A Thirteenth-Century Tile Kiln Site at North Grange, Meaux, Beverley, Yorkshire

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The first Cistercian houses to be founded in the north of England were Rievaulx and Fountains, both established in Yorkshire in 1132. The order expanded rapidly and reached the height of its power about a century later. During this period of prosperity in the mid-thirteenth century the northern Cistercian houses employed a form of tile paving which, though not peculiar to them, is rare elsewhere. This is termed for convenience tile mosaic because it depends for its effect upon patterns composed of small pieces of specially-shaped tile. Pavements of this type are known from the Cistercian abbeys of Byland, Fountains, Meaux, Melrose, Newbattle, Newminster, Rievaulx and Sawley. A plan illustrating the arrangement of a tile-mosaic pavement in the south transept chapels of the abbey church at Byland is illustrated on pl. xx by kind permission of the Ministry of Works, and photographs of a representative series of tile-mosaic patterns from the site of Meaux abbey are reproduced on pl. xxⅰ. In this type of tile mosaic, the pattern, which depended basically upon the shape of the pieces of tile used, was emphasized by the employment of alternating colours. At most sites the colours used were green and yellow, but at Meaux abbey patterns were sometimes executed in brown and yellow.

The tiles themselves were all made of red earthenware and the various colours were obtained by glazes. Brown was produced by painting a clear lead glaze direct on the red earthenware body of the tile, yellow by coating the surface of the tile with a plastic white slip before glazing it with a clear lead glaze. Green glaze was made by adding copper oxide to the lead glaze. This never mixed evenly and green glaze was always mottled or streaked. When placed direct on the red earthenware body it fired to a dark green, often near black. Light green was obtained by coating the tile with a plastic white slip before applying the glaze. Black could be made by the introduction of manganese into the glaze but was rarely used. Although a range of five colours was thus available, normally tile mosaic employed only two.

The exact derivation of this type of pavement has not yet been fully worked out. It has been thought that it was developed in northern France, in imitation of Italian cosmati work, or so-called opus Alexandrinum, in which geometric patterns were executed in different coloured marbles. Tile had the advantage that it could be produced more cheaply than stone, but it was far less durable.
A possible transitional phase from the use of stone to tile as a medium is represented in Canterbury cathedral, where a fine pavement in *opus Alexandrinum* was laid before the shrine of St. Thomas Becket by Italian craftsmen between 1213 and 1220. A short distance away in the corona is the remains of a less elaborate mosaic pavement executed in tile and, judging by the distribution of wear and slight retention of glaze on the tiles nearest the wall, apparently in its original position. The corona was built at the same time as the shrine of St. Thomas Becket, and this fragment of tile mosaic may thus be assumed to be roughly contemporary with the *opus Alexandrinum* and to date from about 1220. These mosaic tiles have a clay-coloured body, which resembles a soft stone, and the remaining glaze is dark green and yellow. The only other pieces of tile mosaic known to survive in southern England are in Rochester cathedral, and the few patterns represented there are all known from northern sites.

It has, however, recently been suggested to me by Mr. John Harvey that the English tile mosaic might be derived from Spanish originals. A pavement of tile mosaic was laid in the cloisters of the Cistercian abbey of Poblet at some date in the thirteenth century. This mosaic is of a type known as *alicatados*, which is made up of shapes cut from fired tiles, whereas the English tile mosaic is composed of tiles cut to shape before they were fired. On the other hand this English method of producing tile mosaic was also known to Hispano-Moresque tile workers and still survives in Tetuan in Morocco.

It is beyond the scope of this paper to pursue the details of the derivation of this type of tile-mosaic paving, but it is clear that it reached the Cistercian abbeys of northern England and Scotland as a fully developed technique. Over sixty designs are known from the abbeys already mentioned, but the same designs tend to recur at different places. For example, the large circular pattern illustrated from Byland on pl. xx is known at five sites. It has therefore been thought possible that a single tile factory supplied many or all of the sites where tile mosaic is found. This however is disproved by a comparison of the fabric and glaze of tiles from different sites. I have examined a wide selection of tiles from the Yorkshire abbeys of Byland, Fountains, Meaux and Rievaulx, and the differences of fabric and glaze exclude the possibility of any two of these sites having been served by the same kiln. This variation of fabric from site to site suggests that a tileworks was set up locally where the tile mosaic was required; but the similarity in design and technique is such that all sites are likely to have been served either by the same band of designers and craftsmen, or by various bands working in close cooperation with each other.

The remains of a number of medieval floor-tile kilns have been found, but unfortunately without very adequate record. As far as is known, all were used

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2. Since this paper was written an extensive area of this type of pavement has been found on the site of the abbey church at Old Warden, Bedfordshire.
for firing rectangular tiles, both plain and decorated. I have already published a general account of the methods of making and firing these tiles.\(^4\) The conclusion reached was that the tiles were subjected to only one firing, being glazed whilst still green, and that they were stacked on edge in the kiln, each layer being placed at an angle, which was not normally a right angle, across the layer below.

The problem of the structure of medieval floor-tile kilns has been discussed in a paper on a thirteenth-century tile kiln found on the site of Chertsey abbey, Surrey.\(^5\) Most known kilns consisted of two parallel rectangular furnace-chambers, usually below ground level, separated from each other by a thin wall, and fired through two parallel tunnels, slightly narrower than the furnace-chambers, roofed by solid arches and opening on to a stoke-hole. The furnace-chambers themselves were spanned by a series of parallel arches running across each chamber at regular intervals. These arches were built up so that they had flat tops to carry the oven floor. The oven floor was a temporary structure made of fired tile and clay with vents in it where required. The oven walls rarely survive to any appreciable height, but appear to have been continuations of the walls of the furnace above ground level. The exact method used for roofing the oven is not known, because no roof has been found. Some large kilns may have carried permanent roofs. Smaller ovens for firing rectangular tiles are likely to have been roofed by layers of fired tiles laid across the top after the oven had been set ready for firing. Some may have been domed over with clay after each setting of the oven.

Kilns varied in size, but the two other kilns of which I have detailed knowledge bear striking resemblances to each other and to that at North Grange, Meaux. The kiln at Chertsey, already mentioned, had a tile-built furnace about 4 ft. long, divided into two chambers 2\(\frac{1}{2}\) ft. wide, each spanned by three tile-built arches 7-8 in. wide, 5 in. apart, springing from the furnace walls about 1 ft. above the floor. It was fired through two parallel tile-built tunnels 4\(\frac{1}{2}\) ft. long, 1\(\frac{1}{2}\) ft. wide and 1 ft. 4\(\frac{1}{2}\) in. high. I recently reopened the site of a mid-thirteenth century floor-tile kiln at Clarendon palace, near Salisbury, Wiltshire, which was excavated in 1937, but remains unpublished. It has a tile-built furnace 4 ft. 7 in. long, divided into two chambers about 2 ft. 2 in. wide, each spanned by four tile-built arches about 6\(\frac{1}{2}\) in. wide and 6\(\frac{1}{2}\) in. apart, springing from the level of the furnace floor. Nothing remained of the oven structure at either of these sites.

The problems involved in making and firing the small and often irregularly-shaped components of tile mosaic were more complex than those facing the maker of decorated rectangular tiles, whose quarries could be moulded in a few standard sizes and whose unfired tiles could all be stacked on edge in the oven in the normal

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\(^4\) Elizabeth S. Eames, 'The products of a medieval tile kiln at Bawsey, King's Lynn,' *Antiq. J.*, xcvv (1955), 162-175.

\(^5\) J. S. Gardner and Elizabeth Eames, 'A tile kiln at Chertsey abbey,' *J. Brit. Archaeol. Ass.*, xvi (1954), 124 f., a paper based on the typescript of one read before the Society of Antiquaries by the late Dr. Eric Gardner describing his work on the Chertsey kiln site in 1922. It is less complete than a publication by Dr. Gardner himself would have been, but the dimensions of the structure had been exactly recorded, and the illustrations were made from Dr. Gardner's photographs and slides.
way. The pieces of pavement illustrated on pls. xx-xxi demonstrate that the mosaic tile-maker had a large range of different shapes and sizes to cut out and fire. The problems of shaping the tiles have been discussed elsewhere. The mosaic shapes were not moulded, but were cut out of a sanded block of clay. The shape required was scored round a template placed on the surface of the block and the tile cut out, its sides being usually pared down at an angle so that the area of the bottom was smaller than the top. This enabled the tiles to be set firmly in a mortar bed without a wide joint of mortar round them at the top. Even the elaborately-shaped tiles seem to have been fired on edge, sometimes stacked in more than one layer. The rectangular components were fired in two ways: either cut out to their final dimensions, or in large rectangular blocks, scored about half way through with the shapes of the tiles, which were not broken apart until they had been fired. These blocks were stacked on edge in the oven. Other rectilinear shapes, such as triangles and lozenges, were also fired in scored blocks. The lines for the scores were sometimes marked on the surface of the uncut block with twisted wire or string. The labour involved in cutting these shapes and in handling so many small pieces, both during the loading and drawing of the oven, and during the laying of the pavements, may well explain the limited number of sites known to have used tile mosaic, and the fact that, whereas decorated rectangular tiles began to be mass produced during the fourteenth century and became very common, tile mosaic seems to have died out.

So far only one kiln for firing tile mosaic has been found. It was located in 1932 by G. K. Beaulah and W. Foot Walker in a moated enclosure in Grange field, North Grange, Meaux, near Beverley, East Yorkshire (fig. 40), when a trial hole revealed a layer of ash and tile debris containing waste tile mosaic at a depth of about 4 ft. below the present turf line. Stacks of fired building and roofing tiles, part of an earthenware crucible or mortar, and the foundations of an entrance to a furnace were also found. It was assumed that nothing more remained of the furnace, the interest at the time being focused on the tile wasters recovered. During the period from 1925 to 1935 G. K. Beaulah and W. Foot Walker carried out extensive investigations on the site of Meaux abbey. These revealed that the abbey church had been paved throughout with tile mosaic of the type already known at Fountains, Byland and Rievaulx. After the dissolution of Meaux abbey the church was completely demolished in 1542 by order of Henry VIII, the material from it being used to build the king's new fortifications at Hull. The pavement was not entirely removed when the church was demolished, but it was found to have suffered heavily, probably during the demolition and certainly later at the hands of people seeking road metal. However, enough tile mosaic was found in and around the area of the church to


7 State Papers, Foreign and Domestic, Hen. viii, vol. xvii (1542), 34-75.

8 Beaulah, op. cit. in note 6, pp. 135-6.
indicate that over fifty different patterns had been used in its pavement. Of the tiles recovered during 1925-35 some are in the British Museum, some in Beverley Museum and some are privately owned. As the tile wasters found on the kiln site at North Grange were of types found in the abbey church it was assumed that the tiles for the church had been fired there.

Meaux abbey was founded as a daughter house of Fountains abbey in 1150-1151. Fortunately some documentary references to the building of the church survive in a chronicle of Meaux abbey, *Chronica Monasterii de Melsa*, compiled by Thomas de Burton, nineteenth abbot of Meaux, after his resignation of the abbacy in 1399. This chronicle states that, having had the existing building demolished, Alexander, the fourth abbot, laid the foundation stone of a new church in 1207; that the church was completed and roofed with lead during the abbacy of Michael, the eighth abbot, 1235-1249; and that the roof of the church was ceiled with wood and the floor paved with tiles during the abbacy of William de Driffield, the ninth abbot, 1249-1269. This date for the mosaic-tile paving of the church was published by G. K. Beaulah in 1929, and when the tile-kiln site at North Grange was discovered in 1932, it was assumed to have been in use during the period 1249-1269 also.

The site was opened again by G. K. Beaulah and myself in September 1957, when scientists from the Cambridge University Department of Geodesy and Geophysics were looking for dated material from kiln sites for use in work on the calculation of the variation in the earth’s magnetic field. We then found the burnt clay floor of the stoke-hole and the mouth of the furnaces, of which a considerable part remained. With the aid of the Cambridge team, the north furnace chamber was cleared, and sufficient was revealed to show that the site would repay more thorough investigation. This was undertaken by us in April 1958 with a grant from the research fund of the Society of Antiquaries of London, assisted by voluntary labour supplied by members of the staff of Hornsea County Primary School, members of the Cottingham Local History Society, John Watt and Nigel Bradley, with whose help the kiln was fully explored and trial trenches were dug in the surrounding area. The site has recently been scheduled as an ancient monument.

THE SITE

The kiln lies in a rectangular moated area in a field belonging to North Grange, outside the precincts of the abbey and ½ mile NE. of the church. The moat, now about 40 ft. wide, was not investigated. The area enclosed by it, is roughly 130 ft. square. It is situated on a small area of boulder clay on the edge of the medieval marshes and one may assume that it was

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13 *Ibid.*, II, cap xxii, 64.
14 Op. cit. in note 6, p. 121.
15a The drawings for the text-figures are the work of Mrs. E. Wilson (FIGS. 40, 42, 43), Miss J. Graham (FIG. 41), Mr. G. K. Beaulah (FIG. 44) and Miss M. O. Miller (FIG. 45).
NORTH GRANGE, MEAUX, E.R. YORKS.

Plan of excavated area within the moat, showing trench nos. (A) and sketch-maps showing position of North Grange (B, C). (pp. 140 f., 143, 149, 153, 156)
chosen for the site of a kiln because of the presence of clay and sand. It was conveniently close to the buildings where its products were to be used and the labour involved in carting them half a mile would not be too great. During the excavations of the 1920s tile wasters and a few pieces of kiln-debris were found in the neighbourhood of the church, where they had been dumped. No trace of a waste heap was found on the kiln site and it may be assumed that all available hard waste was carted away and used for building rubble and road metal. There is no stone in the immediate neighbourhood and the land is low lying and wet.

The remaining kiln structure occupies a position north-east of centre of the moated area (FIG. 40, A) and is oriented west-east, the stoke-hole and furnace mouths being at the west end. When this structure was fully excavated it became apparent that it was not, as had been anticipated, the remains of the kiln in which the mosaic floor-tiles had been made, but the remains of an immediately subsequent structure for the manufacture of roof-tiles. This structure itself showed one complete rebuilding and a major repair. A man-laid stratum of pure clay 8-10 in. thick separated it from an underlying level where the existence of the floor-tile kiln was clearly marked by a well-defined stratum of black ash, tile wasters and other kiln-debris. The bottom of this stratum was about 4 ft. below the present turf line and rested on undisturbed subsoil known locally as carr land. It is interesting to notice that all of the material and structure discovered was on and above its contemporary ground level. Evidence from other sites suggests that it was normal practice to sink the furnace into the ground, preferably into the side of a hill. At Meaux there is no natural hill and the ground was too wet to allow the furnaces to be sunk into a pit, and therefore other methods of strengthening and insulating the furnace had to be devised.

THE ROOF-TILE KILNS

THE UPPER ROOF-TILE KILN

The remaining portion of the roof-tile kiln consisted of the substructure of a double-chambered furnace, backed on the east by a solid stepped bank of baked clay and small tile rubble, and flanked on the north and south by masonry and clay revetments. These were held away from the stoke-hole on the west by curved retaining walls built of tile. The clay floor of the fore-part of the stoke-hole was burnt black and hard by proximity to the furnace mouths and by the charcoal and ash raked out on to it; the rear part was roughly paved with large tiles. This stoke-hole was probably about 9 ft. wide and 10 ft. long and supplied the working area from which the furnace fires were stoked and raked (PL. XXII, A, B).

The furnace walls remained to a height of about 18 in. They were constructed almost entirely of rectangular pieces of roof-tile of which an average of 17 courses remained. The tile courses were bonded together with clay. The furnace lining was one tile thick, built of ordinary roof or building tile, no special high refractory material being used. The two furnace-chambers were separated from each other by a spine wall 9 in. wide, also constructed of roughly broken rectangles
of roof-tile. The spine wall was not bonded into the back wall of the furnace but the side walls were. The spine wall survived to a maximum height of 17 courses (18 inches). At two points on its northern edge the uppermost courses showed the beginning of corbelling out for arches to span the furnace chambers. At this point two cogged segmental arch bricks, belonging to an earlier structure, were incorporated in the spine wall. These were removed by the excavators (Pl. xxiv, b).

One piece of corbeled furnace arch was recovered from the debris of the north furnace-chamber. This also was made of rough rectangles of roof-tile bonded together with clay. It was the only piece of furnace arch recovered and consisted of only four tiles. They were heavily burnt on their outer edges. The internal length of the furnace-chambers was 8 ft. 10 in. The width of the north chamber averaged 2 ft. 7 in., that of the south chamber varied from 2 3/4 ft. at
SCHEMATIC SECTION THROUGH THE SPINE WALL OF THE FURNACE.

SCHEMATIC SECTION THROUGH THE FIRING TUNNELS.

FIG. 42
NORTH GRANGE, MEAUX, E.R. YORKS.
Sections through area of roof-tile kiln (pp. 147, 153)
(The upper section runs W.-E. from trench 6 to trench 2; the lower runs N.-S. across trench 1: see FIG. 40.)
the back to 3 ft. at the front, and its southern wall had bowed outwards in two places.

Access to the two furnace-chambers from the stoke-hole was through two parallel firing tunnels, the northern one being 2 ft. 1 in. wide, the southern 2 ft. 4 in., and both were 2 ft. 8 in. long. These would have been permanently arched over, either by corbelling or by arches constructed of voussoirs. The latter seems the more probable, as voussoirs suitable for constructing such arches were used in the retaining structure, but no part of these arches was recovered. The arches were carried on a massive central pier abutting on the end of the spine wall of the furnace, and on two solidly-constructed outer piers abutting on the outer walls of the furnace. These piers were also constructed of roof-tile, but rounded at the corners of the piers. This part of the structure was very heavily burnt and friable at the exposed surfaces, which were characterized, not by vitrification and clinkering, but by decomposition into a powdery yellow substance.

The furnaces were floored with clay which had burnt hard during firings of the kiln. This hardening was less noticeable at the back, as one would expect. There was a layer of black ash about 5 in. thick over the floors of both furnace-chambers and this may never have been fully raked out, in which case it would have protected the clay floor from the most intense heat. In the firing tunnels the ash was 8 in. thick and baked hard. Holes dug through the floor of the furnace showed that immediately below the hard black level the clay was burnt red for a depth of 3 to 4 in.

The furnace lining was in bad condition. As has already been mentioned the south wall had bowed out in two places, and the spine wall had fractured vertically 3 ft. 8 in. from the back wall of the furnace, the courses dipping down on either side of the fracture, more particularly westwards towards the front, where the heavy central pier had sunk considerably. In the south chamber the spine wall between this fracture and the back was so badly vitrified and eaten away that it was impossible to distinguish the courses. The back wall was also heavily clinkered but showed one clear course of thicker tile at the top. The south wall showed signs of rebuilding in thicker tile from the front to within 2 ft. 8 in. of the back (PL. XXII, D).

The lining wall of the north furnace-chamber was also heavily clinkered at the back, but showed extensive rebuilding from the front to a point opposite the fracture in the spine wall, where its face was broken by the slight projection of a pier. This pier and the rebuilding in the north wall were carried out in the same thicker tile as that used in the repair of the south wall (PL. XXII, D).

LOWER ROOF-TILE KILN

The roof-tile kiln just described was imposed immediately upon the base of an earlier kiln which served as a foundation for it. Only the lowest eight or nine courses of the walls of this earlier kiln remained. The line of demarcation between the earlier and later walls was clearly seen at the back of the south chamber, where the clinkered courses of the later wall overhung the better preserved
courses of the earlier. This was also visible in the unrepaiRed portion of the southern wall, but was most clearly seen in the spine wall dividing the two chambers of the furnace, because the line of the upper spine wall did not coincide exactly with that of the lower one, which projected about 2 in. in the southern chamber and was recessed about 2 in. in the northern one. This lower spine wall had not fractured, but showed a humping of the courses below the fracture in the upper one. The earlier furnaces had been longer than the later ones, and the lower spine wall passed under the central pier of the upper firing tunnels and projected about 5 in. in front of it into the stoke-hole. This projection was matched by a projection of the north wall of the lower furnace under and in front of the north pier of the firing tunnels (PL. XXIV, D). At the southern side about eight or nine courses of this lower wall had collapsed outwards and were lying at an angle under the southern pier of the firing tunnels. This pier appeared to have been built up beside and over the collapsed wall, but was in a very fragmentary condition at its north-west corner (PL. XXIV, E). The spaces at the sides of the lower spine wall, where it passed under the central pier, were packed with pure clay. When this was dug out to reveal the structure beneath, the central pier began to collapse and had to be propped up.

The floor level of the furnace of the lower kiln was 8-9 in. below that of the upper. It was marked by a blackening and hardening of the clay of which it was constructed. Its surface was level with the bottom of the furnace walls, which thus stood upon it without foundations. This clay floor was covered by a layer of ash 5 in. thick, thus repeating exactly the pattern of the clay and ash layers of the upper furnace. When the upper furnace was constructed this ash layer was covered with a layer of clay up to the level to which the walls of the lower furnace had been reduced, and its upper surface formed the floor of the upper furnace. As was to be expected, ash from the first furnace was mixed in the lower part of this superimposed clay (FIG. 42).

The clay floor of the lower furnace showed one peculiar feature for which a possible explanation will be offered later. At the back of the southern furnace farthest from the stoke-hole, where the floor might be expected to show the least sign of burning, there was an area of hard-baked blackened clay which could only have resulted from direct contact with fire, and this extended under the lower spine wall and a few inches into the northern furnace-chamber. This suggests that a fire had been lit on the clay foundation of the kiln before the actual building began.

At the rear of the southern chamber four bottom courses of the lower back wall were in excellent condition. They rested on the burnt clay area just described and were covered in front at the southern end by a solid mass of charcoal, identified by G. K. Beaulah as the remains of an oak log. This was lying against the back wall and had escaped the raking out of the furnace. It had thus protected the wall behind it from direct heat and these courses were in better condition than any other part of the furnace lining at either level. It is worth mentioning that the surviving courses of the lower furnace were in better condition when that kiln was dismantled, and they were covered in clay, than any part of the upper
furnace when it was abandoned. It is possible that the reason for dismantling the lower kiln was that its south wall had collapsed outwards, at least at the front. This is suggested by the piece of collapsed wall preserved under the south pier of the upper firing tunnels (pl. xxiv, e). The walls of the lower furnace had no foundations, but those of the upper furnace had the remaining courses of the lower below their floor level.

THE STOKE-HOLE

The stoke-hole was the working area in front of the furnaces on the west side of the kiln from which the fires were maintained. The stoking of the furnaces called for some experience, as a slow drying fire had to be maintained during the early stage of firing, perhaps for about 48 hours, and then the temperature had to be raised steadily until the tiles were adequately fired, after which the fires could be allowed to die and the kiln would cool gradually. The kiln was fired with wood, of which very considerable quantities would be used at each firing. The stoke-hole of a kiln is often an extension of the pit in which the furnace is sunk. At Meaux the furnaces were above ground level and therefore the stoke-hole was also entirely above ground. It was defined on the north and south by walls curving away in concave arcs from the front of the piers of the firing tunnel. These walls were of 10 in.-square building-tile, but remained only to the same height as the furnace piers, so their original height cannot be ascertained. A height of around 6 ft. to protect the stokers and to prevent draughts across the mouths of the furnace is probable. It is thought that they were probably reduced in height gradually as they went further from the furnace to the rear of the stoke-hole. These side walls were not fully investigated and it is not known how much of their lower courses remains (pl. xxiv, d).

The two levels of floor and wall base in the furnaces were repeated in the stoke-hole. The floor of the area immediately outside the firing tunnels was a hard-baked blackened hearth continuous with that of the firing tunnels at both levels. These hearths were pure clay, burnt by the rakings from the furnace. The lower one showed an unburnt area in front of the projection of the lower spine wall into the stoke-hole, suggesting that that too had terminated in a solid pier, but this had been completely removed, possibly by excavators, as this was the area in which the first holes were dug both in 1932 and in 1957, and it was difficult to draw the first distinction between the closely-packed stacks of tiles and tile rubble, with which the stoke-hole had been filled up, and the beginnings of collapsed structure.

In the rear part of the stoke-hole, where the clay floor was unburnt because it was too far from the fires, a patch of roughly-laid tiles was found at each level (pl. xxxv, f). These tiles were merely bedded on the clay with no foundation and were doubtless a rough and ready expedient to keep the stokers out of the clay and to prevent the back of the stoke-hole from becoming a quagmire as a result of workers tramping in and out carrying the fuel for the furnace. The surviving piece of paving at the lower level began 3½ ft. and ended 5 ft. west of the front of the fire tunnels. It was 2½ ft. wide and roughly rectangular, sloping
The piece of paving surviving at the upper level began 5 ft. 5 in. and extended to a point 9 ft. 8 in. west of the front of the fire tunnels. It was coffin-shaped, 1 ft. 5 in. wide at its narrower eastern end, and 2 ft. 2 in. at its western end. The area of the rear of the stoke-hole was not fully examined laterally and other patches of paving may remain. A trial trench 2 ft. wide, extending westward 10 ft. from the back of this paving, did not reveal any other readily distinguishable feature (FIG. 40, A, no. 6).

THE OUTER RETAINING STRUCTURE AT THE REAR OF THE KILN

The furnaces were strengthened and insulated at the back and sides by extensive retaining structures. The back wall of the furnace was one tile thick and was supported by a similar wall built of rectangular pieces of roof-tile, the two together forming a solid wall 16 in. thick remaining to a height of 20 in. including both levels, which were here continuous. This tile wall was supported externally by a solid ramp of clay which had been baked hard and red, its surface being cut into three wide shallow steps. The edge of the top step was roughly paved with two rows of large rectangular tiles, three of which were accidentally removed. The edges of the two lower steps were paved with single rows of tiles. These steps had sunk at the southern end and inclined downwards (PL. XXII, c). The top step formed a platform, about 2½ ft. wide, along the back wall of the kiln at the level to which the furnace wall had been demolished. The edge of the bottom step was 7½ ft. west of the inside of the back wall of the furnace. East of this step was a level area containing a large patch of blackened clay which had had direct contact with fire, and 5 ft. 7½ in. farther east this area terminated in another shallow step up. This hearth was 2½ ft. below the present turf line and at the same level as the floor of the later furnace. The trench, 2 ft. wide, was extended eastwards for another 7 ft. without revealing any other distinguishable feature (FIG. 40, A, no. 2). This area was not excavated further laterally, but a trial hole 4 ft. square was sunk 4 ft. south of the eastern limit of this trench and also proved sterile (FIG. 40, A, no. 11).

No attempt was made to dig through this stepped ramp, which must have been intentionally baked to give it its colour and hardness. Even where it was in closest proximity to the furnace the tile wall, 16 in. thick, would have given complete insulation from the fire within. It is therefore suggested that the blackened clay hearth just described was the site of a fire kindled to bake the clay ramp into a solid mass. Perhaps this is also the explanation of the blackened clay hearth area at the rear of the lower furnace, described above. There is a difference in level of a few inches, but not more than might be expected, especially as there is a westward subsidence over the whole area. It therefore seems that the material for the back ramp was heaped up and fired as a bonfire in situ before the back wall of the furnace was constructed, and that it was afterwards stamped down and cut into shape and the steps tiled. A strong hard structure was required here because the oven would most probably be loaded and drawn from the back. The 2½-ft.-wide top step would provide a platform for the workmen to stand on,
and to set up a ladder when necessary. Because the furnace itself was above ground at Meaux, the oven would be raised above ground level by the height of the furnace, probably about 3 ft. This created the need for a more elaborate means of access to the oven than was required when the oven floor was at ground level.

THE NORTH RETAINING STRUCTURE

The revetting on the north and south sides of the furnaces was not identical and that on the north side, which was the more elaborate, will be described first. As at the rear of the furnace, the north lining wall was strengthened by another tile-built wall, the two forming a solid structure 1 3/8 ft. thick. Abutting upon the north face of this wall was another tile-built wall of inexplicably elaborate construction, 10 in. thick, and with the furnace wall making a structure 2 ft. 2 in. thick. This outer wall was built of horizontal courses of roof-tile interrupted at two points by well constructed arches built of stabbed voussoirs in two sizes: those forming the sides of the arches were 10 in. long and about 8 in. wide, those forming the tops about 9 1/2 in. long and 3 in. wide. The horizontal courses between the two arches were slightly humped; those at the eastern end were destroyed in the upper part, those at the western end of the wall together with the adjacent part of the more westerly arch were concealed behind stone buttressing. The more easterly arch was 26 in. high from the base of the wall and 28 in. wide at the bottom. It was packed solid with unburnt clay and tile rubble, as was the western arch also. When this packing was removed it revealed only the northern face of the outer wall of the furnace (pl. xxiii, a).

About 15 in. north of this arched tile wall was a roughly-built wall of large blocks of limestone from quarries at South Cave about 12 miles away, where much of the stone used in the building of the abbey was obtained. This wall, varying in width from 18 in. to 2 ft., remained to a height of two courses only and its southern face was damaged near the eastern end, where it curved round to the south to meet the back ramp, but the exact point of junction could not be ascertained. At its western end it made a right-angled bend and abutted on the arched tile wall in a line with the north pier of the firing tunnels. The area between the arched wall and this stone wall was packed with pure clay (pl. xxiv, c, and fig. 41).

North of this limestone wall was an area of closely packed tile rubble consisting mainly of whole or nearly whole roof-tiles and some building-tiles, laid roughly horizontally in clay and forming a very solid packing. The edge of this area was demarcated 3 ft. north of the stone wall by a series of isolated limestone blocks about 1 ft. square placed 2 ft. apart. These probably retained the foot of a bank of tiles and clay heaped against the north face of the limestone wall. This horizontal tile and clay packing was replaced on the line of the pier of the firing tunnel by a more solid structure consisting of two adjacent rows of roof-tiles stacked against each other vertically and retained at the northern end by two contiguous limestone blocks forming part of the series already described (pl. xxiii, b). West of this point the line of the blocks curved round to the south.
The most southerly lay 10-11 ft. west of the north pier of the firing tunnels and its eastern edge was on a line with the outer edge of the upper paving of the stoke-hole. The area between the north retaining wall of the stoke-hole and these stones was not fully explored, but it appeared to be entirely filled with a tile and clay packing similar to that described on the north of the limestone wall and may therefore be assumed to have been a continuation of the same bank (Fig. 41).

To summarize: the solid tile pier of the north firing tunnel was buttressed by 2 ft. 8 in. of limestone wall, supported by 3 ft. 1 in. of closely packed vertical roof-tiles retained by two limestone blocks each 1 ft. square. Immediately north of the furnace wall was an arched tile wall which one may assume to have carried the side wall of the oven. This wall was supported by a limestone wall 2 ft. thick, but placed 15 in. away from it, the intervening space being packed with pure clay. It is not known to what height these walls were carried. The clay between them had been insulated by the tile wall, 2 ft. 2 in. thick, between it and the furnace and showed no sign of burning. Against the outside of the stone wall a solid mass of horizontal tiles and clay had been banked, its base being held in by a series of limestone blocks. On the line of the front of the furnace this bank may be assumed to have curved round to the south, its foot still retained by the limestone blocks extending round to the back of the stoke-hole, where the bank, which was held away from the stoke-hole by the north retaining wall, may be assumed to have tapered down to nothing.

THE SOUTH RETAINING STRUCTURE

The revetting on the south side of the furnace was less extensive but more solid. The lining wall of the furnace, about 10 in. thick, was supported on the south by an arched tile wall similar to that on the north of the furnace but consisted of two adjacent arched walls of which the outer had the same dimensions as that on the north, while the inner was narrower and, with the furnace lining, formed a structure 14 in. thick. The total thickness of tile wall was 2 ft. at the back of the furnace. These arched walls could be investigated only from the top because immediately south of them and abutting directly on their outer face was a limestone wall 1 ft. 8 in. wide (pl. xxiv, A). It was not possible therefore to see whether the arches had been left open or packed, but as the south wall of the furnace had bowed outwards at the two points where the arches occurred in the revetting wall, it suggested that the arches were not packed and constituted a weakness in the structure. The stone wall remained to a height of four courses. There was no trace of any structural work to the south of it, nor of any tile rubble bank on this side of the furnace. On a line with the south pier of the firing tunnels there was a thickening of the limestone wall to 2 ft. 2 in. On the south side of the stoke-hole a retaining wall similar to that on the north held back a solid mass of tile rubble, the extent of which was not investigated. It did not extend eastwards beyond the line of the back of the south pier of the firing tunnels (Fig. 41).
The in-filling and roof-tiles

The whole of this structure, both furnace walls and revetments, was built on a man-laid raft of pure clay, 8-10 in. thick. The burnt surface of the clay layer formed the floors of furnace and stoke-hole at their lower level. When the kiln was rebuilt upon the lowest courses of the earlier structure, a further layer of clay was superimposed only inside the furnace and stoke-hole, the top of this second clay layer forming the floors of the upper furnace and stoke-hole.

In the stoke-hole immediately in front of the firing tunnels were a number of vertical stacks of large thick tiles such as were used in the structural repairs to the upper furnace walls. The rest of the stoke-hole was filled up with masses of broken roof-tile and clay. The furnace-chambers were also packed with masses of roof-tile laid down horizontally, and with some building-tile, particularly at the back of the north chamber, but only the one small piece of corbelled arch already described could certainly be identified as part of the structure. Some of the building-tiles in the back of the north chamber showed signs of burning and could have been collapsed back wall from a higher level. It is, however, possible that other structural material from the furnace arches or oven walls was missed among the debris. It was extremely difficult to sort out relevant pieces from the mass of roof-tile rubble, all of which had to be loosened with a pick before it could be removed. On the other hand it is highly improbable that any noticeable quantity of furnace arch was so missed, because such material would be heavily burnt and grey at least at the edges, whereas the roof-tile was a bright brick red. It seems probable that the oven structure and possibly the furnace arches were beyond repair and were knocked down and carted away for building rubble or road metal, while the lower part of the furnace was left standing with the intention of using it as the foundation for a new kiln, as had already been done once before. Later, however, the site was abandoned and the open holes of the furnaces and stoke-hole were filled in with the mass of waste roof-tile that would be lying about the site.

There can be no doubt that this kiln manufactured roof-tiles. No paving-tiles, glazed or unglazed, were found at this level, and the amount of roof-tile greatly exceeded that of building-tile, which was present only in the quantity which would be needed for use on the site. The roof-tiles at this level were a fairly soft brick-red fabric of the same type as those used in the stacks buttressing the north pier. One of these, 12\(\frac{1}{2}\) by 8\(\frac{1}{2}\) by 3\(\frac{1}{2}\) in., was extracted intact (PL. xxv, B). All of the roof tiles recovered were nibbed, not holed, and were therefore designed to hang over the battens themselves and not to hang on pegs projecting from the battens. Each tile had a single nib projecting from the middle of the back, flush with the upper edge. Large numbers of fragments were recovered and compared, and these had nabs of three forms: one was knife cut, the second was carefully moulded by hand, the third was very roughly moulded. On the last the marks of the fingers of the maker were clearly visible. There was no apparent difference in the fabric or firing of the tiles with the different types of nib and it was therefore assumed that they represented the products of three
contemporary workmen with differing degrees of skill or interest in the finished appearance of their products.

THE KILN FOR MOSAIC FLOOR-TILES

THE LOCATION OF THE KILN

Beneath the 8-10 in. of pure clay on which the lower roof-tile kiln rested was a well defined stratum, varying in depth from 2 in. to 7 in., marking the level of the mosaic floor-tile kiln, which rested on undisturbed natural clay 3 ft. 11 in. to 4 ft. below the present turf line (sections, FIG. 42). It contained ash, charcoal, tile debris and structural material from the floor-tile kiln and a few sherds of industrial pottery. It extended beneath the whole of the existing structure of the roof-tile kiln and 10 ft. north of it where the finds were richest, but petered out 6 ft. south of it and did not yield anything of interest east of the stepped ramp. A trial trench (FIG. 40, A, no. 13), extending towards the north-west corner of the moat from a point 40 ft. west of the front of the furnace of the roof-tile kiln, revealed this same layer of furnace debris immediately above the basic clay, coming to an end about 20 ft. from the north-west corner of the moat. A trial hole 40 ft. north-east from the south-west corner of the moat (FIG. 40, A, no. 14) revealed nothing but 4 ft. of surface soil over the basic clay, and two other trial holes north-east and south-east of the existing structure (FIG. 40, A, nos. 12 and 11) were similarly sterile. It can therefore be assumed that this layer of debris extended under the later kiln, a few yards south of it, not beyond the east of the existing back ramp but 10 ft. to the north, with its maximum spread to the north-west for a diagonal distance of 60 ft. from the front of the existing structure, although it is not certain that this was continuous.

Although the most promising area immediately north of the roof-tile kiln was fully excavated (FIG. 40, A, nos. 8 and 9), and a number of holes were sunk through the floors of the roof-tile kiln and the walls undermined, no structural remains of the floor-tile kiln were found in situ. However, the considerable amount of structural material recovered from the area below and north of the later kiln was sufficient to suggest that the whole of the floor-tile kiln was knocked down and its remains spread as rubble foundation for the later structure. An accidental spread of debris is unlikely to be so extensive or of such even thickness. It was thought that the humping and fracture of the spine wall of the roof-tile kiln might be caused by the presence of an earlier structure beneath it, but the cause proved to be a stack of two fire-bars and four structural tiles that were found in the floor-tile kiln stratum at that point.

It seemed possible that this kiln was smaller than the roof-tile kiln, and that it was orientated in the same way, roughly west to east, but that it lay under the elaborate retaining structure on the north side of the upper kiln, where an area 9 ft. wide remained virtually uninvestigated at the lower level. The presence of an earlier structure in this area might account for this unexpectedly wide north retaining structure at the upper level. There was, however, no time to test this. To find the foundations of the floor-tile kiln it would be necessary to clear
away the north retaining structure of the roof-tile kiln. If the site of the floor-tile kiln was not under the north retaining structure, the search for it would be laborious, because its level is 4 ft. below the present surface. On the other hand it is improbable that all traces of the kiln foundations have been removed, and stripping the site down to that level should reveal them, and might also reveal the location of the work sheds and drying sheds of the tilery, which probably occupied the perimeter of the moated area, because it is unlikely that the workmen carried the unfired tiles across the moat to the kiln.

STRUCTURAL MATERIAL FROM THE FLOOR-TILE KILN

Sufficient structural debris was recovered to make possible a conjectural reconstruction of many features of this kiln. It is worth noting that, whereas in 1932 large numbers of wasters of mosaic-tile were recovered from beneath the later stoke-hole, in the area fully investigated in 1958 north of the upper furnace (FIG. 40, A, nos. 8 and 9) a comparatively small number of mosaic floor-tile wasters was recovered, most of the debris being structural tile, which suggested that that was the immediate area of the kiln.

A considerable quantity of roof-tile was recovered from this level, though not in the profusion associated with the roof-tile kiln. This earlier roof-tile was easily distinguishable from that at the upper level, being better fired and harder, its final colour being a dark red with, usually, a dark blue-grey core. It is probable that some, at least, of this roof-tile was used in the structure of the kiln, but only small pieces were recovered.

In addition many fragments of building-tiles were found. These resembled the thick building-tiles used in the repair of the upper roof-tile kiln. They were of two types: either rectangular or with two adjacent corners cut off to form a three-sided front. All the examples of this second type that were measured were wedge-shaped in section, diminishing in thickness from the straight back edge to the three-sided front. They were thus voussoirs for the construction of springers and arches. Examples of four different sizes were recovered, all incomplete.

Of the rectangular building-tile, one nearly complete example 10 in. square and 1½ in. thick, lacking only one corner of the back, was recovered and restored (PL. xxv, A, 2). It is of well fired, brick-red fabric, and one surface is stabbed with thirteen irregularly-placed holes made by a four-sided pointed instrument, probably a sharpened squared stick. These holes are about ½ in. square at the surface, and one, which is in the line of fracture of the back corner, penetrates the tile to a depth of 1 in. The rest of the stabbed holes are partially or completely filled with the red burnt clay which had bonded this tile to the next in the original structure. A course of pugged clay about ¾ in. thick, which baked hard when the kiln was fired, was the normal means of bonding the tile courses. Most of the structural tiles, as distinct from roof-tiles used to build walls, recovered at Meaux showed this stabbing on one or more surfaces. It acted as keying and gave a firmer bond. The reconstructed rectangular building-tile has its front edge burnt grey by contact with the fire, and the burning of the clay extends through a buff-coloured band penetrating the front edge to a depth of 1½ in. This edge, although
burnt, is in good condition and is not vitrified or broken. It is by no means certain that all of the rectangular building-tiles were as large as this.

One fairly complete example of the largest size of voussoir lacking most of its front edge (PL. xxv, A, 1) has been repaired. It is 10\frac{1}{4} in. wide, 8\frac{1}{2} in. from the back to the least damaged part of the front, which is heavily burnt, 2\frac{1}{4} in. thick at the back and 1\frac{1}{2} in. thick at the front. Both sides are stabbed with rectangular holes approximately \frac{3}{4} in. by \frac{3}{8} in. at the surface and 1\frac{1}{10} in. deep.

On analogy with the thirteenth-century floor-tile kilns at Chertsey and Clarendon (p. 139), it is assumed that the furnace at Meaux was spanned by tile-built arches which carried the oven floor. It is possible that the furnace walls were built of the rectangular tiles and voussoirs just described, placed alternately. The voussoirs might be used from floor level as at Clarendon, or, as at Chertsey, there might be a few courses built of rectangular tiles only, before the voussoirs for the springers were introduced. Walls constructed of this material would build up to arches 10\frac{1}{4} in. wide with 10 in. spaces between them. These dimensions are rather larger than any certainly known, and it is more probable that these very large tiles and voussoirs were used to build the piers and arches of the firing tunnels, which require a more massive structure. It is not certain that the large voussoir recovered was angled off at both front corners, since one is missing, and if only one corner was angled this tile would resemble those used for the piers of the firing tunnels in the Clarendon kiln, which have one corner rounded off.

The second size of voussoir has dimensions more in accord with the known size of furnace arches. One nearly complete example is 7\frac{1}{2} in. from back to front, 1\frac{1}{4} in. thick at the back and 1\frac{1}{4} in. thick at the front (PL. xxv, A, 5). Its maximum extant width is 6\frac{1}{2} in., but estimating from the middle of the chamfered front edge, which is complete, it was originally 7\frac{1}{2} in. wide. On the complete side the front angle begins 4\frac{3}{8} in. from the back at 40° to the side. This tile is stabbed on both sides and heavily burnt, but not vitrified or clinkered. The amount of burning suggests that it formed part of a furnace arch rather than part of a springer in the furnace wall.

It is possible that the third size of voussoir originally matched the second. Only two fragmentary examples were recovered, both heavily burnt and crumbled. One is complete from back to front, measuring 5\frac{5}{10} in.; its maximum width is 3\frac{1}{2} in.; it is 1\frac{7}{10} in. thick at the back, 1\frac{3}{4} in. at the beginning of the front angle, and 1\frac{3}{4} in. at the front. These voussoirs may have formed part of the springers of the furnace arches in the spine wall dividing the two chambers of the furnace, a position where they were open to the action of fire on both sides, because this dividing wall was never wide enough to insulate any part of the material of which is was built. If this dividing wall was originally about 9 in. wide, springers built into it would be shorter from back to front than the 7\frac{1}{2} in. of the voussoirs suggested for the springers in the furnace walls, because they had to be placed in pairs back to back: but they ought originally to have been the same width as those in the furnace wall to carry the opposite ends of the same arches. In the Clarendon kiln the length from back to front of the shaped tiles built into the
dividing wall of the furnace as springers was 6\(\frac{1}{2}\) in. It is therefore probable, though not certain, that this was the function of the third size of voussoirs at Meaux.

Assuming that the furnace was constructed in the manner already postulated, but with the second size and third size of voussoirs forming the springers of the arches in the furnace walls and dividing walls respectively, the furnace would be spanned by arches 7\(\frac{1}{2}\) in. wide and 10 in. apart, and the length occupied by one arch and space would be 1 ft. 5\(\frac{1}{2}\) in. At Chertsey the corresponding length was 1 ft. and at Clarendon 1 ft. 1 in. This may suggest that a space 10 in. wide between the arches would be wider than usual, and too wide to be conveniently spanned by the tiles which made up the oven floor. It is therefore possible, as has been suggested, that the 10-in. square tiles were used only in the piers of the furnace arches. In that case the furnace walls might have been built of rectangles of the roof-tile already described, or of smaller building-tiles. The fact that no smaller building-tile was noticed is no proof that it did not exist, because most of the fragments were too small to indicate the original dimensions of the tiles. A furnace wall constructed of the 7\(\frac{1}{2}\) in. voussoirs alternating with 7\(\frac{1}{4}\)-in.-square building-tiles would produce arches 7\(\frac{1}{2}\) in. wide and 7\(\frac{1}{2}\) in. apart, the length of one arch and space being 1\(\frac{1}{4}\) ft., a dimension comparable to those at Chertsey and Clarendon. A furnace so constructed and spanned by three arches would be 4 ft. 4\(\frac{1}{2}\) in. long, and one spanned by four arches 5 ft. 7\(\frac{1}{2}\) in. On the other hand the main part of the furnace walls at Meaux may have been built of rectangles of roof-tile as they were at Clarendon and Chertsey and in the roof-tile kilns at Meaux.

It is certain that the furnace of the mosaic floor-tile kiln had two chambers, which is again in accord with known medieval tile kilns. A very much damaged piece of the dividing wall between the two chambers was found in trench 8 (FIG. 40, A, no. 8 and PL. XXVI, c). This fragment of wall is 8 in. long and is formed of the vitrified remains of four courses of building-tile pugged together with clay. It has been eaten away by fire on both sides and this can happen only in the dividing wall between furnace chambers. At its narrowest it is only 2 in. wide, demonstrating that it was in very bad condition when it was demolished. The tiles of which it is built are about 1\(\frac{1}{2}\) in. thick, but do not survive to their original length or width.

Besides these pieces of structure, one complete building brick 9\(\frac{1}{2}\) by 4 by 1\(\frac{1}{2}\) in., and part of another, not exactly stratified, were recovered on the site in 1932 (PL. XXV, A, 7). Both are brick-red and show no signs of subjection to intense heat. They are roughly moulded, show marks of the maker’s fingers at some edges, and have four shallow parallel grooves scooped out of the upper surface.

THE OVEN FLOOR

Three pieces of the oven floor, which covered the furnace arches and spanned part of the spaces between them, were recovered. One, roughly 7\(\frac{1}{2}\) by 5 by 2\(\frac{1}{4}\) in., is composed of three layers of roof tile about 3\(\frac{1}{4}\) in. thick, bonded by thin layers
of pugged clay, and daubed over with a thin layer of clay. This is covered by an accidental coating of green glaze and slip, which ran down on to the oven floor from the tiles stacked on it, and shows clearly where slip-coated glazed tiles stood on edge on the oven floor. Two of these impressions are particularly clear and show that the tiles that made them were each 1 ½ in. thick and that one was 3 in. long (PL. XXVI, A, I).

The second piece of oven floor consists of a single piece of roof-tile about 4 ¾ by 1 ½ by ½ in., again covered in rough glaze to which there adheres, standing on edge, a broken piece of rectangular floor-tile, scored ready for breaking into small triangles. The roof-tile shows no trace of any other layer of tile or clay beneath it (PL. XXVI, A, 3).

The third piece of oven floor is part of an extremely distorted lump. The floor here appears to have consisted of thin roof-tile and a top layer of thicker tile all bonded with clay. Of the bottom layer only traces remain. On this floor two large rectangular slabs, scored to be broken into smaller triangles, had been placed side by side on their longer edges. These slabs had swollen and collapsed, probably as a result of being subjected to too much heat too soon in the firing, and the oven floor had sunk under them (PL. XXVI, B).

From these fragments it can be deduced that the oven floor was constructed of several layers of fired tile, probably about three, generally roof-tile but with some thicker tile as well, pugged together and sometimes daubed over with clay. These tiles would be placed to span the arches, but not continuously, spaces being left at intervals to serve as flues and to distribute the heat through the oven.

METHODS OF STACKING THE TILES IN THE OVEN

Further evidence was found for the methods of stacking the tiles in the oven already discussed. First there are rectangular tiles stacked on edge. Two sets of three tiles, 3-in. square, stacked on edge one above the other and accidentally fused together were recovered (PL. XXVI, A, 2). It is not known how high the stacks were carried. Secondly, there are three examples of the large rectangular slabs, none complete, two of which have already been mentioned in association with the piece of oven floor to which they are fused (PL. XXVI, B). They had been placed on this, standing on edge on their longer sides, parallel to each other. Both were scored to be broken into small triangles. They do not remain to their full length and are so fantastically distorted that their original dimensions cannot be ascertained. The third example, 6 in. wide and a little over 9 in. long, is slightly distorted and broken at one end (PL. XXV, c). It is scored to be broken into eight 3-in. squares, and has broken across just beyond the score dividing the third and fourth pairs. It is conjectured that there were only four pairs and that the slab, which is 6 in. wide, was originally 12 in. long.

The firing of the more elaborately-shaped components of the tile-mosaic used at Meaux and allied sites was complicated because they could not be stacked in the usual way. It is unlikely that saggars were used. The pieces are too small to have had individual saggars and no trace of a sagger was found among the debris. Some of these more elaborately-shaped tiles show marks of contact with
others on their edges, indicating that they, too, had been fired on edge, sometimes in more than one layer. The structural material found throws some light on the way in which the problem was solved by the introduction of a removable shelf or shelves in the upper part of the oven. There is at present nothing to indicate

whether only one shelf or more could be used at a single loading of the oven. At some point in the oven walls there were probably horizontal rows of springers built in as part of the permanent structure. The oven could be loaded up to this point with rectangular tiles and blocks of tiles, stacked in the usual way standing on edge on an oven floor of the type already described. Then, if a shelf was required, a series of temporary arches could be constructed across the oven with
their ends resting on the springers in the oven walls. Between these arches firebars could be hung to form an almost continuous shelf, with holes in it to allow the heat to penetrate into the part of the oven above it, and to act as flues to increase the draught, on the principle employed in the oven floor. A

A shelf constructed in this manner would curve down fairly steeply at the sides. This shelf could be repeated higher up the oven if springers for it were provided in the walls. Thus the upper part of the oven could be spanned by one or more curved shelves on which the irregularly-shaped pieces of mosaic could be placed and fired.

The material remains on which this theory is based are as follows. First
there is the fourth size of voussoirs (pl. xxv, A, 6). These resemble those assumed to have formed the furnace arches, but are smaller and do not show the signs of intense burning which would be present in all the structural remains of the furnace. They are slightly burnt on the front only. Secondly, there are stabbed segmental bricks, coggèd on their upper edges (pl. xxv, A, 3). Six of these pugged together in pairs would form an arch which would rest on springers constructed of the small voussoirs and would span an oven 2 ft. 5 in. to 2 ft. 6 in. wide. Thirdly, there are fire-bars of various forms which would hang between these arches and, with the tops of the cogs, form a nearly continuous shelf (fig. 43), pierced at regular intervals by sub-rectangular holes. Confirmation that the components were used in this way is that both the tops of the fire-bars and the tops of the cogs on the arch bricks retain the irregular patches of glaze and impressions of the edges of tiles usually found on the oven floor. This glaze also demonstrates that it was not found necessary to cover the basic structure of the shelf with a floor of fired tiles or to pug it over before placing the unfired tiles upon it. One fragment of fire-bar has a piece of the edge of a tile fused on to the top.

Experiment with the pieces recovered has shown that this curved shelf formed a satisfactory base on which to stand the non-rectangular pieces of the mosaic, and that it is easier to stand some of them on edge on the curve than on a flat surface. Signs of contact with other tiles on opposite edges of some of the simpler shapes suggest that where possible the shaped tiles were stacked one above the other, but it is unlikely that this stack could be carried very high. It is safe to assume that the total surface area of shaped tile that could be fired on a shelf would be appreciably smaller than the area of rectangular tile which could normally be stacked on an oven floor. If only one shelf were used the proportion of rectangular to shaped tile would be considerably greater. It therefore seems probable that two or more of these temporary shelves were inserted in the oven. There would be no serious technical difficulty to be overcome in constructing oven walls with a series of horizontal rows of springers one above the other, capable of carrying several of these arched shelves when they were required. The only problem would be the outward thrust of the loaded arches against the side walls of the oven and this could be countered by external buttressing. It is just possible that the unusually thick revetting and banking up of the side walls of the later roof-tile kiln was an imitation of similar strengthening of the floor-tile kiln designed to counteract such a thrust.

Of the fourth size of voussoirs, thought to have been used to construct springers in the oven wall, two large fragments were recovered (pl. xxv, A, 6). One is complete from back to front and survives to a little over half its length in front and less at the back. This is deduced from a scooped-out key in one surface which is assumed to have been more or less central. A similar round key appears in the second fragment at about the same distance from the edge. Neither of these tiles is stabbed. The centre of these keys is about 3 in. from the side, and the full width of the tiles is therefore assumed to have been about 6 in. The example which is complete from back to front is 4 in. on this dimension. The cutting off for the chamfered front begins 2 3/8 in. from the back at an angle of
60° to the side. The tile is $1\frac{1}{2}$ in. thick at the back, $1\frac{3}{4}$ in. thick at the front which is lightly burnt, a grey colour penetrating the tile for about $\frac{1}{2}$ in., but undamaged and sharp at the edges. The second fragment is the same thickness at the front and $1\frac{7}{8}$ in. thick at its point of fracture 2 in. behind the front. The increase in thickness is a ratio of 1 in 10 to its length in both examples. In the second example also the front is lightly burnt but undamaged. The springers constructed of these voussoirs could be angled more sharply, if required, by an angling of the clay bonding courses between them.

A number of pieces of the cogged segmental bricks, assumed to have formed the arches, were recovered (pl. xxv, A, 3). One is complete but very heavily burnt, because it was recovered from the spine wall of the later roof-tile kiln, as has already been mentioned. It may be assumed to have shrunk on all dimensions. Its length at the bottom is $8\frac{3}{4}$ in. and at the top of the cogs $10\frac{5}{8}$ in., its width to the top of the three cogs is $3\frac{1}{2}$ in., $3\frac{7}{15}$ in. and $3\frac{1}{4}$ in., and its thickness is $1\frac{3}{5}-1\frac{7}{10}$ in. Another which survives to about three-quarters of its length suggests that the complete specimen may have lost as much as half an inch in length. A cog about $1\frac{4}{5}$ in. long spans the width of the upper edge of the brick half way along it, and at each end is half a cog, so that, when two bricks are placed end to end, a cog roughly the same size as that in the middle is formed by the two halves. All of the caged bricks are stabbed on one surface only and it is therefore assumed that they were pugged together in pairs to form an arch about 4 in. wide. An arch constructed of three pairs of these tiles placed end to end would meet the springers in the oven wall at an angle of about 45° and would have a span of about 2 ft. 5 in. It would be fairly flat on top and rather steep at the sides and would be crossed by five 2-in.-wide cogs or ribs on its upper surface and have a half cog at each end (fig. 43). These cogs served two purposes: to form a continuous floor with the tops of the fire-bars at the same level and to prevent the fire-bars from slipping down on the arches.

The fire-bars recovered were of three sizes and showed minor variations of form, but the main features of all were the same. They were made from rectangular tiles from which part of the sides had been cut away to leave two pieces projecting from each end of the same side, which became the top of the fire-bar, the projections serving as lugs to rest on the tops of two arches, leaving the rest of the tile to hang down between them (pl. xxvi, D, 1-5 and fig. 43). Two of these fire-bars could be hung together between each pair of cogs on the top of the arches.

Of the largest size of fire-bar one almost complete, one very much distorted and one fragment were recovered. This size appears to have been cut from a rectangular tile 9 by 4$\frac{1}{2}$ by 1$\frac{3}{4}$ in. The projections left at the top are rectangular, 1$\frac{3}{8}$ in. long and 1$\frac{3}{4}$ in. deep. One of these projections has broken off the example, which is otherwise complete (pl. xxvi, D, 2). This tile is chamfered at the bottom to a depth of 1 in. on both sides leaving a base 1 in. wide. The cut edges show parallel knife marks, as if the tile had been cut with difficulty after it had dried very hard. This example was found below the stoke-hole of the later kiln. It was grey as a result of heavy firing except at the outer end of the remaining lug,
which had been protected by the arch on which it hung. The distorted example
has sagged at the top and the part which hung between the arches has split.
The fragment consists of a base, having the same chamfering as the most com-
plete example, one cut side and the fracture where the lug had broken off. It is
roughly 3 4 in. deep, 3 in. long and 1 3 in. thick. A lot of glaze has run down on
to it, almost covering one side and half covering the other. It shows a knife score
on its cut edge, but not the marks of 'sawing' visible on the more complete example.

The other fire-bars recovered seem to have been a little under 3 in. deep
and 1 4 in. thick and to have varied in length between 6 and 7 in. where their
dimensions are ascertainable. It is not certain whether they represent two sizes,
one 7 in. long and the other 6 in. long or whether all were intended to hang
between arches the same distance apart. There may have been slight variation
in the distance between the arches, necessitating a variation in the length of
the fire-bars. There was a slight variation in the distances between the furnace
arches in the tile kiln excavated at Clarendon. Eleven examples of these smaller
fire-bars were recovered. Ten originally had nibs projecting from the top of
one side flush with the upper edge. These were flat on top and triangular
in section. Only one example had its nib complete and this projects 1 3 4 in. from
the edge of the tile (PL. xxvi, d, 1). One almost complete example had never
had a nib, and this retains on one surface the layer of clay which bonded it to
its neighbour. None of the nibbed examples shows any trace of clay bonding.
These nibbed fire-bars will hang in pairs back to back between the cogs on the
arches, and the nibs then meet across the gap formed by the cogs between each
pair. They thus hold the fire-bars steady, increase the area of the shelf and reduce
the area of the vents in it (FIG. 43). On most of these fire-bars the lugs are tapered
on their under sides towards the outer ends. One incomplete example has the
chamfered base noticed on one of the large fire-bars. Most of the fire-bars are
burnt grey, except at the end of the lugs, which were protected from the fire
by the arches on which they rested and have remained red. It is suggested that
the large-sized fire-bars were not used in the manner described for the rest, but
may have been used to hang between the furnace arches to form the oven floor
instead of the usual tile floor, where, however, they proved unsatisfactory, being
unable to stand the intense heat, and were abandoned in favour of the more
usual floor of horizontal tiles. This is, however, conjecture, based on the burnt
condition of one example and the collapse and fracture of the other, on the
lack of nibs, and on the fact that, because of their greater size, they are unlikely
to have been interchangeable with the rest to be used in conjunction with the
cogged arches.

THE OVEN ROOF

If our conclusions are correct, the top layer of unfired tiles in the fully-loaded
kiln would consist of a large number of small, irregularly-shaped pieces, standing
on a curved shelf. It would therefore not be possible to roof the kiln with a
horizontal layer of fired tiles, placed on top of the tile stacks, in the way in which
an oven full of stacks of rectangular tiles can be roofed; nor would it seem likely
that a kiln of the dimensions envisaged here would carry a permanent roof, particularly if shelves were to be inserted in the upper part of the oven. The roofing of the kiln, therefore, presented an unusual problem. Theoretically it should be possible to roof such an oven with a temporary clay cover such as is used in primitive pottery and glazing ovens, but it is unlikely that this method was employed here, because sites where it is used tend to yield large quantities of pieces of broken clay roof, and none was found. Instead, another series of temporary arches was probably erected, spanning the top of the oven at intervals, and a roof of fired tiles laid on these.

Possible support for this idea is supplied by another type of segmental building-tile, of which six incomplete examples were found. These resemble the cobbled arch bricks, but are more sharply curved and have no cogs (PL. xxv, A, 4). They are 3 in. wide and the largest piece remains to a length of 7½ in., but the full length cannot be ascertained. They vary in thickness from 1¼ to 1½ in. Four are stabbed on one side, one is not stabbed and one has a small, round hole pierced right through it.

**RECONSTRUCTION (FIG. 44)**

A hypothetical reconstruction of the floor-tile kiln can thus be made, based on the dimensions and suggested functions of the recovered fragments described above. Its double-chambered, tile-built furnace resembles the known structure and dimensions of the thirteenth-century tile kilns excavated at Chertsey and Clarendon, and the oven floor is made of several layers of tile laid horizontally on a series of transverse arches in the usual manner. Nothing certain is known at present about the oven structure of any thirteenth-century tile kiln. The reconstruction of the Meaux oven here suggested makes use of all the structural fragments not included in the furnace, and, with its removable, tile-built shelves and roof ribs, provides possible solutions to the practical problems involved in firing irregularly-shaped pieces of mosaic-tile.

**THE INDUSTRIAL POTTERY**

The excavated area yielded no trace of occupation or use other than that directly associated with the kiln, except two sherds of later pottery, found in trench 4, 9 in. and 18 in. below the present turf line, both levels being above the strata containing debris of roof-tiles. Part of the rim and neck of a jug with a purplish external glaze and rouletting on the upper edge of the rim and at the base of the neck, found at the upper level, is provisionally dated seventeenth-century by Mr. Gerald Dunning. The base of a strap-handle including the point of junction with the vessel, from the lower level, has a greenish-brown glaze and Mr. Dunning suggests a fourteenth-, or early fifteenth-century date.

The following sherds of industrial pottery were recovered in association with the kiln (PL. xxvii, FIG. 45):

1. The larger part of a mortar or crucible (PL. xxvii, C) recovered in 1932 below the stoke-hole floor of the roof-tile kiln, 14·5×12×10 cm. Complete vessel probably c. 15 cm. square at rim and 11 cm. square at base. The interior is a round basin c. 6 cm. deep and 9 cm. diameter at rim. Thickness of walls at side 2-2·5 cm., across lug 4 cm. Externally the walls slope or curve out from a flat base and the one remaining
corner is cut away in a strip 2 cm. wide to within 2 cm. of the top to leave a rudi-
mentary lug level with the rim. Top of rim cut off flat, and angle between rim and
interior pared away. Hand-made, of hard red earthenware with some grey on inner
surface. Considerable remains of light slip and lead glaze inside, and some also outside.

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e
b
a

FIG. 45
NORTH GRANGE, MEAUX, E.R. YORKS.
Industrial pottery found in association with the kiln (pp. 163, 165 f). Sc. 1:

2. Four sherds (pl. xxvii, d), including part of rim and base, of shallow circular
Hand-made, of slightly gritty, light-red earthenware, washed inside with light slip.
Angle between flat bottom and straight side sharp outside but rounded inside. Restored.
Diam. at rim 35·5 cm. (external), 34 cm. (internal); Diam. at base 29·8 cm. (external); Ht. 4 cm.

3. About one-third (pl. xxvii, A, E) of a shallow circular flat-bottomed dish with handles. Found in trench 10 inverted on top of layer of debris of floor-tile kiln (which here consisted only of 2 in. of black ash) and under stratum of pure clay 1 ft. 10 in. deep, thought to be remains of clay heap. Base survived only as orange-stained layer too fragile to lift. Hand-made, light-red earthenware washed with thin brown slip. Restored. Diam. at rim 46·2 cm. (external), 44·4 cm. (internal); Diam. at base 41·3 cm. (external), Ht. 5 cm. One rectangular knife-cut handle (5·7 × 2·2 × 1 cm.) extant, its flat top continuing the flat knife-cut top of rim. In the handle there is an irregularly-placed, knife-cut, rectangular hole, 2·4 × 1·2 cm.

4. Sherd (fig. 45, c) from edge of flat-bottomed, straight-sided dish. Hand-made, of light-red earthenware with pale grey core, washed inside and out with thin, light-coloured slip of which only traces remain. L. 8 cm., W. 3·3 cm.; Ht. 3·5 cm.; Thickness of base 1·1 cm. Dish apparently made from an ordinary roof-tile with a vertical strip of clay 2 cm. high wiped on to the edges to form the sides. Sanded bottom, knife-cut outer edge.

5. Two adjacent rim-sherds (fig. 45, d) of round dish or bowl. Max. dims. 7·8 × 5·2 × 0·8 cm. and 4·5 × 4·7 × 0·9 cm.; Diam. of rim (external) c. 13·7 cm. Hand-made, of hard, red earthenware with pale grey core, exterior shaped with a knife, interior coated with plastic white slip, 1·2 mm. thick, and washed with thin, buff slip, brush marks very clear. Two adjacent patches of light olive-green glaze accidentally dropped on rim and down sides both inside and out.

6. Two sherds (fig. 45, a, b) from base and rim of flat-bottomed dish. Max. dims.: base-sherd 8·5 × 8·4 × 2·8 cm., and 1·5 cm. thick; rim-sherd 5·8 × 4 × 1·2 cm. Base probably rectangular with rounded corners. Hand-made, of hard earthenware, red outside, grey inside, the outside pared with a knife. Angle between base and side rounded inside, cut off outside. On the inside are small irregular patches of lights lip and a lead glaze which appears dull green on the grey fabric.

7. Sherd (fig. 45, e) of rim and side of large, straight-sided pancheon with interior ridges suggesting wheel-turning. Max. dims. 19·5 × 15 cm.; Thickness at rim 1 cm., at base 1·6 cm. Exterior irregular, with traces of burning, soft, gritty, light-red earthenware. Rough, hand-moulded, pie-crust decorations at rim, probably applied. Marked thickening towards bottom of sherd suggests position near base of vessel. Ht. of vessel perhaps c. 17·5 cm., and, if so, Diam. at rim c. 33 cm.

8. Sherd (fig. 45, f) from rim and side of straight-sided pancheon. Max. dims. 9·5 × 7·5 × 1 cm. Hand-made, of hard red earthenware with dark grey core and purplish surface. Lead glaze on inside appears brown and olive-green over mottled red and grey inner surface. Neatly executed pie-crust ornament at rim. Top of wall possibly frilled out and bent over in series of neat folds. Upper part of rolled rim cut off to leave a sharp-angled flat top.

9. Two adjacent sherds (pl. xxvii, b), one from the rim, the other bearing a loop handle, from a flat, roughly circular object, perhaps a lid. Roughly modelled disc of sandy, light-red earthenware, similar in fabric to no. 2, with handle made from looped roll of clay with ends pressed out and wiped on to surface of disc. Dims. as restored: Diam. 22·7 cm.; Thickness 0·75–1·0 cm.; Ht. handle 3·5 cm.

10. Part of unidentified object (fig. 45, g), hand-made, of hard, gritty, dark-red earthenware with dark blue-grey core. Max. dims. 14·5 × 14·5 × 3·2 cm. Apparently made from rectangular tile, 2 cm. thick, sanded underneath, scraped off with wooden implement on top. On surface, applied handle, of which only root remains; near this, cut surface of a slot or hole, 3 cm. long, 1·3 cm. from which is half of a small round perforation, 0·5 cm. diam.

11. Handle (fig. 45, h) of light-red earthenware, roughly modelled into flattened
ball resembling door-knob; solid, cracked across top, and broken off at point of junction with parent object. Diam. c. 5·5 cm.; Ht. 4·2 cm.

12. Pear-shaped knob (fig. 45, i) of dark-red, gritty earthenware, hand-made, asymmetrical, partly faceted with a knife, and fractured at both ends. Hollow; probably moulded on core of combustible material, small pieces of which rattle inside the knob. Possibly a spiked finial. Diam. c. 6 cm.; Ht. 6·7 cm.

With the possible exception of no. 7, this pottery is probably not the work of professional potters, but of the tile-makers. The techniques of moulding on a sanded board and cutting and paring with a knife (already described, p. 140, as those used to shape the mosaic tiles) seem to have been used here also. Some of the work, particularly the rim-decoration on no. 8, is very skilful. Only three vessels, nos. 1, 6 and 8, were glazed internally. No. 5 had a thick internal coating of white slip. Most of the vessels except no. 7 appear to have been brushed or wiped with a thin coat of slip, made either from pipe clay or from the clay used for the earthenware. This may mean no more than that the vessels, when finished, were smoothed over with a damp brush or rag that had some clay on it.

It may be assumed that the vessels were used during the various processes of manufacture of the tiles. No. 1 was at first thought to be a crucible, but it is more probably a mortar. Its thick walls and base are stabbed all over the outside, but in spite of this it cracked while it was being fired, as is demonstrated by glaze which ran down inside the fabric at one point in the line of fracture. The vessel shows no sign of the subjection to intense heat which would mark a crucible, but the internal glaze is worn at the bottom, which suggests that it had some use as a mortar before it broke along the line of the original crack. Tests carried out in the British Museum Research Laboratory have shown that no. 3 was used to carry lead ash, particles of which were still adhering to the interior of the sherds recovered. This is of considerable technical interest because it suggests that the lead oxide used in the glazes was prepared by the somewhat primitive and wasteful method of raking lead in an oven, instead of melting metallic lead, salt and sand together in a crucible in a furnace, after which the liquid glaze was poured out on the ground, left to set, and then pounded up with a pestle and sifted, leaving a powder which was mixed with watered wine or ale and brushed on to the tiles. It is not impossible that the two methods were combined and that lead oxide was used instead of metallic lead to make the glaze. If this were so, vessel no. 1 might have been used for pounding it up.

The pancheons, bowls and dishes were probably used to hold water, glazes and slips. No. 9 was probably a lid for one of these vessels. It has been suggested that it was an implement for smoothing clay, but, whereas the handle is noticeably burnished with use, the rough, sanded under side of the object shows none of the signs of rubbing such a use would produce.

This pottery forms an interesting group, demonstrating the versatility and independence of the tile-makers in supplying their own needs. As far as is known, it is the first industrial pottery to be recorded in association with a medieval tile kiln; but it would not be surprising to find that the Meaux tile-makers were unusual in this practice of making their own vessels, and that most tile-makers used current domestic wares, which would not be recognized as having been put to specifically industrial use.

THE DATE OF THE KILNS

The floor-tile kiln can be dated (p. 141) with reasonable certainty between the years 1249 and 1269, the period of the abbacy of William, the 9th abbot, when

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15 This method is described in an addition, probably of the late thirteenth century, to a twelfth-century MS. of the Diversarum Artium Schedula of Theophilus Presbyter in the British Museum (Harley MS 3915, fol. 145v-147r). See Gardner and Eames, op. cit. in note 5, pp. 28 and 42.
the abbey church was paved. It is, however, by no means certain that all of the
tile mosaic used to pave the church was made in the kiln at North Grange.
G. K. Beaulah is very probably right in thinking that there were other kilns
within the abbey precincts, just as it is thought that at least three different
floor-tile kilns were used at different dates between 1240 and 1300 on the site
of Clarendon palace.

The date of the roof-tile kiln is less certain. The whole appearance of the site
suggested that very little time elapsed between the demolition of the floor-tile
kiln and the construction of the first roof-tile kiln, for there was no intrusion of
humus or other occupation material between the two levels. The structure of the
upper roof-tile kiln contained, in the spine wall, two of the highly specialized,
cogged, segmental-arch bricks from the floor-tile kiln. Apparently identical
10-in-square building-tiles were found at the floor-tile kiln level and were used
in the structure of the upper roof-tile kiln. The technique of cutting the nibs of
the roof-tiles with a knife, used by one workman, suggests that he had been
employed on the cutting of mosaic tiles. This all suggests a fairly close follow-on,
though it is possible that the floor-tile kiln stood derelict for a number of years
before it was demolished and the first roof-tile kiln was built.

It is difficult to estimate the length of the working life of such a furnace, but
I incline at present to put it at about four years. None of these furnaces at Meaux
was built of high refractory material. A nineteenth-century publication on
contemporary practice in the manufacture of bricks and tiles states that in
Nottingham, where the furnaces were not built of high refractory material, but
of ordinary brick, their lining had to be renewed after about one year.16

It is improbable that the Meaux kilns were operated all the year round,
because of the unfavourable climate, and one may perhaps estimate that the
use of these nineteenth-century kilns was at least two or three times as intense
as that of the thirteenth-century kilns, which, therefore, remained usable for
three, or perhaps four, years. Some slender support for this is given by docu­
mentary evidence about floor-tile paving at Clarendon palace, where activity
seems to have been concentrated in several short periods of a few years each.
It is possible, therefore, that ten or twelve years covered the whole working life
of the roof-tile kilns, and that, if it followed immediately upon the cessation of
work in the floor-tile kiln, the tilery at North Grange ceased to function about
1280. On the other hand, if short periods elapsed between the abandonment
of the floor-tile kiln and the building of the first roof-tile kiln, and again between
that and its rebuilding and final repair, sporadic activity may have continued
on the site at least for the rest of the century.

The roof-tiles produced there were not used for the church, which had been
roofed with lead during the abbacy of the 8th abbot, Michael, between 1235 and
1249,17 but were perhaps used in a considerable building programme, including
the erection of an abbot’s lodging, which was carried out between 1286 and 1310

16 Edward Dobson, *A Rudimentary Treatise on the Manufacture of Bricks and Tiles...* (Crosby Lockwood
17 Cf. p. 141, notes 10-12 above.
during the abbacy of Roger, the 13th abbot. During this period also the lead from the roof of the converts' dormitory was handed over to the Friars Minor of Scarborough in part settlement of a debt, and used by them to roof their church. This lead could have been replaced at Meaux by some less expensive roofing material, possibly tiles. One cannot say more than that there was opportunity for the use of a considerable quantity of roofing-tile on domestic buildings at Meaux abbey during the last quarter of the thirteenth century and the first decade of the fourteenth.

Detailed description of PL I XXIV, A-V; XXV, A-C; XXVI, A-D

PLATE XXIV
A. Tops of contiguous arches in S. retaining wall, from SE. (p. 151)
B. Spine wall of furnace, showing cobbled segmental bricks in top course, and remains of corbelling for arches (p. 144)
C. Junction of N. retaining structure with back furnace wall and ramp (p. 150)
D. NE. corner of stoke-hole showing projection of lower roof-tile kiln walls in front of N. and middle piers of furnace arches of upper kiln (p. 147 f.)
E. Collapsed S. wall of lower roof-tile kiln under remains of S. pier of furnace arches of upper kiln (p. 147 f.)
F. Patches of paving at rear of stoke-hole (p. 148)

PLATE XXV
A. Structural bricks and tiles from level of floor-tile kiln: 1. voussoir (10 in.); 2. building-tile (10 in.); 3, 4 cobbled and uncobbled segmental bricks; 5, 6 voussoirs (7½ and 8 in.); 7. brick (pp. 154 ff., 160 f., 163). Sc. 1
B. Roof-tile from roof-tile kiln structure (p. 152). Sc. c. 1
C. Scored block of 3-in. squares for tile mosaic (p. 157) Sc. c. 1

PLATE XXVI
A. 1. part of oven floor; 2. two squared tiles and part of a third stacked and fused; 3. part of tile fused to top layer of oven floor of floor-tile kiln (p. 157). Sc. 1
B. Scored slabs of tiles fused to top layer of oven floor of floor-tile kiln (p. 157). Sc. 1
C. Part of spine wall of floor-tile kiln furnace (p. 156). Sc. 1
D. Fragments of fire-bars, nibbed and unnibbed, from floor-tile kiln level (p. 161 f.). Sc. 1