard kiln could have been closed down and abandoned.

Excavation procedure

From the moment that the tile kiln was identified and it had been established that a considerable part of it remained intact, it was decided to treat its excavation as a research project. An examination of the ceramic building material from the upper fills of the kilnpit revealed that there were several types of unusual brick and tile present which, following identification of the kiln as such, prompted an assessment of the excavation strategy. It was decided to adopt a very high level of recording matched with the retention of all the ceramic building materials. Every element of the kiln structure (great brick, voussoir, tile, clay in various forms other than definitive ceramic building material, lime mortar and stone) was given a context number, recorded in both the written and drawn records, often in three dimensions, and appears in at least one photograph. All the ceramic building material from the kiln, and indeed from all subsequently excavated features at Borelli Yard, was retained for post-excavation analysis. This policy allowed the fitting together of complete tiles during the post-excavation process and indeed helped to ensure that tile types were correctly

identified from individual contexts or phases. It should be noted that not a single intact tile was recovered from this excavation; all the tiles were pieced together from two or more pieces. This procedure probably accounts for the presence in the identified assemblage of at least three types of ceramic building material that would otherwise have been missed. It is also the case that this depth of analysis provided a greater insight into the range of measurements that pertain to individual forms of both brick and tile.

The area of the kilnpit occupied by the kiln was covered with a scaffolding framework to which were attached several tarpaulins and this provided adequate protection for the site through the damp autumn of 1985 until the excavation closed in late January 1986. Following the removal of all the fills above the kiln structure, and having lifted all the collapsed kiln rubble, the kiln was dismantled piece by piece, working from the firebox end into the kiln, leaving only the base brick of each structural element in place to provide a final picture of the basic layout of the kiln. By the close of the excavation, the entire contents of the kilnpit had been removed, that is, all the stokepit deposits, the ceramic building materials that formed the kiln oven structure and the masonry walls that enclosed the kiln.

It is pertinent to note here that the tile kiln itself formed part of a larger industrial setting, a tiliary, of which various elements were noted although the full extent of the tiliary was not established.

The site occupied by the tile kiln remained undisturbed following its abandonment and backfilling until the mid-20th century when some of the fills of the kilnpit were cut by the construction of an Anderson air-raid shelter.

The finds from the excavation (all the pottery together with samples of the different tile types and fabrics) have been deposited with the Museum of Farnham (acc no A985.169).

The tile kiln

KILNPIT

The tile kiln was constructed in a large, sub-rectangular pit *c* 8m long by *c* 4m wide (figs 3–4).

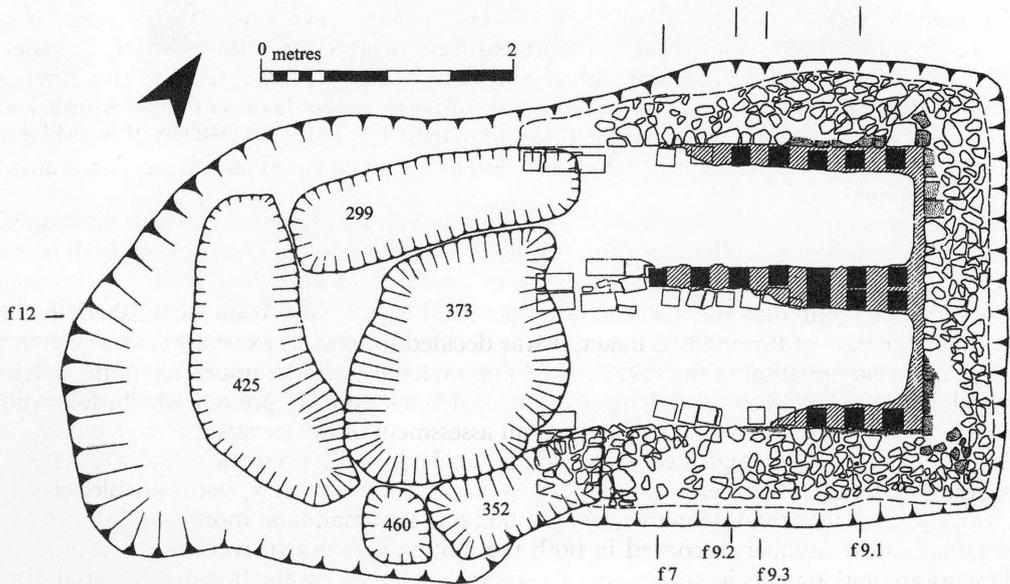


Fig 3 Borelli Yard, Farnham. General plan of the kilnpit. The location of sections across the kilnpit reproduced in this report are shown marked f7–f12 (see figs 7, 9 and 12).

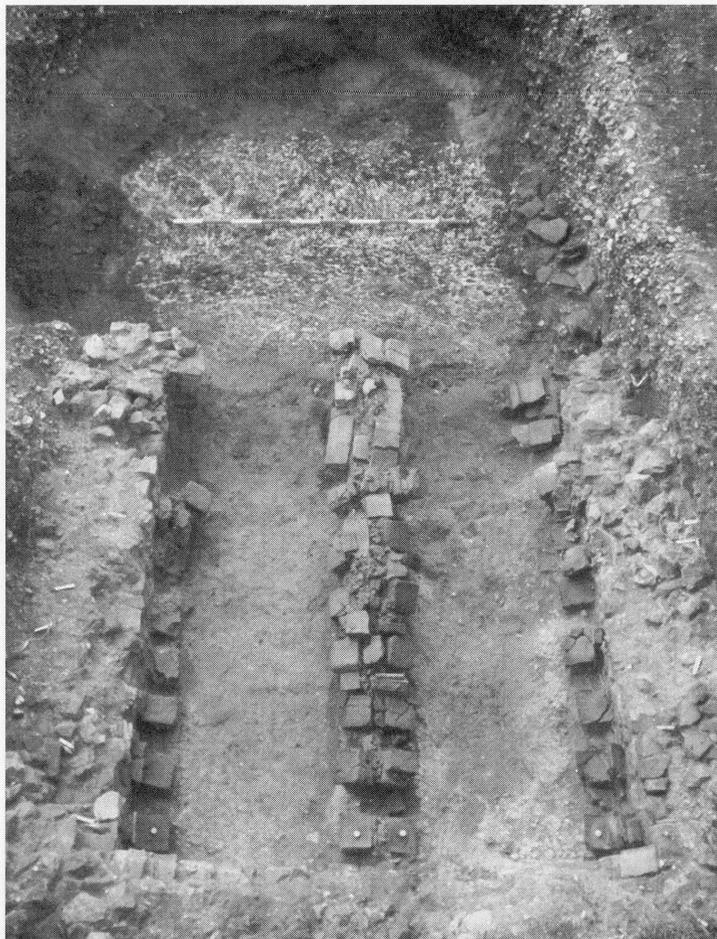


Fig 4 Borelli Yard, Farnham. View from east showing remains of the kiln structure and the final stokepit floor, feature 292, and traces of revetting on north side of stokepit. Scale 2m. (Photograph by Nicholas Riall)

This pit had near vertical sides, with a flat bottom, which had been cut through the natural gravels and sands to a depth of *c* 1.25m. A roughly square masonry structure was built in the eastern half of this pit within which the voussoir, great brick and tile structure of the oven was created to provide the tile kiln itself, leaving the other half of the pit to be used as a stokepit. There was only a minimal amount of stratigraphic contact between the two features (fig 5), kiln and stokepit, which permits each to be treated in isolation: all the phases of activity in the stokepit will be described in one section leaving the more complex development of the kiln itself to be described in stages (fig 4).

CONSTRUCTION OF THE KILN: PRIMARY PHASE

Raft

The construction sequence was as follows. A layer of clay, probably derived from a source close by as this type of clay occurs in the next geological terrace to the south of the site and within 30m of the kiln, was spread and levelled across the eastern half of the kilnpit. This

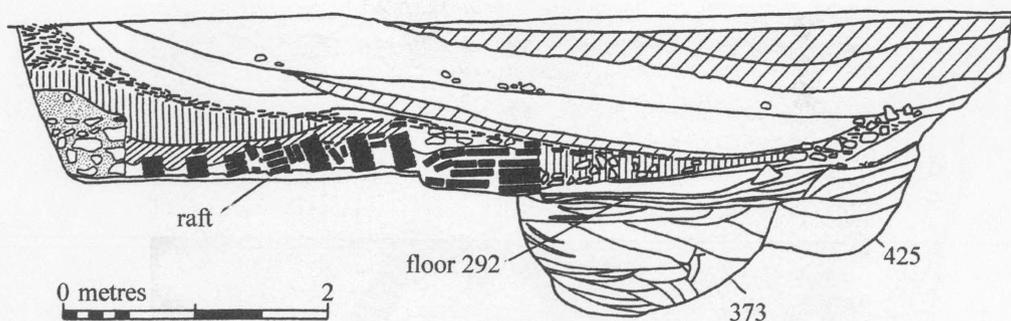


Fig 5 Borelli Yard, Farnham. Composite east-west section through the remains of the kiln structure and the stokepit.

clay raft varied from 0.4 to 0.7m thick and, where it had survived, it is clear that great effort had been made to ensure the raft was a flat surface (figs 5-7). Next, a series of lines were scored into the surface of the raft using a sharp, pointed instrument leaving, even after a long sequence of firings, a series of lines little more than 2-3mm wide. These lines were scribed to provide the placement points of the individual voussoirs for each arch and to ensure the bricks conformed to a straight line down each side of the two flues. Further lines marked the outside face of the masonry walls round the three sides of the kilnpit. The raft had not survived beneath the firebox at the front of the kiln but is presumed to have been present in the primary phase of the kiln structure. The purpose of the raft was to seal the sand, the geological horizon immediately below the gravels on this part of the Farnham terraces, and provide a suitable surface upon which to raise the kiln structure.

Walls

The north, east and south walls were constructed next, leaving the west side with the firebox open. The stonework for the walls was laid in rough courses, bonded together with a sandy lime mortar, and laid to provide a fair face internally. Most of the walling material comprised greensand blocks together with some malmstone, flint nodules; also some great brick, large great brick and some tile was also used as walling material. Much of this brick occurred in the back (east) wall of the kiln where it was presumably used as a ledge (fig 6). Both brick

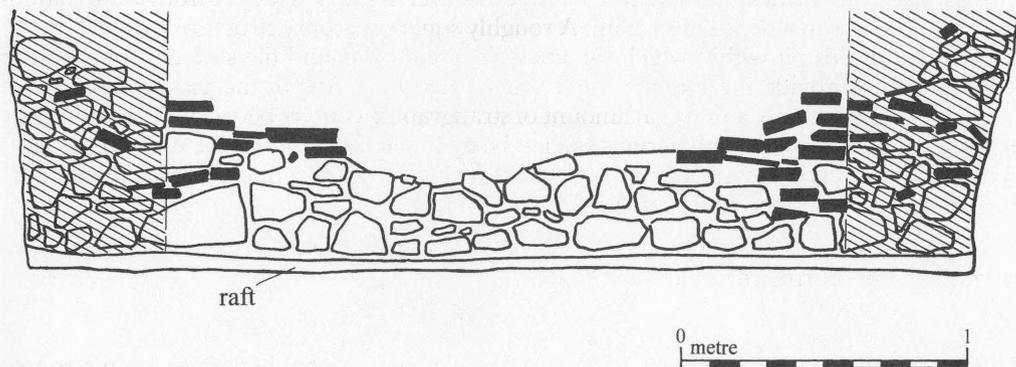


Fig 6 Borelli Yard, Farnham. The east or back wall of the kiln showing an elevation of the wall facing the oven and sections through the north and south walls (shaded).

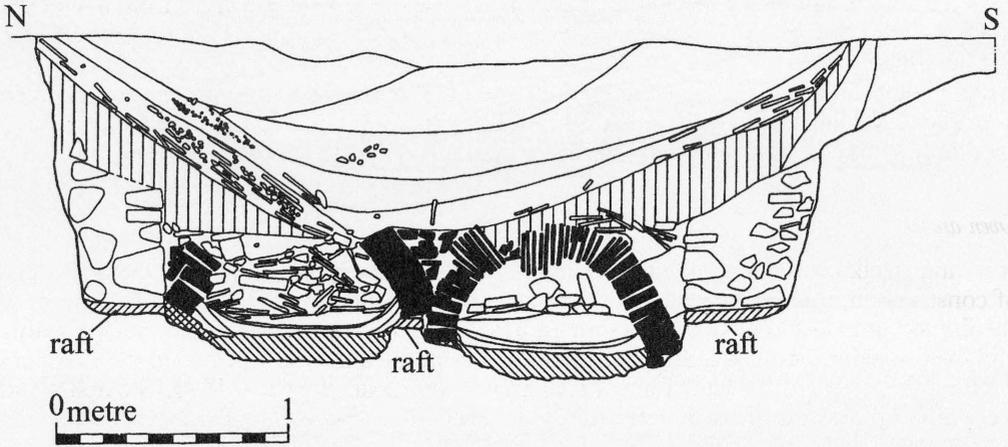


Fig 7 Borelli Yard, Farnham. Section across kilnpit seen from the west showing backfill layers and remains of oven structure. Mortar 269 shown in vertical hatching, the primary raft is marked, with later raft repairs hatched and cross-hatched.

and tile were present in the core of the walls indicating that fired ceramic building materials were available to the kiln builders at the outset. Most of the greensand was uncut and undressed but a number of finer-quality pieces with dressing on at least two faces were used in the kiln walls. Similar stonework occurs in the castle walls and was also used in the Farnham



Fig 8 Borelli Yard, Farnham. View from west of section across kilnpit and surviving arch structure with remains of firebox in the foreground. Scale 0.5m. (Photograph by Nicholas Riall)

Park tile kiln. It has been suggested that all this stone quite probably derived from one of the stone quarries in Bentley (Hampshire) which are quite often mentioned in the bishop's pipe rolls (Riall 1997, 147).

None of the walls had survived above a height of 0.6m, the approximate level of the oven floor (figs 6–8), which was itself at least 0.6–0.7m below ground level. The bulk of the stone used in the kiln walls was removed from the site during the demolition phase.

Oven arches

It is quite probable that with the three walls raised to at least ground level that the next stage of construction, the erection of the oven structure, was undertaken leaving the erection of the firebox until last. The oven was formed by erecting two series of seven arches, probably laid over wooden formers, along the east–west axis of the kiln which provided the two flues running the length of the kiln. The pairs of arches were spaced some 0.16–0.18m apart and were built up of voussoirs that were approximately 0.16m square. The flues were 0.8m wide

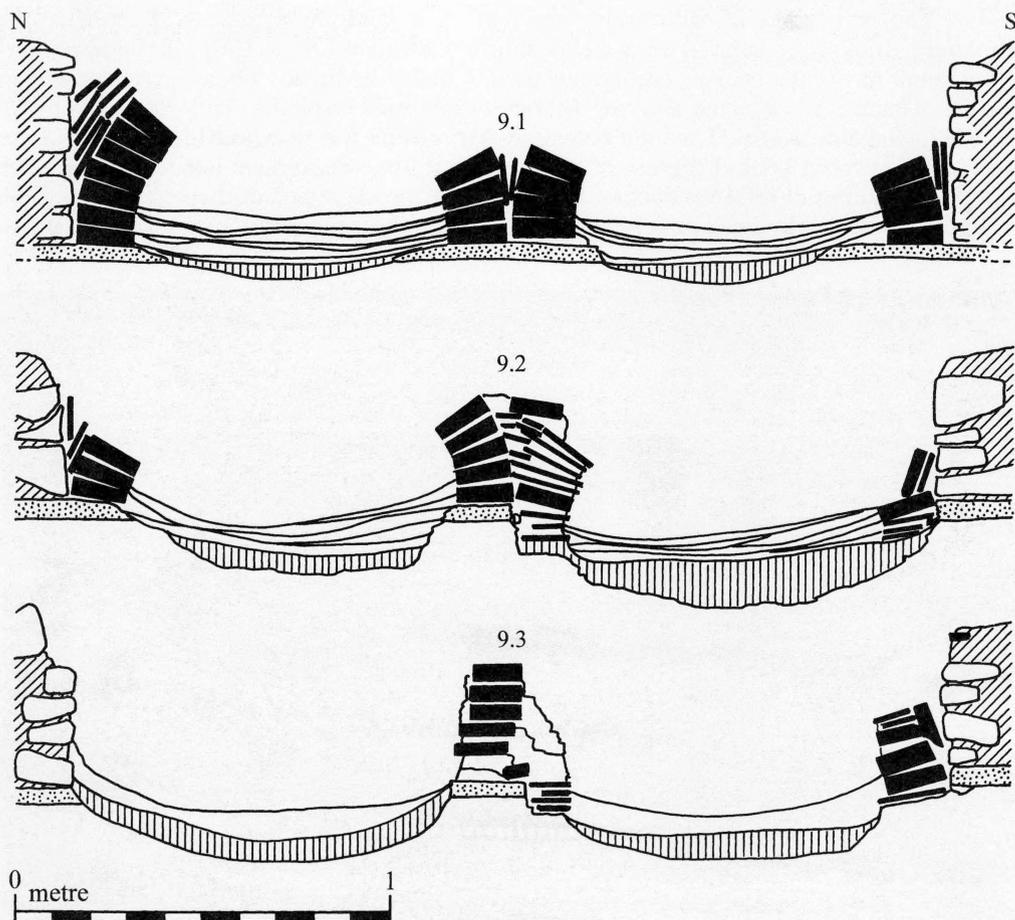


Fig 9 Borelli Yard, Farnham. Sections through the kiln structure showing: 9.1 primary phase structure; 9.2 replacement arches of secondary phases; 9.3 infilling between arches. The primary raft is shown stippled with the secondary raft in vertical hatching. The fills above the raft in the flue are comprised of ash and firing debris.

with the entire oven area approximately 2.3m square. This work produced seven double-arches which would have supported several courses of tile laid along the arch tops and which would have been finished to a common level across the kiln. On top of these platforms was laid a series of specially formed kiln bars which acted as the oven floor. Any material that was to be fired in the kiln, mostly flat roof tile, would have been laid onto and above the kiln bars.

None of the arches survived intact, most had been rebuilt to a great extent by the time the kiln was abandoned, thus very little of the primary structure survived (figs 9–10). That said, sufficient material remained to permit some insight into the original structure. All the arches were built of green (that is, unfired) clay voussoir bricks. These voussoirs were wedge-shaped bricks which appear to have been specifically manufactured for use in kiln arches. Their use as a building material is otherwise unrecorded. They were mould-made on a sanded surface and have a concave upper (struck) face. The Borelli Yard voussoirs conform to a standard size of approximately 160mm square and taper from 50–62mm to 38–46mm in thickness. All the voussoir bricks, and the three variants of great brick, have combing on the side faces of the bricks. The purpose of this combing is unknown but may reflect an earlier technological process when the combing was used as a key for a rendering.

The first two bricks in each arch were laid on a sandy lime mortar. Thereafter the remaining bricks were bonded using a clay mortar – a watered-down slurry of the same clay, but without any of the coarse components used to make the bricks. The concave surface on the top of each voussoir acted as a frog although each brick was in fact laid with the concave surface facing downwards. The joint between each voussoir was thus little more than 1–3mm thick. The purpose behind the use of a lime mortar appears to have been to prevent the voussoirs bonding to the clay floor of the kiln while the clay used in the remainder of the structure of each arch would have effectively fused the whole mass of material into one piece.



Fig 10 Borelli Yard, Farnham. View from north showing repairs and modifications to the kiln structure alongside remnants of the original kiln. Some of the thermo-remnant (TRM) dating discs are visible on the voussoirs at the back of the kiln. (Photograph by Nicholas Riall)

It is estimated that up to 33 voussoirs would have been required for each arch and it is assumed that the arches were roughly semi-circular. The spaces between the arches and the kiln walls and between the backs of the two sets of arches were filled with roof tile (exclusively FBY-T2 type tile) set on edge and coarsely bonded with a clay mortar. Once a rough level had been reached the roof tile was laid flat across the top of the tile on edge and the backs of the voussoirs (fig 11). Like the voussoirs, the roof tile was laid while still green – a factor that contributed to the clean-cut appearance of the tile lengths used for this packing. The arches were set up approximately 160mm apart. The gaps between each pair of arches, both along the spine and along either side of the kiln remained open at this stage as deposits of ash, fragments of ceramic building material and glaze drips were found sealed between later period additions and the raft.

Firebox

The purpose of the firebox was to provide two tunnels within which the fuel which fired the kiln was burnt. This part of the kiln would have been subjected to sustained, high temperatures which would have inflicted considerable thermal damage on firebox brickwork. The firebox was certainly completely replaced at least once, and may well have been substantially repaired on a number of occasions. There were certainly sufficient numbers of very burnt-out pieces of great brick in both kiln contexts and from fills in the town ditch to substantiate this possibility. The final phase firebox was placed at a lower level than the remainder of the kiln oven structure and, presumably, lower than the primary firebox thereby removing any stratigraphic links between the stokepit and the flues (fig 5).

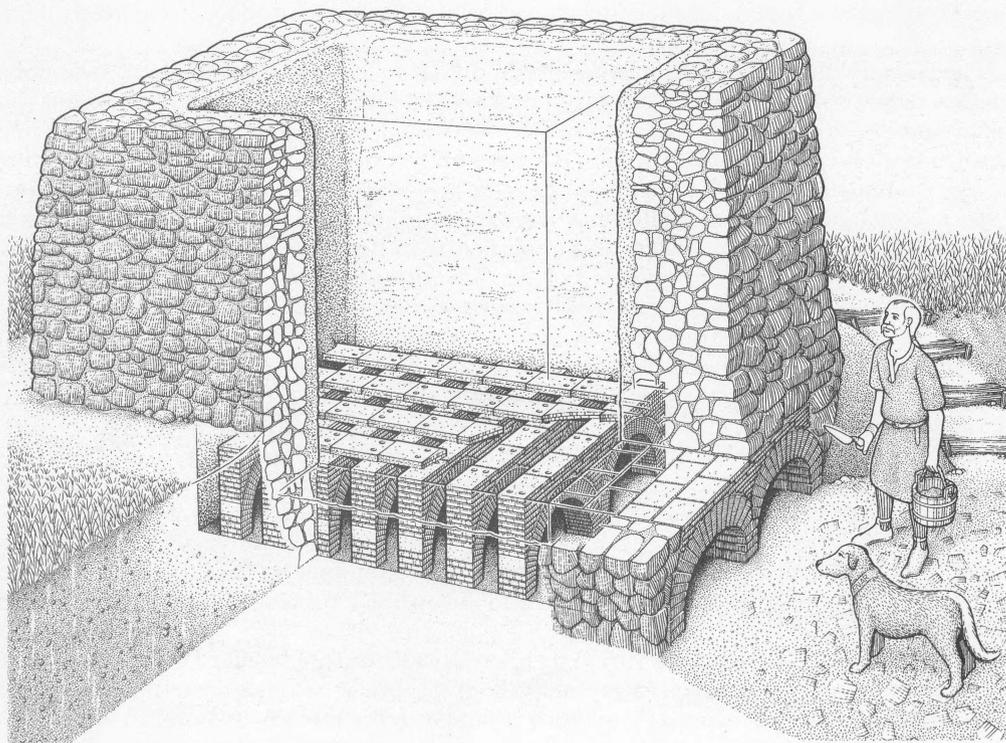


Fig 11 Borelli Yard, Farnham. Reconstruction of the kiln. (Drawing by Jim Farrant)

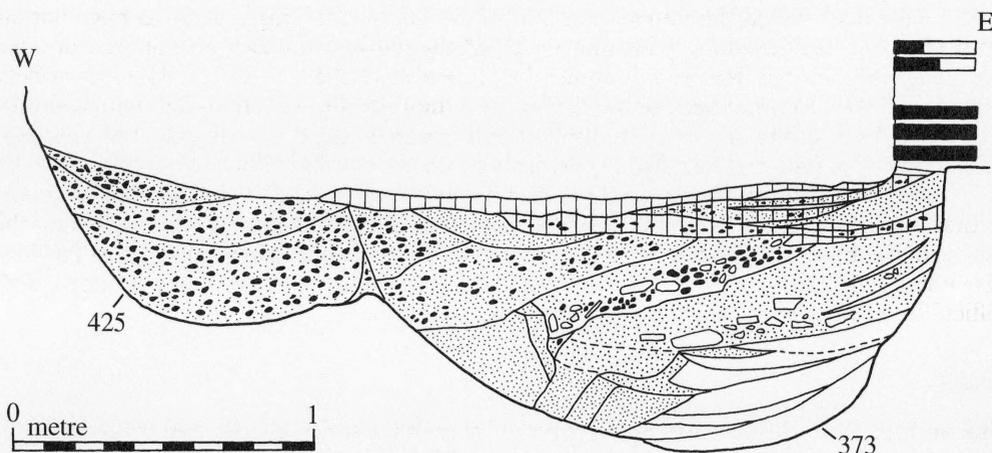


Fig 12 Borelli Yard, Farnham. Section through stokepit showing secondary period firebox above earlier phase firing deposits in the stokepit. The ash and clay fragments in 373 are shown stippled with ash alone shown clear.

The presence of several features in the stokepit also complicates the interpretation of the various developments that affect the firebox (fig 12). The position of features 299, 352 and 373 in the stokepit, all of which belong in the working phases of the kiln but are earlier than the final phase rebuild of the firebox, imply that the primary firebox was approximately 0.4m long. By the close of operations the firebox had been extended to produce a flue nearly 0.8m long.

The primary phase firebox would have been similar to the final phase firebox. When first constructed, it is most likely that the clay raft was extended into the area to be occupied by the firebox which would have been constructed between the two ends of the walls projecting forward from the oven area of the kiln. The two firebox flues were formed by constructing a pair of tunnels built out of great brick. Like the voussoirs, great brick seems to have been a specialized building material that may have been produced almost exclusively for use in tile kilns. However, in East Anglia, and in particular in Essex, great brick was used during the second half of the 12th and early part of the 13th centuries in many ecclesiastical buildings, with Coggeshall Abbey (Essex) perhaps the best-known site (Rodwell 1998; Ryan 1996). Two types of great brick occur in the Borelli Yard assemblage. FBY-GB1 which is 308–315mm long by 135–145mm wide and 50–55mm thick and FBY-GB2 which is 320–330mm long by 140–150mm wide and 50–55mm thick. The slightly smaller FBY-GB1 bricks were found in residual and re-use contexts, such as arch rebuilds, while FBY-GB2 bricks were used exclusively in the final phase firebox rebuild.

It is possible that the original firebox was single-flued in the same manner as that provided for the Farnham Park kiln (Riall 1998). The presence in the kilnpit rubble of many pieces of a large slab-like great brick, FBY-LGB, raises the possibility that the original firebox flue was formed from these much wider bricks that were 300+mm long by 265–270mm wide and 38–45mm thick. None of these bricks were found in their original setting and none was recovered complete.

Only a small part of the firebox survived at Borelli Yard, but at Guildford Castle and Palace the contemporaneous firebox, also built of great brick, was preserved intact (Riall forthcoming, a). The structure at Guildford is similar to the remains at Borelli Yard, which suggests that the Borelli Yard firebox would have been a solidly built structure with great brick laid in random courses (the concept of overlapping the joint beneath each course with a brick seems to have been unknown at this period). Above the two tunnels of great brick

would have been raised the fourth, and last, of the kiln walls. This is likely to have had an internal ledge corresponding with the brick and tile work at the east end of the kiln, and matching a similar feature present above the firebox at Guildford. There would have been a vent-space between the back of the firebox and the first of the oven arches, with a similar vent at the back of the kiln between the last of the arches and the back wall. The west wall may have had a battered face (fig 11), which was the case at Guildford.

It was probably at this point, with the firebox constructed, that the kiln walls were raised to their full height but there is no evidence from Borelli Yard to put forward regarding this aspect of the kiln. All that can be said here is that the walls may have stood up to 2m high above the kiln floor. Anything much greater than that is likely to have made it increasingly difficult to efficiently fire the materials stacked in the kiln.

Oven floor

The arch tops within the oven were covered by another series of specially made bricks to create a chequered effect criss-crossing the oven. Some 200 fragments of kiln furniture were recovered from within the kiln and associated contexts. Two main forms were made, a multi-part kiln bar with nib and wings (FBY-KF2), and a straightforward kiln bar (FBY-KF1). The multi-part kiln bars were formed by modifying great bricks by cutting away sections of the brick and adding a nib or lug in the centre. The overall design was to produce a piece of kiln furniture with a 'wing' either side of a nib and a larger piece, or body, in the middle (see *Kiln bars*, below). The wings rested on top of the kiln arches, the body between each pair of arches and the nib acted as a spacer between each piece. The FBY-KF2 bars, probably also modified from great bricks, were plain rectangular bars. The purpose of both types of bars was to create a series of vents across the base of the kiln load that would regulate and constrict the flow of hot gases up into the kiln load. Tile making depended upon a long, slow firing with a slow rise in temperature taking place over a period of several days. Constricting the flow of hot gases into the oven would have helped to keep the process in check; additionally, the kiln load would have been loosely covered with turf or broken tile and earth with occasional vent holes to permit a throughput of hot gases at a slow rate (Eames 1980). The kiln bars would also have provided some rigidity to the whole oven structure and it may be that these pieces were actually bedded into the tops of the arches with tile laid between each bar. A number of bars show a differential in burning from centre to ends which suggests that the bar ends were protected from the full thermal impact. None of these bars was found *in situ* and it is entirely possible that by the close of operations at Borelli Yard the use of these bars had been superseded by the use of plain roof tile laid at right angles across the oven floor (fig 11) in a manner that is well known from kilns dating to later in the 13th century.

Oven wall lining

The complete loss of the walls from a point at about the level of the oven floor makes it difficult to comment on the character of the kiln walls above the oven floor. It is known from many tile kiln sites that the oven walls were either built of tile or lined with tile laid horizontally and bedded with clay. This seems unlikely to have been the case at Borelli Yard as there was insufficient broken tile among the kiln debris to support such an interpretation. It is worth noting that tile used for such a purpose is usually in a very fragmentary condition and thus does not lend itself to being re-used elsewhere. At Guildford the interior of the oven appears to have been lined with a clay daub which may have been applied to a wicker-work frame attached to the masonry walls. The presence of large quantities of fragments of fired clay in the Borelli Yard stokepit suggests that at Borelli Yard also the walls were lined with clay. A last possibility, that the walls were lined with or partially lined with brick, must also be examined. From about the mid-point level of the oven arches brick was incorporated into the faces of the kiln walls (fig 6). This brickwork did not form a continuous face and thus is

not seen as a deliberate lining but was incorporated as an available building material which was then covered with clay daub. The thicker form of great brick (FBY-GB2), together with large great brick (FBY-LGB) and, occasionally, tile were used. While all this material had been fired before being used in the kiln walls there is no suggestion that this was as a result of repair work.

Stokepit

Nothing remains of the primary phase stokepit. The entire area of the stokepit bottom was cut into and reduced in level during the working life of the kiln (figs 5 and 12). The size of the stokepit was determined by the length of the firebox and kiln flues for it was necessary to rake out ashes and debris from these features during and after each firing. One effect of this raking out was to reduce the level in the flues and firebox so that it was necessary to reline the flue bottoms from time to time as can be shown by the traces of at least five layers of clay in the flues (figs 7 and 9).

During the earlier stages of working the kiln a large pit-like feature, 373, was opened in front of the firebox (figs 3 and 12). This was filled with a sequence of ashes and charcoal, presumably the remains of kiln firings, interdigitating with considerable quantities of very small fragments of fired clay. Very little of this was identifiable as broken up brick or tile although there were a few 'plugs' from tile peg holes. The most likely source of this fired clay would appear to have been the putative clay lining applied to the inside of the kiln. The presence of at least nine distinct layers of ash makes it clear that this feature was not cut to produce a convenient one-off dumping ground for waste materials from the kiln, although the sand into which feature 373 was cut could have been used in the tile-making process, but was open as a feature for at least an entire season of firings. Feature 373 was finally capped with a layer, 471, which was spread across much of the kiln floor and formed the first of several spreads used to provide a firm working surface in the stokepit (fig 12).

Three sub-rectangular slots, features 299, 352 and 425, were cut around the sides of the stokepit at some point after pit 373 was cut but before 373 was fully backfilled and covered by layer 471. The three trench-like features seem to have been cut down into the sands and were quite soon after refilled with a gravelly loam. Very little ceramic building material was found in these features and no pottery. Their purpose is not known but, in view of the lack of any evidence for the provision for revetting around much of the sides of the stokepit during the earlier phases of the kiln's use, it is possible that these slots may be the remains of packing for timber supports for revetments. It is interesting to note that during the period of the excavation the sides of the stokepit were significantly eroded by the weather. No comparable features are known from other tile kiln excavations, although it should be noted that at the Farnham Park site the stokepit had been destroyed while at Guildford the stokepit was only partially excavated.

A considerable area of the stokepit bottom was covered with another spread, layer 470, which sealed the three features around the sides of the stokepit. A final layer, 292, was spread across almost the whole of the stokepit bottom. This was a layer of chalk up to 100mm thick which was itself then covered with a series of ash deposits mixed with some brick and tile. Layer 292 butted up against a large mass of stone, brick and tile dumped around the west end of the kiln pit. This may have served as a form of revetting around this part of the kiln in the final stages of its use. A small section of brick and tile, bonded together with clay, was found on the north side of the stokepit, and above layer 292, suggesting that there had been a more formalized attempt to revet the sides of the stokepit here. Nothing remained *in situ* on the south side of the stokepit.

The remaining layers in the stokepit consist of a thin deposit of gravels and silt, immediately above the last of the ash deposits, which is suggested as representing the abandonment phase of the kiln with a series of dump layers starting with a thick deposit of lime mortar and finishing with clays and loams which represent the demolition and backfill phases of the kiln.

There was no evidence to show how the kiln operators gained access into the stokepit but the most likely method was by ladder.

Kiln secondary phases

A number of repairs, alterations and rebuilds were carried out on the kiln during its working life. The most notable of these was the complete replacement of the firebox. It is not possible to provide a clear-cut sequence for these various operations as there is no overall stratigraphic relationship that links all the elements of the kiln structure. It is possible to use some of the roof tile as dating evidence for placing any use of roof tile as arch material in the later phases, and also the use of peg-and-nib tile as evidence of later activity as peg-and-nib was itself a later kiln product. It is however pertinent to note here that once a tile is broken it is virtually impossible to determine which form the tile originally took particularly, as at Borelli Yard, when all the tile is made from the same fabric. This is not enough to allow any step by step understanding of the processes through which the kiln was developed from its primary structure to the structure as excavated. There is thus every likelihood that this development was more complex than has been allowed.

Spine

In the primary stage the series of arches stood alone and there were open spaces between each set of arches and the next. One of the earliest modifications to this arrangement may have been to fill the spaces between the arches along the centre of the kiln – ie between the two flues – to create a spine. It was possible to determine that the spaces between each arch had initially remained open because the clay surface of the raft was less burnt beneath the voussoirs of each arch than it was in the spaces between. Additionally, thin deposits of ash and other debris were sealed beneath the new ceramic building materials laid along the spine. This was achieved by laying pieces of brick and tile, bonded as usual with clay, in between each arch in a pyramid-like fashion. This filling stopped short of the top of each arch.

Much of this first alteration was swept away when a substantial part of the front end of the arch system, the west end of the oven, was rebuilt using a mass of roof tile as a footing and then recreating the arches in a mixture of tile and brick. This rebuild is also characterized by a completely informal approach to the use of materials in the structure. Pieces of voussoir and great brick were laid flat, on edge and on end depending more on the fit than on careful craftsmanship, all bonded together with large quantities of clay. The rough and ready workmanship of these repairs is in strong contrast to the geometrically precise layout and work of the original kiln builders.

A third and perhaps final alteration to the spine that is clearly detectable was the partial removal of some of the original infilling of the spine and its replacement with a mass of brick and clay wedged in an *ad hoc* manner between each set of arches. By this point in the kiln's working life the arches themselves seem to have become distorted and had begun to lean or tilt backwards (fig 10). It is likely that this repair work coincided with the replacement of the firebox as pieces of heavily fired great brick were used and set in a way that meant these had been burnt in other settings in the kiln before being re-used in the spine. The most likely source for this material would have been the primary firebox.

Arch rebuilds

Five of the original arch settings survived intact on the left of the kiln and only three on the right, with seven and three respectively along the spine (fig 3). As none of the original arches survived complete it is difficult to be certain as to the full extent of repairs to individual arches. While it can be shown that some at least of the ceramic building material was removed from

the site during the demolition of the kiln (insufficient material was left in the kiln rubble to permit full reconstruction of all the arches), analysis of the remaining ceramic building materials from the oven suggests that possibly as many as the back three sets of arches survived intact as voussoir-built arches. The spaces between the arches alongside either kiln wall seem always to have been left open and thick deposits of ash and other material, up to 200mm in depth, accumulated here. Towards the front of the kiln, where the original arches were fully replaced in the later stages of the kiln's use, the original voussoirs were re-used along with fragments of great brick and FBY-T4 and T5 type tile. On the left-hand side of the kiln the individual nature of the arches was preserved while across the kiln, and spanning the right flue, a mass of tile and brick was laid in two blocks to form a rough platform from which replacement arches were then sprung. These new arches were all formed from type T4 and T5 tile. It is possible that more than one operation is represented in these repairs but this cannot now be determined as fact.

The presence of T7 type tiles in the front arches (fig 8) may suggest a late, additional repair here that may well have been made at the same time as the final phase firebox. T7 tile is restricted to these two arches and to kiln abandonment phases though, as noted before, it is possible that this tile might have occurred elsewhere in the kiln but would have been unremarked if broken.

Flue linings

The effects of continued use and high temperatures are reflected in the damage sustained by the clay raft that underlies the entire kiln structure. The remaining areas of the raft are shown as stippled areas in figures 7 and 9. Along the length of the flues the raft was replaced on at least five occasions with various mixes of clays, small pieces of brick and tile, with the occasional pieces of gravel, into which was merged a mix of ashes and also lime mortar that was either derived from the kiln walls or was, perhaps, deliberately laid in the flues. None of these flue re-linings extended the length of either flue but were, perhaps, more in the nature of partial patches; that said, continued use of the kiln appears to have also resulted in the part-removal of these re-linings.

All this material was partially overlain by, or interdigitated with, deposits of what appeared to be a very chalky lime mortar that had minimal sand content. These chalky deposits were particularly noticeable towards the back of the kiln and in between the voussoirs of the arches butting against the kiln walls. The possibility that these chalky deposits represent occasional lime burning in this kiln is discussed below (see *Lime kiln*, below).

Secondary firebox

One major rebuild phase of the kiln was the provision of an entirely new firebox; this seems to have involved the removal of the entire front end of the kiln including the masonry walls and raft. No new raft was laid and the new firebox was built up directly from the natural underlying sands. The kiln walls were extended, they partially overlay features 299 and 352, and were both narrower and less well-built than the original walls. The new firebox was built from a mixture of newly moulded and re-used great bricks, some of the bricks in the new firebox had burnt faces that cannot have been produced in that setting, to form what were presumably two solid tunnels matching those at Guildford. Very little of the Borelli Yard firebox survived but the remaining elements suggests there was no attempt to lay the brick in any form of bond but rather they were laid *en masse*, probably over a wooden framework, with only the intent to produce two solid flues. It seems likely that production of great bricks underwent some minor modifications in that most of the brick used in the new firebox conforms to a somewhat thinner and slightly shorter size range than great brick which is thought to have been used in the primary structure. While the space between the surviving firebox and the first of the oven arches was filled with a mass of clay and tile, mostly FBY-

T2 tiles, this was presumably only carried partially up the face of the first oven arch otherwise the air vent between this arch and the firebox would have been blocked, thereby reducing the flow of hot gases into the front part of the oven.

Placing the firebox in the sequence of repairs and alterations is difficult. Clearly the new firebox is later than features 299 and 352, the two slots cut into the stokepit floor. Also, it would certainly seem to be the case that the firebox was built up against an arch that was already leaning backwards (fig 5) and against the replacement materials in the front right-hand arch (figs 7–8). A further potential indicator is the contrast in levels of burning between the voussoirs in the primary arches and the great bricks in the firebox. The voussoirs are heavily blackened around the edges with dark red cores compared with the less burnt colours of the firebox great bricks. This suggests the new firebox was little used before the kiln was abandoned and also that the new firebox marks the final repair to the kiln.

The entire west wall of the kiln, which would have been raised above the new firebox, was removed when the kiln was demolished.

Abandonment, demolition and backfilling

The reason for the abandonment of the kiln was not discovered although there seems to be some merit in the idea, as discussed above (see *Documentary evidence*, above), that operating the tiliary was brought to a standstill by the outbreak of civil war in 1215. The period in which the kiln stood idle is unknown but was possibly long enough for the kiln to deteriorate to a point where it was not worthwhile to repair it. Why tile production ceased at Borelli Yard remains one of the enigmas surrounding this site. Tile production certainly continued nearby in the Farnham area: a potential site on the east side of the town and close to the excavation site on the town ditch at Bear Lane has been suggested after kiln-type waste material was found there (Poulton 1998b, 136). Further, the kiln in Farnham Park was in operation during, probably, the 1220s. Whatever the reasons, the kiln at Borelli Yard was shut down by no later than c 1220. The kiln walls were demolished and suitable stone removed from the site to be re-used elsewhere. Also, much of the great brick, voussoirs and at least some of the roof tile was taken from the oven structure.

The stonework from the kiln walls was evidently cleaned off on site and the unwanted lime mortar tipped back into the kiln pit forming a thick deposit that sealed the remains of the kiln structure and oven arches (figs 5 and 7). Above the lime mortar was thrown a large mass of broken roof tile that was in turn buried beneath a sequence of gravels, sands and clays. Most of the material seems to have been thrown into the kilnpit from the east end of the pit as all the layers form tip lines inclining down into the stokepit. A thick deposit of clay was additionally found in the fills above the stokepit; this is presumed to be abandoned raw materials. The whole pit was levelled off with a gravelly loam similar to that found in the bulk of the town ditch fills (Riall 1998, 125–9).

The site of the kiln remained virtually undisturbed from the 13th century until excavation in 1985–6. The backfill layers were partially cut during the construction of an Anderson air-raid shelter built in the Second World War.

Kiln products

The main products of the kiln were roof tile, with both peg tile and peg-and-nib tile being produced. Ridge tile was probably also produced although very few examples of such material were found during the excavation. It is also possible that brick might also have been manufactured for use in hearths, ovens and chimneys as some great bricks have been identified in a hearth at Farnham Castle (Riall forthcoming, b).

A fragment of Borelli Yard type crested ridge tile is among material excavated by the late Stuart Rigold at Bishop's Waltham Palace, Hampshire (Riall 1998–9, 160–1). A writ in the pipe rolls of the bishops of Winchester for 1213–14 states that 'three shillings and ten pence

spent at Farnham buying ridge tiles ('crest') sent to Winchester' and continues '6s 9½d spent at Farnham in making shingles [...] sent to Winchester to cover the cloister'. The Borelli Yard style crests at Bishop's Waltham are associated with a particular type of peg-and-nib tile from the kiln at Guildford Castle and Palace, GCP-T3. The three pieces of evidence when taken together strongly indicate that the pipe roll evidence relates to tile production in Farnham and Guildford being used as sources of supply for manors where tile making was not being undertaken. At this time slate was the principal roofing material in Winchester and at Bishop's Waltham.

It is not thought that floor tile was a product of this kiln although there is a case to suggest that great brick might have been produced for use in hearths, kitchen ovens and chimneys. Borelli Yard type great brick is present in a fireplace in the keep at Farnham Castle, along with a large quantity of FBY-T2 type tiles. Both types of material are also to be found in the wall faces of the shell keep curtain wall and turrets. However, the principal product would have been roof tile.

Associated features

Two pits, features 276 and 277, were found just to the south of the kiln (fig 2). Both pits were almost square and quite deep at 1.8m and 2.4m. Feature 276 contained a thick deposit, layer 255, of peg tile and peg-and-nib tile sandwiched between layers of clean clay. Feature 277 contained only a little tile deposited in between layers of clay and considerable quantities of gravel. Their position, together with the presence of the roof tile, indicates they may have been associated with the working of the kiln. Both pits also appear to respect a common line which is shared also by the eastern edge of the kilnpit and this may mark a property boundary along the eastern edge of the tilery.

Analysis of the tile from layer 255 revealed that well over 400 tiles were represented in this deposit. Most were peg-and-nib tile (FBY-T4 and T5), which are considered to have been among the final products of the kiln; similar tile was found in the kilnpit. It would seem possible that the tile in layer 255 may have come from a one of the sheds or buildings that would have stood in the tilery area; there is no suggestion that these were waster tiles.

Nineteen postholes were noted across the excavation area and some, at least, of these might represent one or another of the tilery buildings. None could be satisfactorily dated and an insufficient area was excavated to be able to make any structural sense of them.

The northern edge of the tilery was bounded by the town ditch (fig 2; Riall 1998). Brick and tile was recovered from many of the fills of the town ditch, but not from the primary fills, layers 186 and 187, but the quantities of ceramic building material in the ditch fills is quite low at less than 5%. More pertinently, all the brick and tile was randomly scattered through the ditch fills: there was no clustering of this material, no thick deposits of waster tiles, no ashes or other evidence of kiln waste. Double peg and peg-and-nib tile both occurred together in layer 183 when it might have been expected that double peg tile would have been deposited on its own. Additionally, fragments of great brick, voussoir and kiln bar also occurred in layer 183, similarly mixed in a random way with the roof tile. It is clear from the stratigraphy of the ditch that layer 183 is the fill of a cut that partially removed the earlier ditch fills of 186 and 659 and, perhaps, 167. The remains of these layers contained small quantities of building material most of which was roof tile. Layer 183 contained pottery dated to the mid to later 13th century while layers 186 and 187 can be dated to the early part of the 13th century. There is no evidence here for a sequence of deposits that reflects the working of the tile kiln nor does the pottery dating of layer 183 correspond with the pottery dating of the kilnpit fills. It would seem clear enough that the ceramic building materials present in layer 183 have been redeposited, the implication being that this recut of the town ditch should be dated to the earlier part of the 13th century, probably before 1220–5. It would appear that there is a connection between the abandonment of the kiln and this recut of the town ditch, with implications for the dating of both.

Another kiln?

Part of a large feature, pit 240, was excavated in the southern end of trench 2. Only the eastern end of this feature was found. The feature was sub-rectangular and was about 4.5m wide and at least 1.5m deep. It was filled with a dark brown loam above several layers of gravelly loam. This pit produced a few sherds of pottery, all of which can be dated to before the early 13th century and several pieces of T2 tile. This pit may have been excavated to produce sand for the tile making process, but the possibility that it might have been the site of an earlier kiln cannot be discounted.

Lime kiln?

Deposits of very chalky, virtually sand-free, material in the kiln flues raises the possibility that the kiln was occasionally used to burn chalk to produce lime. A layer of chalk was also found used as a levelling material across the stokepit, layer 292. Apart from the use of chalk, in the form of lime, in the construction of the primary kiln walls and again in the rebuild of the west wall following the reconstruction of the firebox, it is difficult to explain the presence of any chalk within the kiln pit. While one cannot be certain about what material was used to construct the kiln walls there seems no good reason to suppose that the greensand and malmstone found in the surviving walls were not also used for the walls that were later demolished.

The possible explanation for the presence of this chalk, with the potential that it was a result of using the tile kiln to make lime, is supported by some archaeological and documentary evidence. At Bletchingley (Surrey) during the final phases of use the tile kiln was stripped of its internal fittings and used as a lime kiln; whether this kiln was used for burning lime while still producing tile is not known (Poulton 1998a). At Quarr Abbey, Isle of Wight, chalk was present in the backfill layers of the stokepit and was present in small quantities within the kiln flues, and was also used to cap the backfill layers in the kilnpit (Riall

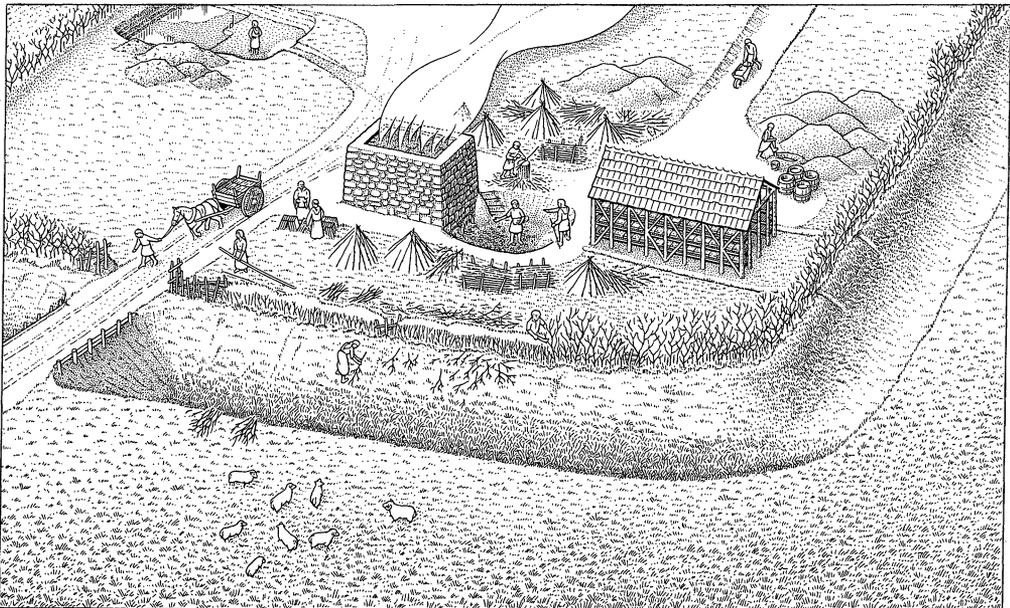


Fig 13 A reconstruction of the tiler's at Quarr Abbey, Isle of Wight. The tiler's at Borelli Yard, Farnham, would have been very similar. (Drawing by Jim Farrant)

et al 1996). Philip Brooks noted that whenever roof tiling occurs as an expense in the Farnham pipe rolls there is also a reference to lime mortar. He pointed out, while the Borelli Yard excavation was ongoing, the possibility that lime could have been burnt at the same time as tiles, based on his reading of the pipe rolls for the later 14th century (Philip Brooks, pers comm). This view was not then shared by the excavators. None the less, it was never entirely clear that the documentary record for Farnham implied a clear case for suggesting that lime burning and tile making were concurrent activities carried out in the same kiln.

Documentary evidence relating to tile production at Highclere, Hampshire, reveals the probability that lime was burnt in the tile kiln there and that, when large quantities of lime were required, a formal lime kiln or clamp (both can be inferred from the documents) was used. This material is discussed below (see *Tile making at Highclere: evidence from a documentary source*, below) but it seems from a reading of the Highclere material that there is good reason to suppose that lime burning was ordinarily carried out in small quantities in the same kiln used for tile making. It is therefore probable that this was also the case at Borelli Yard in the early 13th century.

The Farnham Park kiln produced no evidence for lime burning.

The finds

POTTERY

Resources have not been made available to compile a formal report on the pottery from the excavations at Borelli Yard. All the pottery from the kilnpit and associated features was examined and spot-dated by Phil Jones of the Surrey County Archaeological Unit. His conclusion was that the 103 sherds of pottery from the kiln pit and associated contexts were all of 12th or early 13th century types.

THE FABRIC OF THE CERAMIC BUILDING MATERIALS, by the late Robert Foot

Nineteen fragments of ceramic building material were examined, as follows:

Kiln construction: peg tile (1290), glazed peg tile (1922), voussoirs (1290 and 1916) and great brick (1920).

Primary packing: peg tile (1284).

Top fill of kiln pit: glazed peg tile fragments (from 248).

Pit 276: peg-and-nib tile (from 255).

Town ditch: peg tile (from 172 and 980), glazed peg tile (from 173 and 980), peg-and-nib tile (from 980), and voussoir fragments (from 183).

Kiln raft: sample of clay used for the raft (951).

The aim of the analysis was to characterize the material by fabric and to note any differences in fabric, which might indicate modification of the kiln structure, or distinguish the kiln products.

Method

Fresh breaks were examined under $\times 20$ and $\times 30$ magnification using a binocular microscope. The grain-size distributions of tempering/moulding sand were calculated using a grid graticule as an aid to random grain selection. Grains lying below an intersection were measured using a 1cm graticule divided into 0.1mm divisions.

Results

All but one of the samples appeared to be closely similar and are described as fabric 1.

Fabric 1

Homogeneous, fine-textured clay matrix. Orange/red in colour (Munsell 2.5 YR 6/8) with a light grey core in a few specimens. The clay is micaceous with moderately abundant flecks of white mica (>0.2mm across) scattered throughout. Sparse rounded grains of fine-textured, red/brown ferruginous material (>3mm across but generally smaller) were also present. In some specimens one or two small fragments of white/grey material can be seen (>4mm). These react weakly with dilute hydrochloric acid and may be chalk or greensand-like rock.

A fairly coarse quartz sand has been added to the clay as tempering. The quartz grains are well rounded and varied in colour – mainly translucent white, grey, transparent or pink/orange. Very occasional opaque black grains also occur.

The same sand was used to facilitate the moulding process and remains were found adhering to some surfaces, particularly the undersides of roof tiles.

Fabric 2

Represented by a single fragment of glazed roof tile from layer 173 in the town ditch. Fine textured clay matrix. Light orange/red in colour (Munsell 5YR 7/8) with streaks of whitish colour which distinguish it from fabric 1. The fragment has a reduced grey core. Scattered orange/red ferruginous inclusions occur. These are fine-grained in texture and rounded in shape (as fabric 1). Appears less micaceous than fabric 1, although minute flecks of white mica (<0.1mm across) are visible. The tempering/moulding sand is similar to that of fabric 1 but has a smaller proportion of large grains.

Clay sample

The sample of clay from the raft (951) is apparently the same raw material as was used for the brick and tiles produced on this site. It is of a dull greenish-grey colour (Munsell 5Y 7/8) and is micaceous. There is no intrinsic coarse sand content. The pieces examined were, however, encrusted with a quartz sand on one face (derived from the sands underlying the kiln). The size distribution and shape of the grains is similar to that of the moulding sand. The main difference is that the unfired grains appear to be mainly clear or opaque white. There is a ferruginous coating on their surfaces which presumably causes the pink-orange colour of some of the fired grains.

A small piece of clay was disaggregated using a 20 volume hydrogen peroxide solution and sieved through a 300 μ mesh. This resulted in a residue consisting of hard clay flakes, occasional fine clear quartz grains, sub-spherical ferruginous concretions and one or two calcareous fragments. Such an assemblage would be consistent with that obtained from Gault Clay (Davies 1939, 99).

Discussion

It was not possible to use fabric type as a means to distinguish between materials used in the kiln construction, its presumed products, and residual fragments from the town ditch. This is probably because the clay deposits of the Farnham area are extensive and relatively homogeneous. Roman tiles from sites nearby show a very similar clay fabric and sand content (pers obs) as do those from the Farnham Park kiln (Riall 1997, 158). Peg tiles in this fabric type have also been observed in archaeological material from Winchester (pers obs) and possibly represent the products from kilns located towards Farnham. The significance of the single fragment of fabric 2 is difficult to determine – it may have been the product of another kiln but there remains the possibility that it could have been made at Borelli Yard.

Finer techniques of analysis may be necessary in order to characterize the Borelli Yard tiles more closely.

Note

Robert Foot and this author had intended to conduct a wider survey of medieval tiles across north-east Hampshire and, where possible, into adjoining counties. His comments on the products and materials from the three Surrey tile kilns added greatly to existing knowledge of their construction and use.

Manufacturing process

All the tile and brick was made using the same basic technique. An open mould, or frame, was laid on a sanded moulding table. A lump of clay was pressed into this frame until more or less level with the top of the frame when it was 'struck' or cut level with the top of frame using a wire or wooden strike for the purpose. Tile seems always to have been struck lengthways. The moulded object was turned, or cut, from the frame and stood aside in a stack to dry until leather hard. Some of the tile exhibits secondary pressing and wiping following striking. Peg holes were either made by pushing a carved wooden tool through the tile head or were cut using a knife; both methods seem to have been used at Borelli Yard. Peg holes are often conical with the larger hole on the sanded surface, which implies that they were cut after tiles had been turned from the moulds in order to leave, presumably as a deliberate stage in the making process, the sanded tile face as the upper face. Nibs were attached to peg-and-nib tiles as separate pieces, and moulded into place: they were not drawn up from the body of the tile. The peg holes on peg-and-nib tiles are often set further from the tile head than the nib (fig 14); this has sometimes been taken to infer that a nail was used through the peg, driven into the lath, while the nib was hung on top of the lath. It seems it was in fact common practise to use only one peg per tile thus with the peg-and-nib tiles there was the option of using either. A practical demonstration of this is afforded by the reconstructed hackstead at the Weald and Downland Open Air Museum, Singleton, where the tiles are mostly suspended from one pin.

Glaze was applied to approximately one-third of all tiles in the Borelli Yard assemblage suggesting that this part of the process was less common than has been supposed. It would seem to be the case that shouldered tiles were usually glazed and it may be that common practice was for tile to be increasingly left unglazed as the 13th century wore on. The earlier Borelli Yard tiles, T2 and T3, have coarser sand than the later tiles on the mould faces. Paw prints and other forms of marks on tile and brick in this assemblage are very rare – five paw prints from in excess of 10,000 pieces of tile. Finger and hand prints are also surprisingly uncommon. All forms of brick were made in a similar manner, using moulds and sanded surfaces, but all the faces of these pieces were then combed or scored with a comb-like tool. When the tile and brick was fully dried to the leather-hard state it was fired. The kiln capacity is unknown but may have been between 9000 and 12,000 flat tiles per firing. The level of wastage is also unknown but from the moment that the tiles were moulded, through the drying stage and then the firing stages, with the loading and unloading stages of the kiln also to be accounted for, it is likely there would have been significant wastage. No waster dumps were found at Borelli Yard, nor at Farnham Park or Guildford Castle and Palace, although roof tile in the kiln pit backfill and pit 276 may represent wastage. Brick and tile from the Borelli Kiln remains in use at Farnham Castle 800 years after manufacture, a testimony to its durability.

Catalogue of tile types**FLAT ROOF TILE**

Eleven types of roof tile are present in the assemblage recovered from the Borelli Yard tile kiln, its associated features, and from the town ditch (Riall 1998,

120–32). All the ceramic building materials excavated from the kilnpit were retained for analysis. This mass of material is here divided into flat roof tile, ridge tile and brick. For the purposes of this analysis all pieces

of roof tile recovered from the kiln and other features and which provided a full dimension in one of the two main axes were included in each tile type sample. It may also be noted that no single tile survived from the Borelli Yard kiln intact and that complete tiles exist in two or more pieces. The best example of a T2 tile was re-assembled from 19 pieces scattered through six contexts. A similar situation was found with the material assembled from the Guildford kiln. The numbers shown in each sample within each tile type show the number of tiles actually identified in the assemblage and it should be noted that once these tiles are broken and mixed it becomes extremely difficult to identify individual tile types. It has become clear during the examination of the three assemblages from the kilns at Borelli Yard, Farnham Park and Guildford Castle and Palace, that there is no typical size for each type of material, nor is it sufficient to suggest an average or a norm. The flat roof tile would appear to conform to reasonably tight dimensions but the brick types display a range of sizes that require some explanation.

Type: T1 (not illustrated)

Sample: seven fragments of tile head.
Description: single peg, shouldered tile.
Size: not known.
Suspension: single peg hole, centrally placed.
Weight: not known.
Fabric: well-mixed clays with finely crushed quartzites and silica, ranging from <1mm to >3mm, evenly spread through the fabric. Colour ranges from pale yellows to pale buffy-pink. Similar to fabric 1 but not identical.
Phase: kiln backfill and ditch redeposits of mid to later 13th century. FBY-T1 tiles have only been formally identified as a result of cross-comparing the Guildford Castle and Palace assemblage with the Borelli Yard material. The T1 tiles at Borelli Yard are closely similar, and are probably identical, to the T1 tiles from Guildford where they were categorized as the earliest tile types present.

Type: T2 (fig 14)

Sample: three complete tiles, 100+ widths and 27 lengths.
Description: rectangular roof tile, occasionally part glazed.
Size: 335–340 × 200–210 × 14–16mm.
Suspension: peg hole both corners, some variation in position and size of peg holes.
Weight: 1700–1900g.
Fabric: mould face – coarse, often pitted, with fine to medium coarse components (flint, quartz and sands) in surface. Occasionally glazed, a high gloss dark brown to dark green very opaque glaze being the norm, >160mm from bottom edge. Occasional impressions of vegetable matter. Occasional pressure rings visible around peg holes. Struck face – smooth, occasional traces of finger moulding and finger wiping along edges. Occasional drag marks running along length of tile but seldom across the tile width.
Phase: T2 and T3 tiles form the first series of tiles

produced in the Borelli Yard kiln and were used in the primary arch construction.

Type: T2a

Although not categorized as a fully separate tile type, there is a possibility that some T2 tiles produced in later batches of tile making were made with larger peg holes, from 18 to 22mm in diameter. The bulk of the T2 tiles have peg holes 14–18mm in diameter. In all cases the peg holes were cut or manufactured from the mould face, providing a slightly conical hole with the wider circumference on the sanded face.

Type: T3 (fig 14)

Sample: one complete tile, nineteen widths.
Description: T3 tiles are T2 tiles cut into approximately half lengthways.
Size: 338 × 90–110 × 14–17mm.
Suspension: single peg hole placed centrally.
Weight: 920g.
Fabric: as T1, sometimes glazed.
Phase: as T1.

Type: T4, T5 (fig 14)

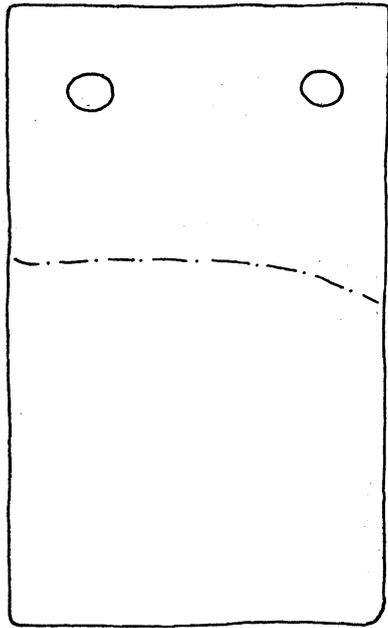
Sample: one complete tile, 100+ full widths, seven lengths.
Description: T4 – peg-and-nib and T5 – nib-and-peg tiles.
Size: 340–350 × 198–205 × 14–16mm.
Suspension: T4 – small peg hole on left with a nib on the right with both placed closer together than the two peg holes present in T2 tiles. T5 tiles have the reverse arrangement of peg-and-nib but most of this tile type is represented by T4 tiles with less than 10% by T5s. About 20% of T4–T5 tiles show signs of having been part glazed. The glaze is thinner and more translucent than that on the T2 tiles, often pale to dark green.
Weight: 1600–1800g.
Fabric: similar to T2 but generally with a smoother finish on both faces.
Phase: Mid-end production phases of kiln, used as repair material in kiln oven and, possibly, as covering material for a building associated with the kiln works.
No double nib or centrally placed nib tiles and no 'cut' versions of T4 and T5 tiles similar to T3 tiles were found at Borelli Yard.

Type: T6 (not illustrated)

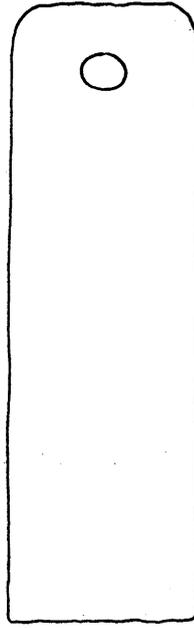
Sample: three
Description: rectangular roof tile with single peg hole.
Size: ? × 190–200 × 14–16mm.
Suspension: single peg hole centrally placed.
Weight: not known.
Fabric: as T2.
Phase: final firing phases of kiln.

Type: T7 (not illustrated)

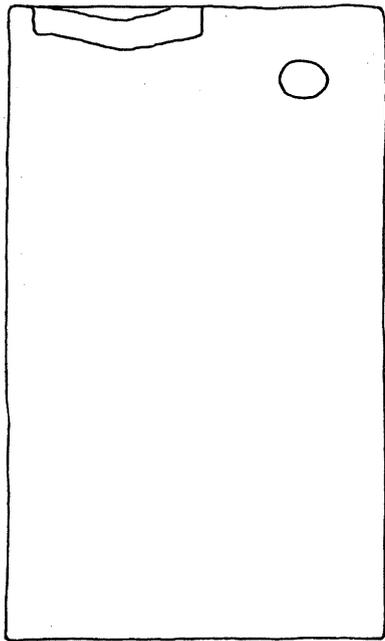
Sample: no complete tiles, fifteen widths, no lengths.
Description: rectangular roof tile with peg holes at



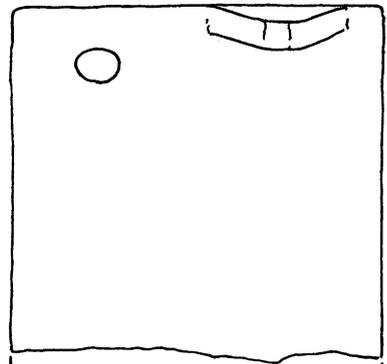
T2



T3



T4



T5

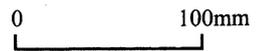


Fig 14 Borelli Yard, Farnham. Flat roof tile, T2-T5.

each corner, classified as a tile type on the basis of its greater width than T2 or T4–T5 tiles.

Size: 320+ × 222–229 × 15–18mm.

Suspension: peg hole at each corner.

Weight: not known.

Fabric: as T2, none glazed and generally darker in colour.

Phase: occurs only in firing deposits in kiln stokepit.

Probably produced after T2 but before T4–T5 tiles.

Type: T8 (not illustrated)

Sample: no complete tile, two widths, no lengths.

Description: smaller rectangular roof tile.

Size: ? × 160–165 × 14–16mm.

Suspension: peg hole at each corner.

Weight: not known.

Fabric: as T2 but T8 tiles are all brown or dark brown in colour and are smooth to touch.

Phase: both T8 tiles occurred in the kiln rubble of the abandonment phase.

RIDGE TILES

Eighteen pieces of ridge tile have been identified in the Borelli Yard assemblage with eight of these from deposits in the town ditch. Most of these pieces are very small and abraded and are also heavily overfired, making it difficult to be positive about precise identification as to tile type. Some of these are probably straightforward, plain, imbrex tiles. There are also four fragments of glazed, knife-cut, crested ridge tile which are broadly similar in design to ridge tiles found in the Farnham Park tile kiln (Riall 1997) and in the assemblage from the Guildford Castle and Palace kiln (Riall forthcoming, a).

IMBREX RIDGE TILE

Type: T9 (not illustrated)

Description: fourteen pieces of tile showing curvature all of which are probably fragments from undecorated, imbrex-style, ridge tiles. All are 18–24mm thick, none are glazed and the fabric is similar to that used for the T2 tiles. No fragments in the assemblage are of sufficient size to allow any useful comments to be made about overall sizes of this tile type.

No evidence for hip tiles was found.

KNIFE-CUT CRESTED RIDGE TILE

Four fragments of crested ridge tile were recovered from the site and these represent two distinct designs although presumably based on the same overall style of ridge tile. Knife-cut ridge tiles are so called to differentiate them from other styles of crested ridge tile where the design is, most usually, created by moulding the clay along the top of the ridge tiles through the use of finger and thumb to produce a range of decorative tiles with various forms of 'pie-crust' style points and valleys along the top of the tile. Very occasionally the same pie-crust design is created by the use of knife trimming. Knife-cut crests provided the roof tile

maker with an opportunity to create a range of bold designs based on the simple production method of taking a rectangular piece of clay, cutting a geometrical design both through the body of this piece of clay and along its top edge, and then fixing this along the top of an otherwise normal ridge tile. The Borelli Yard crests are all glazed, employing a very glossy glaze over an orange to buff-brown fabric. Similar crests from the Farnham Park kiln were unglazed though it remains uncertain whether this was because these tiles were found among the kiln rubble, and perhaps therefore part of an abandoned kiln firing, or whether these tiles were not intended to be glazed. The Borelli Yard crested ridge tiles are also paralleled by crests from the Guildford Castle and Palace excavation where the ridge tiles were mostly (seventeen of twenty) glazed.

The combination of glazed knife-cut crested ridge tiles and part-glazed flat roof tile, perhaps in a deliberate range of colours for the Borelli Yard flat tiles exhibit a range from glossy oranges through dark greens to dark browns and almost black, would have produced a striking and colourful effect. This style of the knife-cut ridge tile may be seen silhouetted against the skyline on the roofs of Victorian and Edwardian houses. It is worth noting here that medieval ridge tile does survive in use in Farnham although very much more is to be seen in Winchester, especially around the Cathedral Close, and at the Hospital of St Cross (pers obs).

Type: T10 (fig 15)

Crest with semi-circular, arch-like openings cut through the crest with a square-cut, crenellated, style

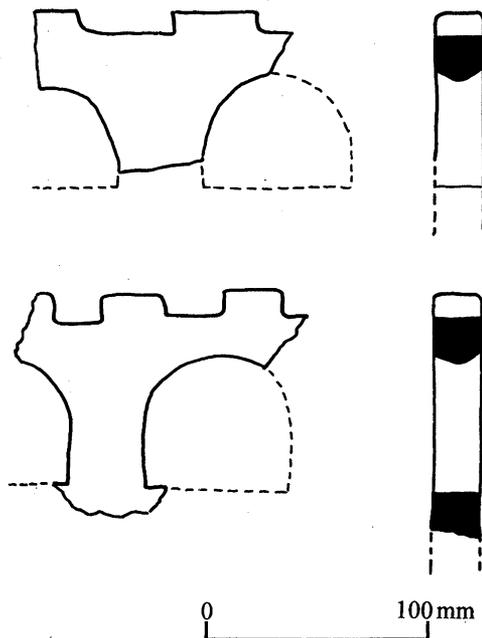


Fig 15 Borelli Yard, Farnham. Crested ridge tile: T10 (above) and T11 (below).

cut along the top edge. The crest is 20–22mm thick and may have been only a little thicker at the base where the crest was joined to the ridge tile. The fabric is the same as that used for the T2 tiles.

Type: T11 (fig 15)

Similar to T10. Crest with semicircular, arch-like openings cut through the crest and with further curved decorative cuts along the top edge.

All the imbrex and knife-cut crested ridge tile can be associated with the tile kiln and is therefore datable to the earliest part of the 13th century.

PIE-CRUST STYLE RIDGE TILE AND LATER MEDIEVAL
FLAT ROOF TILE

Quantities of flat roof tile, ridge tile and, from later phases, brick were found during the excavations at Borelli Yard. No complete examples of flat roof tile from any of the post-tile kiln deposits was found and such material as was recovered provides insufficient data to make any analysis worthwhile. A number of pieces of pie-crust style ridge tiles were found in the excavation and more were found still in use on the roofs of buildings in the Borelli Yard complex. They were not products of the Borelli Yard kiln and all date from, at the earliest, the later 13th century or from the 14th century.

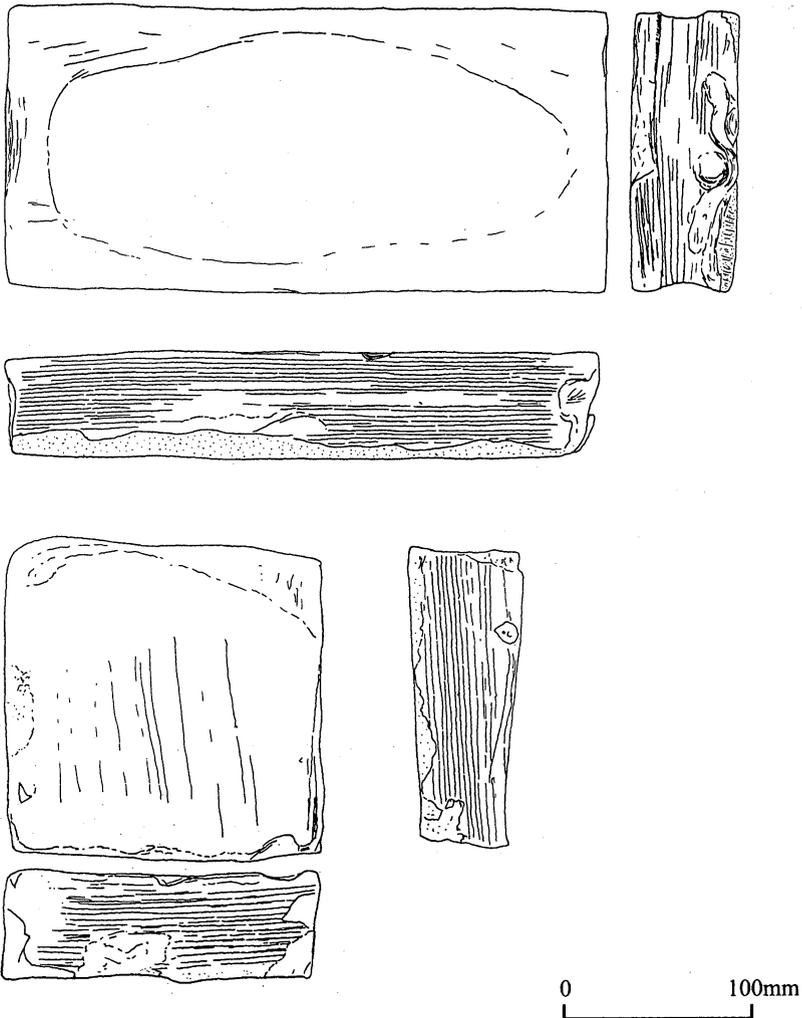


Fig 16 Borelli Yard, Farnham. Great brick and voussoir. (Drawing by Malcolm Lyne)

The tile kiln building material: brick

Three classes of brick were used in the construction of the kiln: great brick, voussoir and kiln furniture. All this material was manufactured, on current evidence, for use within the kiln itself. There seems to have been no intention to produce brick as a building material although great brick has been found in structural contexts at Farnham Castle (Riall forthcoming, b).

GREAT BRICK (fig 16)

So called to differentiate this type of brick from the earlier Roman types on which it is probably based and also from the later medieval bricks, often termed 'Flemish', that date from the later 13th century and the 14th century and were much used, especially in Essex. Outside East Anglia, great brick only occurs in west Surrey.

Great brick is a long and thin brick, distinctly rectangular, that was made in a mould. It has clearly defined struck (upper) and lower faces. The struck face is always slightly concave while the lower face usually has a coarse texture resulting from sand derived from the mould table being left on the bottom of the brick. The concave characteristic of the struck face appears to be a deliberate design feature and was used in the same fashion as the frog that is characteristic of more recent brick. A clay mortar was mostly used to bond great brick together, this mortar being a watered down or liquefied version of the same clay that was used to make the bricks but without any sand or coarse components being present.

A particular feature of all the Borelli Yard, Farnham Castle, Farnham Park and Guildford Castle and Palace bricks (great brick, voussoirs and kiln furniture) is the presence of a series of lines scored along the four vertical sides (fig 17). These lines cannot have been the result of cutting the bricks free from the mould – this would have produced drag marks and not the series of lines that are present and, when compared with cut marks on the kiln furniture, it can be seen that knife trimming leaves altogether different markings.

The presence of the scored lines on the kiln furniture seems to indicate that the scored lines were cut or made as part of the manufacturing process regardless of the use to which this material would be put. These scored lines are also present on similar bricks in Essex, for example those at used in the chapel of St Nicholas at Coggeshall and also at the church of The Holy Trinity, Bradwell-juxta-Coggeshall which, it is suggested, was completely rendered externally (Rodwell 1998, 82). While it is possible that the scored lines reflect a continuation of Roman brickmaking traditions, for instance the practice of combing bricks for use in hypocaust systems, it may be that the scored lines on great brick were intended to provide a roughened surface onto which a rendering could be applied. Such an idea is not altogether without some merit as large quantities of clay fragments, that can really only have derived from a rendered surface, were present in the Borelli Yard stokepit while it is known that at Guildford the tile kiln was lined with clay (Riall forthcoming, a).

Examination of all the great bricks and voussoirs in some detail reveals that there is both variation in size and weight which can, in part, be explained by the use of more than one mould and that variation also results from a hand-making process. There is some evidence also that replacement great brick and voussoirs produced for repairs differed in size to the original material. The great bricks have been divided into two groups as there is a clear case to associate a second series of bricks with the secondary firebox. The voussoirs cannot be as clearly defined and no attempt has been made here to establish a type-series for this material. Although evidence was taken for voussoirs that may have been secondary repairs this suggested only that voussoirs from primary contexts could potentially be re-used in settings where later voussoirs were found to underlie them. In other words, arches seem to have been rebuilt with a mixture of new and re-used voussoirs in no clear order of use. It would appear to be the case that both great brick and voussoirs from primary contexts exhibit greater care

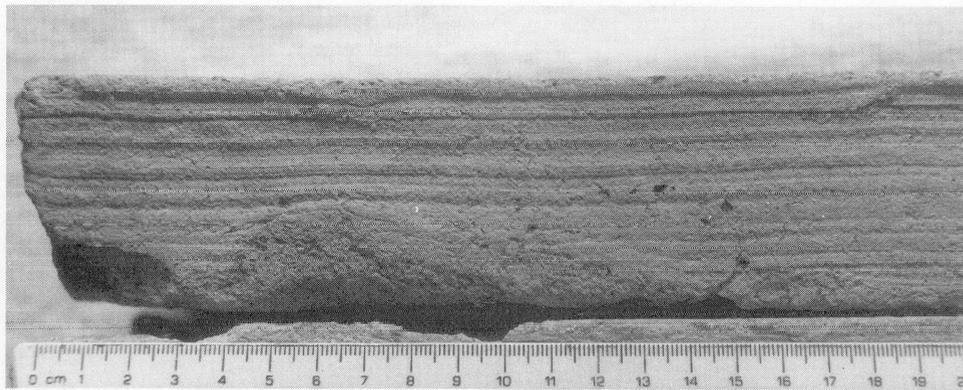


Fig 17 Borelli Yard, Farnham. Detail of combing on bricks. (Photograph by Nicholas Riall)

TABLE 1 Comparison of great brick from sites in East Anglia and from the three Surrey kilns

	Type	Length (mm)	Width (mm)	Thickness (mm)
East Anglia sites				
Bradwell-j-Coggeshall	most	330	160	50
	some	360	190	60
Coggeshall		330	152	50
Pleshey Castle	A	305	130	75
	B	c265	130-135	45-50
Rivenhall Church	B	320	145	50
Shouldham Abbey	6	300	150	45
Surrey sites				
Farnham - Borelli Yard	GB-1	308-315	135-145	50-55
	GB-2	320-330	140-145	50-55
Farnham - New Park	GB	305-314	145-151	48-52
	GB-V	320-340	195-205	49-54 (30-33)
Guildford Castle palace	GB	340-350	170-175	52-58

in their making and modelling and would also seem to conform to a tighter size specification.

FBY-GB1

Size: 308-315 long × 135-45 wide × 47-55mm thick

Sample: twelve complete with 50+ pieces.

Fabric: as T1.

Weight: 4000-4500g.

FBY-GB2

Size: 320-330 long × 140-45 wide × 50-55mm thick.

Sample: 27 complete with 100+ pieces.

Fabric: as T1.

Weight: 4000-4500kg.

LARGE GREAT BRICK

FBY-LGB

Size: 300+ long × 265-270 wide × 38-45mm thick.

Sample: no complete examples, five widths, 60 fragments.

Weight: not known.

Fabric: sandier version of T1.

A large, relatively thin brick which is more like a ceramic slab or tile than a brick, that was not recognized as a distinct brick type until the post-excavation analysis of the ceramic building materials was undertaken. In its overall design and characteristics, the LGB bricks are like the remainder of the Borelli Yard bricks in that the upper face has a concave surface and the thin faces are scored with lines. The concave surface is more pronounced in LGB bricks than in the voussoirs with a distinct edge around the upper, mould, surface. It is however very much larger, in its horizontal dimensions, than the great brick. The presumption is that the LGB bricks were created for use as a building material for firebox flues; there is no suggestion that they might have

served as an oven flooring material as none recovered are sufficiently damaged by thermal action, in the way that the identified pieces of kiln furniture are, to substantiate such an interpretation. Where the LGB bricks have been over-heated this has been along one or two faces only and in a manner similar to the observable thermal impact on the firebox great bricks at both Borelli Yard and Guildford.

VOUSOIR (fig 16)

As with the great bricks, it is possible to suggest that more than one class of voussoirs is to be found in this in assemblage. In addition to the problem of not knowing how many moulds were in use there is an additional problem in that voussoirs were certainly distorted when laid in place in each arch and before the kiln was fired so that a number of the lower-most voussoirs were squeezed by the weight of the arch above. This may account for some of the discrepancies in the dimensions but cannot account for all of them.

FBY-V

Although often square, many voussoirs are slightly rectangular with the longer side running from front to back, along the wedge. Table 2 gives details of measurements from 20 voussoirs from across the kiln. The overall dimensions of the voussoirs are as follows: 152-160mm wide × 148-165mm front to back, 38-46mm thick at front and 50-62mm thick at back.

Sample: 200+

Weight: 1900-2250g.

Fabric: as great brick.

These are specialized, wedge shaped bricks, manufactured in a mould for, use in the flue arches of the kiln. Like the great bricks, voussoirs have combed faces (fig 17). The struck surface of the voussoirs is slightly concave - up to 5mm deep in the centre of the voussoir but averaging at about 3mm - which, like the great bricks, was intended to serve the same purpose

as a frog in modern house bricks. Many of the voussoirs retain traces of the fired clay mortar, which is generally sand-free and often differs in colour to the voussoir. The side faces of all the voussoirs were combed.

KILN FURNITURE

Approximately 200 pieces of brick recovered from the kiln pit, kiln associated featured and from deposits in the town ditch can be defined as fragments of kiln furniture. All of this was heavily fired, some of it grossly so, indicating that this material had been used as an oven floor structure onto which has been stacked successive loads of kiln products. Pieces of kiln furniture were most usually fired so that the whole body was in the grey to black colour range, although some pieces were very dark red. This contrasts with the blackened edges of the voussoirs and great bricks but these retained brick red to pale red cores.

Most of this material falls into one of two classes – kiln bars and multi-part nibbed kiln bars – leaving some 120 pieces of material that could not be classified owing to either its size or to the level of thermal destruction to which this material had been subjected. None were *in situ*. There is a strong likelihood that even before its final firing, the tilers operating this kiln had abandoned the use of a complex system of kiln furniture in favour of lying flat roof tile in a chequered pattern across the arches of the oven to create an oven floor. A number of flat roof tiles that might have performed this function were found among the kiln debris. However, up to 60 pieces of kiln furniture were recovered from contexts within the oven flues indicating that they had been in the final phase oven structure. This may, however, have

simply been as re-used material within dump-construction of larger sections of arch or infilling between arches.

The numbers of pieces of kiln furniture from Borelli Yard falls well below the quantities recovered from either the Farnham Park kiln, where most of the oven floor appears to have survived, but exceeds that found at the partially excavated kiln at Guildford. Kiln bars similar to the FBY-KF2 bars were found in the Guildford kiln: 41 fragments from Guildford compared to the 27 in total from Borelli Yard, which may again reflect the amount of material removed from the Borelli kiln when it was dismantled. This may also reflect a possibility that kiln bars were no longer used in any numbers by the time of the final firing at Borelli Yard.

KILN BARS

FBY-KF1 (fig 18a)

Size: 110–120 wide × 50–55mm thick. Length unknown.

Sample: 70 pieces, none complete, most very fire-damaged.

Weight: not known.

Fabric: as great brick and voussoir.

Rectangular bars, up to 300mm long, that were probably used in conjunction with the nibbed kiln bars (FBY-KF2) to form an oven floor across the top of the oven arches. These bars show a lower level of thermal damage at the ends than in the body which might indicate that these were partially built into the tops of the arches. The KF1 bars were made, like the FBY-KF2 pieces, by cutting up great brick to produce

TABLE 2 Voussoir dimensions

Context	Width (mm)	Front-back (mm)	Front face (mm)	Back face (mm)
1001	149	152	42	56
1019	162	155	58	40
1046	155	155	55	40
1061	159	153	58	41
1063	160	155	42	59
1070	161	160	42	58
1080	156	158	40	60
1082	152	157	41	62
1150	160	163	38	57
1152	160	156	45	56
1191	160	158	42	58
1193	155	158	39	55
1194	154	161	40	58
1196	156	160	39	58
1212	160	155	45	50
1280	170	163	44	54
1292	155	155	44	56
1316	153	153	40	59
1330	155	155	40	58
1332	153	153	40	59

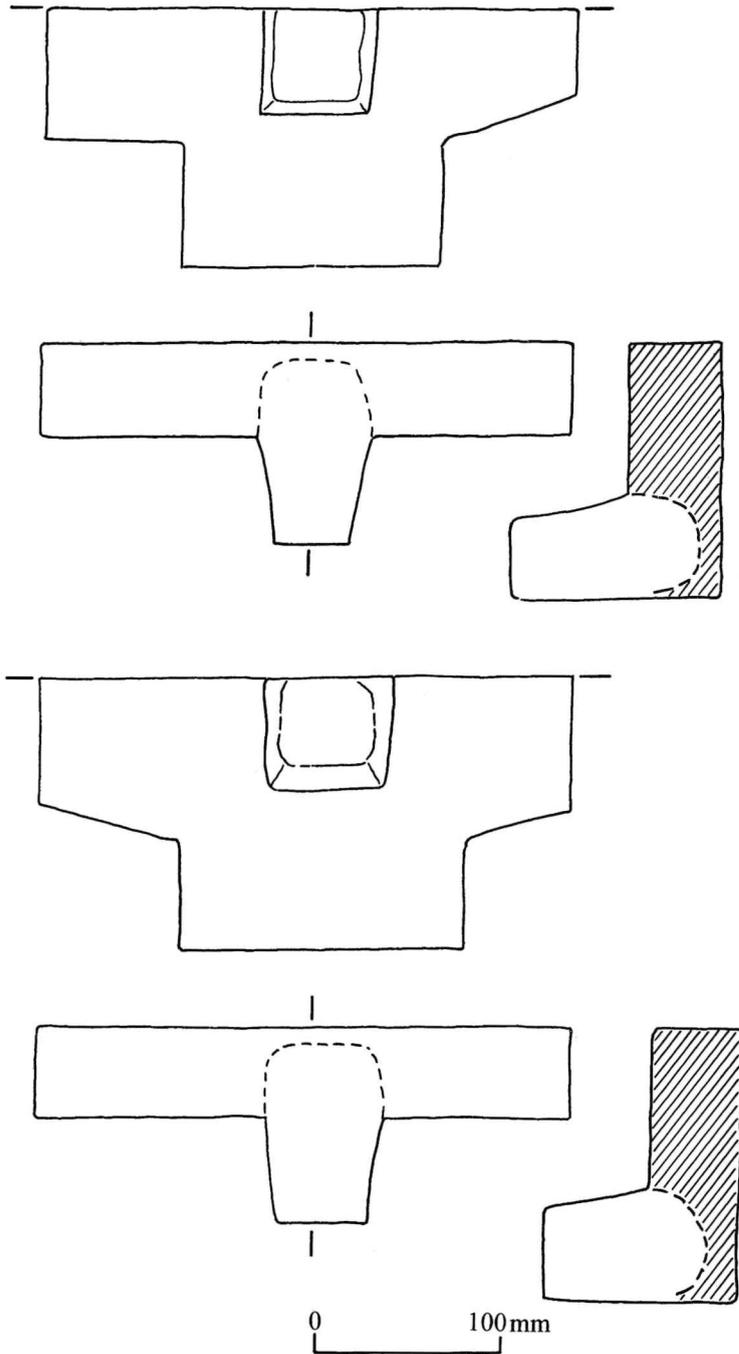


Fig 18a Borelli Yard, Farnham. Kiln furniture, FBY-KF1 (top) and FBY-KF2 (below).

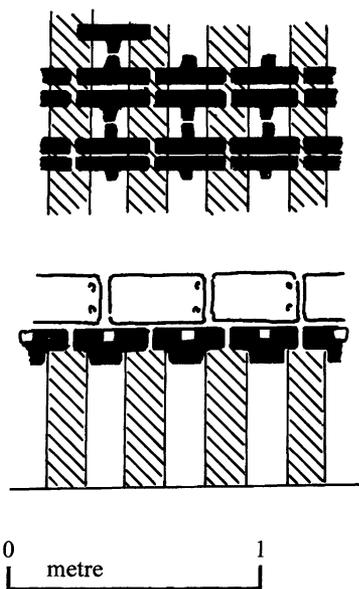


Fig 18b Borelli Yard, Farnham. Diagram showing in plan and section the possible arrangement of the kiln bars (shown in fig 18a) in the kiln.

material of the required size. Both types of bar have the characteristic combed faces of great brick.

FBY-KF2 (fig 18a)

Sample: 27, none complete, one full length and one width with only three nibs. Most pieces represent one of the bar ends.

Weight: not known.

Fabric: as T1 but with a much coarser sand with larger pieces of flint and quartzite used as a moulding sand.

FBY-KF2 bars were also based on remodelling pre-made, unfired, great bricks. The 27 pieces of bar all

belong to the same basic design of kiln bar although there are minor variations in shape, size and geometry. As at Guildford, none were found *in situ* and their exact function and placement in the kiln is imperfectly understood. None the less, from what could be learnt about their use at Guildford and taking into account the impact of thermal damage on these pieces it seems reasonable to suggest that these pieces formed an interlocking series of bars that would have been laid across the oven arches to form a floor.

The bars were formed by removing pieces from each end of the original great brick to leave a 'wing' either side of a central 'lug' (fig 18a). At about midpoint below the lug, but flush with the lower surface of the brick, a hollow was made in the brick into which a lump of clay was inserted and then formed into a nib. A number of knife marks observed on both the Borelli Yard and Guildford pieces, interpreted as marking out or measuring points, indicate that these pieces were not haphazardly cut but that attention was paid to the detail. Some of the wings are square cut and others slope from the lug to the end of the bar.

The bars were up to 300mm long with wings that are mostly 70–75mm long with a few shorter and one 90mm long. Bar thickness ranges from 45 to 57mm. Only one bar showed evidence for the width of the lug, about 160mm, with another giving the lug as projecting about 60mm. This would allow these bars to sit on top of, and at right-angles, to the arches which are formed from vousoirs nominally 160mm square set 160–170mm apart (fig 18b). The lug would hang down between the arches with the nib acting as a spacer between each bar and also creating a vent. The nibs ranged from 50 to 65mm square. It is not known how these bars would have been organized within the kiln; they may have been laid nib to nib, nib to back of bar, or interspersed with FBY-KF1 bars. About 160–170 bars in all would have been required to create an entire oven floor for the Borelli Yard kiln.

Apart from the similar bars from the kiln at Guildford Castle and Palace the only other site to have produced similar bars was the kiln site at Haverholme Priory in Lincolnshire (Eames 1976, and finds in the British Museum).

Discussion

The excavations at Borelli Yard, combined with those at Farnham Park and Guildford Castle and Palace, afford an opportunity to review the early development of the roof tile industry, its products, manufacturing processes and output volumes. Discussion of kiln development has already been covered in the report on the kiln at Guildford (Riall forthcoming, a).

The archaeological evidence presented here has benefited from new work on documentary sources by Dr Christopher Phillpotts on the pipe rolls of the bishops of Winchester relating to the manor of Highclere in north Hampshire. Dr Phillpotts' work is based on sampling every fifth accounting year (where surviving) with intervening years also being read for selected periods. Among those not consulted were the rolls for 1302–3, 1304–5, 1311–12, 1312–13, 1313–14, 1314–15, 1316–17, 1318–19, 1319–20, 1323–4, and 1324–5 (Phillpotts 2000).

TABLE 3 Tile sizes and weights

Site	Tile	Suspension	Length mm	Width mm	Thickness mm	Approx date	Weight g	
Chertsey Abbey	—	double peg	266	196	12–14	1240–60	not known	
Clarendon Palace	—	double peg	290	180–185	16–17	<i>c</i> 1240	not known	
	—	double peg	262–264	170–172	13–15	<i>c</i> 1240	not known	
Coggeshall, Grange Barn	—	peg-and-nib	342	170–180	15	1180–1225	not known	
Cressing, Barley Barn	—	peg-and-nib	320	200	16	early 13thC	not known	
	—	double peg	330	198–203	15–18	early 13thC	not known	
Guildford (GCP)	T1	single peg bat	318–320	190–193	18–22	1180–1200	1760–1810	8–10mm nail hole
	T1a	single peg bat	—	—	—	—	—	10–16mm peg hole
	T2	double peg	370–380	215–231	16–22	1190–1210	1500–1800	16–20mm peg hole
	T3	peg-and-nib	375	215–225	17–21	1200–25	2700–2800	'dented' head
	T3a	peg-and-nib	—	—	—	—	—	infrequent variant
	T7	peg-and-nib	<i>c</i> 300–325	203–207	18–22	1200–25	<i>c</i> 1800	
	T8	peg-and-nib	<i>c</i> 300–325	192–207	16–22	1200–25	<i>c</i> 1800	
	T9	peg-and-nib	<i>c</i> 300–325	201–213	16–22	1200–25	<i>c</i> 1800	
	T11	double peg	320–340	212–218	18–22	1200–25	1500–1800	scalloped tail
	T12	double peg	<i>c</i> 280–300	185–194	14–19	1220–50	<i>c</i> 1250–1400	
	T13	double peg	<i>c</i> 350–370	<i>c</i> 210	16–22	1200–25	<i>c</i> 1800–2000	
Facombe Netherton		double peg	279–305	170–184	16	1250–1300		
		double peg	302–308	175–178	16	1250–1300		
		double peg	279–298	165–191	16	1300–15thC		
		double peg	267–292	165–181	16	1400–25		
Farnham, Borelli Yard (FBY)	T1	single peg bat	—	—	—	—	—	fragments only
	T2	double peg	335–340	200–210	14–18	1200–20	1700–1850	
	T3	single peg	338	90–110	14–18	1200–20	920–980	half-width T2
	T4	peg-and-nib	340–350	198–205	14–16	1210–20	1600–1800	
	T5	nib-and-peg	340–350	205–210	14–16	1210–20	1600–1800	
	T6	single peg	<i>c</i> 300	190–200	14–16	1210–20	not known	
	T7	double peg	320+	222–229	15–18	1210–20	not known	
	T8	double peg	—	160–165	14–16	1210–20	not known	
Farnham Park (FPK)	T1	double peg	260–270	190–210	14–18	1220–30	1200–1500	
	T2	double peg	260–270	210–220	18–22	1220–30	1200–1500	scalloped tail
	T3	single peg cut	<i>c</i> 260–270	110–115	14–16	1220–30	<i>c</i> 600–700	

TILE MAKING AT HIGHCLERE: EVIDENCE FROM A DOCUMENTARY SOURCE

The pipe rolls of the bishops of Winchester survive from the accounting year 1208–9 through to the post-medieval period although there are the occasional gaps. The pipe rolls for Highclere contain a particularly high level of information relating to tile making as the bishop retained the tile kiln in his own hands and paid for his tile production, unlike the situation at Farnham where the bishop bought his tiles on the open market like any other customer. Much of the information given here derives from the period 1300–1400 and, while this is distant in time from the period in which the kiln at Borelli Yard was operating, the practical aspects of tile making would have changed but little. One principal difference that must be noted at the outset is that the tile sizes would have been very different. Early 13th century tiles were very much larger than those being produced in the 14th century (table 3). Typological studies of roof tile show that there was a general reduction in tile size from the early 13th century through to the later 14th century. In part, this can be explained by practicalities; smaller tile was easier to handle (both for the producer and for the tiler who laid them) but it might also be that smaller tiles were more durable than the larger ones, and that smaller tiles were more weather (especially wind) resistant.

Roof tile and lime occur as expenses in the Highclere accounts from early in the 13th century, as bought-in goods, and it is not until 1245–6, when a kiln was made at Highclere, that references to tile being made on the manor begin to appear. The 1267–8 account refers to the production of 4000 tiles with crest and *hypetiles*, and also to lime. Lime production alongside tile making is discussed below.

The 1290–1 account shows 18d spent on repairing the tile kiln; this would become a constant feature of the entries in the accounts. A cluster of accounts from 1300 to 1325 seems to be particularly revealing:

- 1301–2: In making 7000 tiles and 8 qrs [quarters] of lime 8s 7d, at 13d per 1000 tiles and 1½d per qr of lime.
 1305–6: Re-making broken kiln.
 1306–7: 36,000 tiles made at task 39s, at 13d per 1000, lead bought for these tiles 18d, repairing house for making tiles, broken, 12d, making 54 qrs of lime at task 6s 9d at 1½d per quarter.
 1307–8: 28,200 tiles made to roof buildings of courtyard, 30s 8d, at 13d per 1000, lead bought for these tiles 20d, 36 qrs of lime made, 4s 6d at 1½d per quarter, repairing kiln for tiles, broken, 18d.
 1308–9: wages of 1 man roofing tile-house of whole courtyard for year by agreement at task, 13s 4d (?), wages of 1 man re-erecting carpentry of tile-house, collapsed, at task 13s 4d, repairing broken tile-kiln, 12d, making 20,000 tiles and 50 holwerk, 22s 2½d at 13d per 1000, making 30 qrs of lime 3s 3d.
 1309–10: wages of 1 man roofing tile-house of whole courtyard for year by agreement at task, 13s 4d (?), newly roofing stable next to gate into tile barton, 2s, making 32,000 tiles, 34s 8d, at 13d per 1000, 48lb of lead bought for this, 2s, making 200 qrs of lime for this, 13s 4d.
 1310–11: wages of 1 man roofing tile-house of whole courtyard for year by agreement at task, 13s 4d (?), making 30,000 tiles, 32s 6d, at 13d per 1000, 36lb of lead for this work, 18d, making 80 qrs of lime 10s, at 1½d per quarter, repairing broken tile kiln, 12d.
 1315–16: hip tiles bought to mend gutter, 8d, 8 tilers to roof buildings at task, 8s 8d at 13d per 1000 [sic, ? 8000 tiles made], burning 12 qrs of lime for this, 18d, at 1½d per quarter.
 1320–21: completely re-making broken tile kiln at task, 2s, carrying tiles from kiln to tile house, 4d, lock with key bought for tile house, 4d, mending broken wall of tile house, 1d, 23,300 tiles made in courtyard this year.
 1325–26: making kiln for tiles at task, 5s.

While it is a pity that there is not an unbroken series of accounts for these two decades, the documents are none the less very revealing. At this stage tile making was being carried out in the 'courtyard', close to the buildings of the manorial complex, probably within a specific area that can be identified with the tile barton mentioned in 1309–10. It is entirely possible that the same kiln was in use for much of this period and that annual repairs were enough to keep the structure in good enough shape to permit its continued use. Thus the more or less annual expenses of 12d to 18d can be interpreted as minor repairs, the larger payment in 1320–1 can be seen as a larger overhaul with, in 1325–6, the payment of 5s being the cost a new kiln although it is probable that this kiln was built on top of the levelled remains

of the earlier kiln or was a replacement of the oven structure rather than a new building. Such an interpretation accords well enough with the archaeological evidence. Kilns at Beverley (Atkins *et al* 1987) and Meaux (Eames 1961), both in East Yorkshire, with others at Haverholme in Lincolnshire (Eames 1972) and at Shouldham in Norfolk (Smallwood 1978) all provided evidence of kilns superimposed one upon another. It is probably not possible to calculate the length of time that the Borelli Yard kiln was operating although the various strands of evidence point to a period longer than ten years and anything up to 20–25 years. It would certainly be a mistake to assume that these structures had short working lives. A brand new kiln was built in the park at Highclere in 1370–1 at a total cost, insofar as the accounts can be depended upon to show this, of 26s 8d. While costs were certainly rising by the end of the century, this difference can only really be explained by interpreting this evidence as that of a new kiln on a new site in 1370–1, compared to substantial refurbishments, or a new oven, in 1325–6. Evidence from account rolls of Christ Church Priory, Canterbury, for kiln building at their manor of Great Chart, Kent, reveals that 48s 4d was paid to a mason for the construction of a tile kiln: 7000 tiles at 3s and 2000 at 4s per thousand were bought for use in this kiln. The tile house erected beside this kiln had a thatched roof and plastered walls (Adams 1996, 44). Archaeological excavation of contemporary tile kilns in Kent – Addington (Philp 1977, 237–9), Keston (Philp 1973, 79–82) and Tyler Hill, Canterbury (*Time Team*, Channel 4 TV, 2001) – and also Danbury, Essex (Drury & Pratt 1975), shows that these kilns had arches and floors formed from roof tile while the oven walls were lined with horizontally laid roof tile.

The kiln itself had a temporary roof which is not mentioned in the Highclere accounts but does occur in the Farnham accounts; the 1374 Farnham account notes the expense of gathering bracken to cover the tile house at a cost of 2s and goes on to note the expense of two masons repairing the arches of the tile kiln. Philip Brooks was of the opinion that the bracken was used to cover an ancillary structure; it is more likely that this was used as a temporary roof to cover the kiln itself. Of some interest also is the occurrence in the 1364–5 Highclere account of the expense of 2s for daubing the kiln with clay. Does this refer to the oven? The oven at Guildford was lined with clay possibly applied to a framework of withies attached to the kiln walls. At Borelli Yard, the stokepit produced large quantities of burnt clay that seemed more likely to be derived from daub than from tile making. It would seem quite likely this reference hints at one way in which the medieval tilers sought to extend the working life of their kilns.

While no tiliary buildings were identified at any of the three Surrey sites, tile houses have been excavated at Beverley and at Danbury, Essex. That a lock was bought for the Highclere tile house indicates that these buildings were not necessarily open-sided structures.

An entry in the 1361–2 Highclere account offers: ‘2 carpenters working for one week to mend tile house and make other tools for tile making, tile moulds, shovels, spades and wheelbarrows, 5s 6d, [...] 4 men working to groundsill, stud and wattle this building with withies collected for it, 5½ days at task, 7s 4d at 4d each per day’. This suggests that the tile house here was built up from beams laid either on the ground surface or laid in beam slots.

In the absence of postholes at the Quarr Abbey tiliary, where the site of the potential tile house was marked by substantial areas of broken slate and pie-crust style ridge tile, it remains a possibility that the tile house there was built up from beams laid on the ground. The Highclere tile house had a tiled roof, as revealed in the 1308–9 pipe roll and again in 1371–2. The presence of large quantities of broken roof tile in the kilnpit and pit 276 at Borelli Yard, which produced the sole substantial group of peg-and-nib tiles, has been taken as suggestive of roofing material from a tile house rather than dumped spoiled stock. The constant repairs to the Highclere tile house might help to explain why the last of the Borelli Yard tile types was in use on site as a roofing material. At Guildford, the earliest of the tile types, GCP-T1, was predominantly recovered from the backfill layers above the oven and these have been interpreted as coming from a building associated with the kiln. The presence at Quarr Abbey of slate is readily understood when it is explained that the main purpose there of the tiliary

was to create roofing materials for a major building campaign at the abbey in the late 13th century (Riall 1996).

It should not be assumed that tile was wholly supplanting slate as the roofing material of choice. The 1301–2 account for Highclere shows ‘1,500 slates bought for roofing the oriel of the chapel, 2s 2d’. Slate was recovered from the nearby site of Facombe Nethererton (Fairbrother 1990, 1, 224) and shown to be quarried from beds of the Gurrington series of Upper Devonian slate. These extend from Newton Abbot to near Plymouth in Devon. The slates at Facombe Nethererton are thought to have been laid in the 12th century and were superseded by ceramic roof tile from early in the 13th century. It may be noted here also that at Farnham Castle wooden shingles remained in use long after the introduction of ceramic tile.

The lead mentioned in these accounts was possibly used to make lead glazes which are more likely to have been applied to the crested tile than the flat tile. Roof tilers did not ordinarily lay lead on roofs or gutters: this was very much the preserve of the plumber. The 1301–2 Highclere account provides a case in point: ‘In stipend of one carpenter rebuilding and mending the gutter between the hall and lord’s chamber with boards sawn for the same, 2s 6d [. . .] in 8½ feet 6lb of lead bought, £1 1s 6d [...] in stipend of the plumber smelting the said lead and laying it on the aforesaid gutter, 2s 6d’. The relative costs also say something about the quantities involved and therefore the likely use to which the tilers would have put the lead.

Raw materials for producing both tile and lime was obtained locally from within the manor at Highclere. The 1370–1 account is particularly interesting for the information it gives about local materials and also about the level of organization that was involved in gathering the material together.

1370–1: allowed to John de Ketton and Henry Watisford £7 paid to Walter Gorlee for burning lime, because he was commonly due for each qr [quarter] 4d; and afterwards account was made that Gorlee received these £7 beyond what he should have received, because in making each lime kiln (?lime pit) he accounted for 200 qrs, whereas only 120 were found. And so Gorlee was obliged to Watisford in a certain sum of money for this debt because of deception.

101 men hired with their horses and carts for 1 day to carry lime and sand from park to courtyard, 100s 8d at 12d per day less 4d in all. 1 man hired with his horse and cart for 11½ days to carry lime and sand, 9s 7d at 10d per day. 1 man hired with his horse and cart for 9½ days to carry lime and sand, 6s 4d at 8d per day. 1 man hired with his horse and cart for 15 days to carry wood to the tile kiln. Making and baking 37,000 tiles 74s, at 2s per 1000, making and burning 25 qrs of lime amongst these tiles, 4s 2d, at 2d per qr, digging clay for making these tiles, 2 men for 11 days, 4s, 1 man hired with his horse and cart for 7½ days for carrying tiles from park to courtyard, 7s 4d, at 12d per day less 2d in all, 49 men hired with their horses and carts for 1 day to carry wood and lime to pit, 49s and 12d per day, 1 man hired with his horse and cart for 12½ days to carry wood and lime to same, 10s 7d plus 2d in all, making 1 pit for burning lime, 10s at task. Making and burning 1040 qrs of lime by Walter Helyer, £17 5s 8d at 4d per qr. 4 men hired for 4 days to clear 1 plot and knock down trees and dig the ground to have lime there, next to lime pit, 4s at 3d per day. 1 man hired for ½ day for same, 2 masons working for 3 weeks and 3 days on making 1 kiln for baking tiles, 16s 8d, at 2s 6d each per week, 3 masons working for 3 days on making this kiln, 3s at 4d each per day, 2 men working to serve them for 2 weeks 2 days, 7s at 3d each per day. In 83 men hired for 1 day to cut down wood for 8 lime pits, 20s 8d at 3d each per day less 1d in all. In making and burning 228 qrs of lime, 57s at 3d per qr.

Other accounts tell more about the digging of clay and sand, and carting these materials to the tiler, as well as the constant supply of firewood. The pipe rolls also reveal much about the volume of production that these kilns were capable of, although one must also take account of the likelihood that the Highclere kiln was geared to manorial demand rather than operating as a commercial enterprise. The 1290–1 account shows 40,000 tiles produced, with 17,000 in 1296–7, 8000 in 1300–1, 7000 in 1301–2, back up to 18,000 in 1305–6, surging to 36,000 in 1306–7, with 28,200 in 1307–8, 20,000 in 1308–9, 32,000 in 1309–10 and 30,000 in 1310–11. The upper practical limit of production for the tiler seems to have been around the 40,000 tile mark a figure that was only achieved, as far as is known, in 1290–1, 1365–6, and 1371–2 with figures of 20,000 to 30,000 being fairly routine. Similar figures

appear in the accounts for Farnham; in 1374 the tile kiln (site unknown) produced 30,000 tiles and 1500 curved tiles at a rate of 2s per 1000 for flat tile and 2s per 100 for curved (Philip Brooks, pers comm). This compares with the commercial tile production run by Christ Church Priory, Canterbury, on their Kentish estates where, recorded in the prior's accounts for the mid-14th century, 80,000–100,000 tiles were being produced annually. This production must have been the result of working two or three kilns. An entry for the Great Chart manor shows a kiln being used four times in 1315–16 to produce 36,000 tiles. This however does not mean the kiln held 9000 usable tiles; there is always wastage in tile production but this was not something that the accountant would have recorded (Adams 1996, 35–59). The Great Chart kiln would have held at least 10,000 tiles per load.

Lime burning was, on occasion, a major activity at Highclere with selected individuals responsible for burning large quantities of lime from time to time or, perhaps more regularly, the tile makers burning lime every year if in small volumes.

The 1362–3 Highclere account shows: '2 carpenters working for 2 weeks to lengthen 1 tile house in Park to put lime in, 11s, wattling and daubing walls of this building and roofing it, at task, in gross, 8s 4d'. At this stage, the Highclere tilery had been moved away from the complex of buildings forming the bishop's house into the park. The need to lengthen the tile house to provide storage for lime tells much about the involvement of the tile makers in the manufacture of lime although lime burning was occasionally carried out by individuals who were not necessarily involved in tile making as would seem to be the case in the 1370–1 account quoted above. There does appear to be some distinction between creating major quantities of lime that would have been required for substantial construction projects, and thus a requirement for specific lime kilns, and burning the minor quantities of lime which was required by the tilers in their roofing work. Ridge tiles were bedded on mortar, hip tiles could be both nailed and mortared, while flat tile was sometimes also laid on a mortar bed. The inclusion of the expense of 4s 2d for burning lime 'amongst these tiles' in the 1370–1 account, alongside references to burning lime in specific pit, might at first sight seem to be an accountants or copyists error. The 1364–5 account states that the same four men who were tile making and also burnt the lime, and this is repeated in the following year: '4 men working for 1 week to break limestone for tile kiln and cut wood for it, 7s. The 1372–3 has 24qrs of lime made between these tiles'. The clear inference from this is that lime was being burnt in small quantities in the tile kiln, probably in between loads of tile rather than simultaneously. This documentary evidence certainly points to an interpretation of the chalky deposits at Borelli Yard and Quarr Abbey as being derived from lime burning.

DATING EVIDENCE

There is no specific documentary evidence that unequivocally states when the kiln at Borelli Yard was in operation although there are, as has been seen, a number of documentary references to the production of tile at Farnham in the first decades of the 13th century. There remains the archaeological evidence in the form of pottery, roof tile and brick, the kiln structure and one scientific dating technique. None of these offers a finite solution with the result that any comments on dating this kiln will constitute an interpretation based on this range of methods.

Archaeomagnetic dating of the Borelli Yard kiln, by the late A J Clark

The Borelli Yard kiln was sampled by the method that is now standard. Small plastic discs, some of which are just visible in figure 4, were stuck with epoxy resin to fourteen parts of the structure that had obviously not moved since its abandonment. The discs were levelled with a small spirit level to provide a horizontal reference for measuring the angle of dip, and then a north-related line was marked on them as a reference for the declination (east–west variation). This was done with a gyro-theodolite, which finds true north by the interaction

TABLE 4 Dates for the Surrey kilns obtained by measurement of thermo-remnant magnetism

Farnham, Borelli Yard	1220–50	(68% confidence level)
	1205–65	(96% confidence level)
Farnham, New Park	1240–75	(68% confidence level)
	1220–60	(68% confidence level)
Guildford	1210–70	(96% confidence level)

of a spinning gyroscope with the rotation of the Earth. The discs were then removed with small samples attached, and taken to a laboratory, where the direction of their magnetic field was measured in a spinner magnetometer. The average result obtained from fourteen samples of the brick flue arches was AD1235±15 years at the 68% confidence level, but at the 96% confidence level this calibrates at 1235±30 years.

Dr Clark went on to apply the same dating technique to the kilns at Farnham Park and Guildford Castle as shown in table 4.

Pottery

These dates can be adjusted through reference to other pieces of archaeological data from the three sites. The pottery from the kiln pit at Borelli Yard is not especially helpful but indicates that the kiln pit was backfilled by no later than 1220–40. The kiln in Farnham Park produced no pottery at all while at Guildford the tile kiln contexts were all spot-dated, on pottery evidence, to before the 1230s. The pottery does however make it reasonably certain that the kilns were being worked in the period 1200–30.

Roof tile

It is clear from the materials employed in the construction of these three kilns, and the range of products associated with them, that any discussion must focus on all three sites in order to produce an acceptable date not only for the Borelli Yard kiln but also for the other two Surrey kilns. The various types of roof tile associated with each kiln offer one way forward and this, alongside the materials used to build the kilns, offers a potential tool for dating the kilns. Researchers are nevertheless at something of a disadvantage in that the Surrey tile kilns, and tile production, under discussion here, were themselves exemplars of an industry that was already organized and beginning to evolve elsewhere, quite possibly in London and south Essex (Smith 1998–9; forthcoming). It is not known to what stage in this process the Surrey kilns belong. The most obvious aspect of this is the occurrence of large quantities of shouldered tiles (or bat-tiles as they are sometimes termed) in the Guildford kiln pit and their minimal presence at Borelli Yard in the fills of the town ditch.

Roof tile is, by its very nature, exceedingly difficult to date and it is of course to be preferred if roof tile from dated kilns can be used to create a dated type series. Failing this, tile from well-dated contexts is another potential source of information but it hardly needs be stated that there are hazards here since tile has the potential for considerable longevity of use.

The earliest forms of roof tile in southern England fall into two groups: Roman style *imbrex* (curved) and *tegula* (flanged) tiles and, second, shouldered tiles. The first system mimics the Roman method of roofing and which was presumably re-introduced into England in the 12th century. This style of roofing occurs mostly in London (Armitage *et al* 1981, 351–62) and Southampton (Platt & Coleman-Smith 1975, 1386–90) and has been noted in several high-status sites including Battle Abbey (Streeten 1985) and Bishop's Waltham palace (pers obs). Shouldered tile is dated to the mid to later 12th century and has mostly been found in contexts across London (Betts 1990, 220–5) although it has been found elsewhere, for example at Lewes Priory where it has been assigned to the period 1170–80 (Lyne 1997, 101). Shouldered

tile from London, and now from Guildford, is strikingly similar in design to wooden shingles recovered from Winchester (Keene 1990, figs 73 and 74: the reconstructed shingle in fig 74 might easily have originally been shouldered rather than rectangular as shown) and, as such, it is possible that shouldered tiles were simply skeuomorphs in ceramic of wooden originals. It seems quite clear from deposits in London that shouldered tiles were superseded by rectangular tiles, of the double-peg type, some time from late in the 12th century to early in the 13th century although the evidence for this process is far from clear (Smith 1998–9; forthcoming). The London evidence is based entirely on residual materials with no early kiln sites having so far been identified. It would seem likely that rectangular, double-peg, roof tile which also occurs in London deposits alongside shouldered tile was superseding shouldered tile by the end of the 12th century. Along the south coast the picture is confused by the almost universal use of slate in preference to ceramic tile so that the early tiling systems were replaced by non-ceramic roofing materials for at least 100 years and up to 150 years before ceramic tile became an economically viable alternative. Thus many of the sites where early tile has been recognized do not have a tile sequence that includes the earliest tiles followed by the early double peg or peg-and-nib tiles.

At Guildford Castle and Palace the shouldered tile is present only in the kiln pit backfill layers and, as such, can be interpreted as coming from a tiliary building which was demolished when the tiliary was closed down. The shouldered tile here, GCP-T1, is made from the same fabric as the first of the rectangular, double peg tile types, GCP-T2, a large, rectangular tile. This would tend to suggest that shouldered tiles enjoyed a longer period of use and manufacture and that the Guildford kiln can be dated to the late 12th century, perhaps the 1190s. The larger problem at Guildford was to reconcile the production of shouldered tile in a kiln that appears to have still been in operation in the 1220s which, in the light of current research, seems an improbably long period. At what point in this kiln's output the next tile type, GCP-T2, was introduced is a moot point. This tile is a large, rectangular, double-peg tile which is of a similar size and shape to FBY-T2 tiles. The Guildford T2 tile is seen as the first major departure in that kiln's tile sequence but, as the kiln structure itself was not excavated, it remains unknown whether T2 tile was used in structural contexts within that kiln. By contrast, the FBY-T2 tile was used exclusively in the primary construction of the Borelli Yard kiln. While the two tiles are relatively different in design, the Guildford tiles have especially large peg holes, the size of the tiles is an important factor. Peg-and-nib tile are later than double-peg tile, but it should also be noted that peg-and-nib, or single nib, tiles enjoyed short spans of popularity and occur from time to time, over the centuries, in the typological sequence.

At the other end of the date bracket for the Surrey kilns, approximately the middle of the 13th century, the tile from well-dated contexts is far smaller. As a broad generalization tile was reduced in size during the first half of the 13th century, with early tile being of large dimensions and the latest tile being up to one-third smaller. Perhaps the best example of this is the floor tile kiln excavated at Clarendon Palace, Wiltshire, and which is now displayed in the British Museum. Documentary evidence for this kiln shows it was producing floor tiles from 1237 to 1244–5 (Eames 1980, 29). The walls of this kiln were lined with peg tile broken into approximate halves with further, complete, roof tiles laid in the kiln flues. Two sizes occur among the Clarendon tile: 290×180 – 185×16 – 17 mm and 262 – 264×170 – 172×13 – 15 mm. This is much smaller than the Farnham/Guildford tile. Tile from the kiln at Chertsey Abbey, dated to after 1240, measures 265 – $270 \times 195 \times 14$ – 16 mm (Gardner & Eames 1954). On the basis of tile size, it is therefore possible to date the three Surrey kilns to the earlier part of the 13th century.

Within the kilns themselves were further pieces of dating evidence: the great bricks and voussoirs which formed the firebox and oven structures.

Great brick

Like roof tile, great brick and voussoirs remain largely neglected topics and, outside Essex, great brick is virtually unknown. This may partially be a result of the potential for confusing great brick with the Romano-British brick on which great brick would appear to be modelled. A further difficulty is that great brick enjoyed only a brief period of use before being supplanted by 'Flemish' bricks that were either imported from the Continent or were manufactured locally, especially in East Anglia (Drury 1977, 83–6; Ryan 1996, 22–41). Great brick was identified as specific building material belonging to the 12th and 13th centuries at Coggeshall, Essex and thereafter was noted in a number of ecclesiastical buildings in Essex (Gardner 1955; Drury 1981, 126–7; Ryan 1996, 22–41). Close to Coggeshall Abbey is Holy Trinity church, Bradwell-juxta-Coggeshall. Here a new church was built with all its primary dressings executed in great brick, with, additionally, a limited quantity of tile used in turning the heads of the window arches. The construction of this church is placed, on architectural grounds only, in the period 1125–50 (Rodwell 1998). The Bradwell great brick is a little larger than the Surrey material but this does not pose a particular problem (table 1). The tile at Bradwell is thought to be peg-and-nib tile, though it may be noted that this tile has only been seen *in situ* thus the flat faces (with the nib) of this tile have not been revealed; similar (*sic*) tile has been found at nearby Cressing Temple. Rodwell's suggestion that the Bradwell tile can be identified as nibbed tiles would require a major re-think of the dating of tile development in London and elsewhere, especially with regard to the *imbrex* and *tegula* system and to bat tiles. It is more likely that Bradwell is actually later in date, perhaps 1150–75, and that the Bradwell tile is actually bat tile if not double peg tile. Nevertheless, the use of great brick at Bradwell shows clearly the use of this material from an early date. The Essex material is generally assigned to the period 1150–1225, while much of the tile at Coggeshall was in place before 1200 (Ryan 1996; Rodwell 1998).

Great brick and tile from the Borelli Yard kiln occur in a hearth and in the structure of the walls of the shell keep of Farnham Castle (Riall forthcoming, b). The hearth may well date to a period after 1220, although this should not be taken to deny the possibility that this feature might be earlier, while the brick and tile in the keep walls is most likely to belong to the original construction. It is clear from reading the pipe rolls relating to work at Farnham Castle that the shell keep, with its turrets, was built before 1208–9. The implication of this is that the great brick in the keep dates to before 1208, which in turn places the construction of the Borelli Yard kiln early in the first decade of the 13th century.

The use of Farnham-Guildford style voussoirs for creating kiln arches was seemingly short lived. The kiln at Clarendon, dated to the late 1230s, was fitted with quite a different form of voussoir, much thinner and with a rounded or polygonal leading edge. Both were anyway replaced by a probably universal use of roof tile as the main material for arch construction by the late 1200s. The voussoirs in the Surrey kilns thus present further evidence of an earlier date.

Other dating material

The presence of large quantities of shouldered tile in the kiln at Guildford suggests a date in the 1190s for the Guildford kiln, with the Borelli Yard kiln being constructed in the early 1200s. The two kilns have many features in common and it is entirely possible that lessons learnt in the construction and use of the Guildford kiln were applied to the Borelli Yard kiln. One aspect of this is the construction of the oven floor, which at Guildford used a limited series of kiln fire bars of a relatively crude design. The oven floor at Borelli Yard seems to be somewhat more sophisticated and refined (see *Oven floor*, above). This is further borne out by changes to the design of the roof tile. Shouldered tile was almost certainly not a product of Borelli Yard and the earliest Borelli Yard tile, FBY-T2, mostly has peg holes of a size that would be almost the standard size throughout the medieval period. FBY-T2a presents tile

of same size as T2 but with very large peg holes similar to Guildford T2 tiles which are also very large. While the two kilns may well have been set up by the same tiler the production runs from the two kilns are quite different. Both kilns produced peg-and-nib tile but to quite different designs.

The kilns at Guildford and Borelli Yard remained in use into the second decade of the 13th century. Operations at both were probably suspended during the civil war of 1216–17 and while it is likely that tile production was resumed at Guildford, the kiln at Borelli Yard was abandoned and demolished. A new kiln may have been established at Bear Lane but a further kiln was soon after erected in Farnham Park (Riall 1997); this kiln appears to have been operating contemporaneously with the Guildford kiln. A particular form of roof tile, scalloped tiles, from Farnham Park (FPK-T2) occurs also in the Guildford assemblage (GCP-T11). Additionally, knife-cut crested ridge tile is common to both assemblages although the Farnham material is unglazed while the Guildford material is glazed. This would suggest that in its final phases of use, possibly 1220–5, the Guildford kiln was being worked at the same time as the Farnham Park kiln. This is not altogether surprising as the bishop of Winchester, Peter des Roches, on whose land the kiln at Farnham was operating, was guardian to Henry III to whom belonged the castle and palace at Guildford. The personal connection is further emphasized by the presence of the very distinctive peg-and-nib tile, GCP-T3, at des Roche's episcopal palace at Bishop's Waltham; this tile can only have been produced in the Guildford kiln but when, exactly, in the Guildford sequence and at what date is impossible to say. This is paralleled by the presence of crested ridge tile, FBY-T10 and T11, from Farnham.

Placing a date on the close of operations at Borelli Yard is problematic but can be viewed in two ways. Firstly, the kiln was deemed unfit for further use and, after a period of non-use was abandoned in favour of a new site: Bear Lane or Farnham Park. An alternative view envisages that the tiling was forced to shut down as a result of the civil war of 1216–17 during which time the kiln became so dilapidated that it was decided to abandon the site in favour of a new works.

It is difficult to understand why the kiln would have ceased production when it is clear from the pipe rolls that at the castle alone there was a constant demand for tile; it is not possible to say what sort of market there was for tile in the town or on the parish church. The kiln had also undergone a major refit which included a new firebox and stokepit floor. This firebox had clearly not been much fired before the kiln was abandoned. While it is not possible to be certain as to the state of the oven, for this was mostly collapsed or robbed out in the medieval period, there is sufficient evidence from there too to indicate that there remained the potential to continue firing the kiln.

Town ditch

At this point it is necessary to consider the evidence from the town ditch. As has been seen above, quantities of ceramic building material were deposited in the town ditch but much of this was dug up when the town ditch was recut (Riall 2002). These ditch fills were redeposited in the ditch later in the 13th century, a process that thoroughly mixed all the ceramic building materials. Had the town ditch not been recut it is likely that there would have been a deposit sequence of double-peg roof tile followed by evidence for kiln repairs in the form of burnt-out kiln bars, voussoirs and great brick with, later in the sequence, evidence for peg-and-nib tile. This is not the case; all the material is muddled together. It is difficult to believe that the recut of the ditch cannot be connected with the outbreak of civil war in 1215–16, rather than any later date, a period which is marked in the documentary record at Taunton by the expenses incurred in refurbishing the town defences. It is altogether possible that similar activity took place at Farnham. This would certainly explain the abandonment phase of the kiln as it is hardly to be expected that tile production could have continued during 1216 and 1217 with the likelihood that there was either none or only a limited period of production in 1215. One might even wonder whether the immediate areas outside the town

ditch would have been cleared of buildings and structures in order to create open ground rather than leaving potential cover for an enemy. Could the tilery have been allowed to survive intact? This may never be known.

Whatever happened in this period it is certain that by no later than 1220 the Borelli Yard kiln had been abandoned and the tile works moved to another location.

ACKNOWLEDGEMENTS

The excavation at Borelli Yard was conducted in advance of redevelopment of the site by Arundell House Securities Ltd and was funded as a Manpower Services Scheme operated by Waverley Borough Council. Most of the acknowledgements and notices of thanks are provided in my earlier report (Riall 1998, 120) and it remains for me to thank, in particular, David and Audrey Graham without whose support this report would not have been written, also: the Surrey Archaeological Society, the Farnham & District Museum Society and the Society for Medieval Archaeology, all of which produced funding for various aspects of the post-excavation work. I am indebted to various specialists for their reports: the late Dr A J Clark for his archaeomagnetic dating of the kiln and his discussion with me of the results from both of the Farnham kilns and from the Guilford kiln; the late Robert Foot (ceramicist with the Archaeology Section of the Winchester Museums Service) for analysing many samples of brick and tile from Borelli Yard and other sites in the region; Phil Jones of the Surrey County Archaeological Unit for his comments on the pottery; Bernice Candy of the Swansea Museum for her report on the snail shells. I most grateful to Dr Christopher Phillpotts for sharing with me his work on the documentary evidence contained in the pipe rolls of the bishops of Winchester for Highclere.

The excavation and analysis of the kiln and its products depended in no small measure on the enthusiasm and practical knowledge of Val Shelton-Bunn to whom I am most grateful.

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