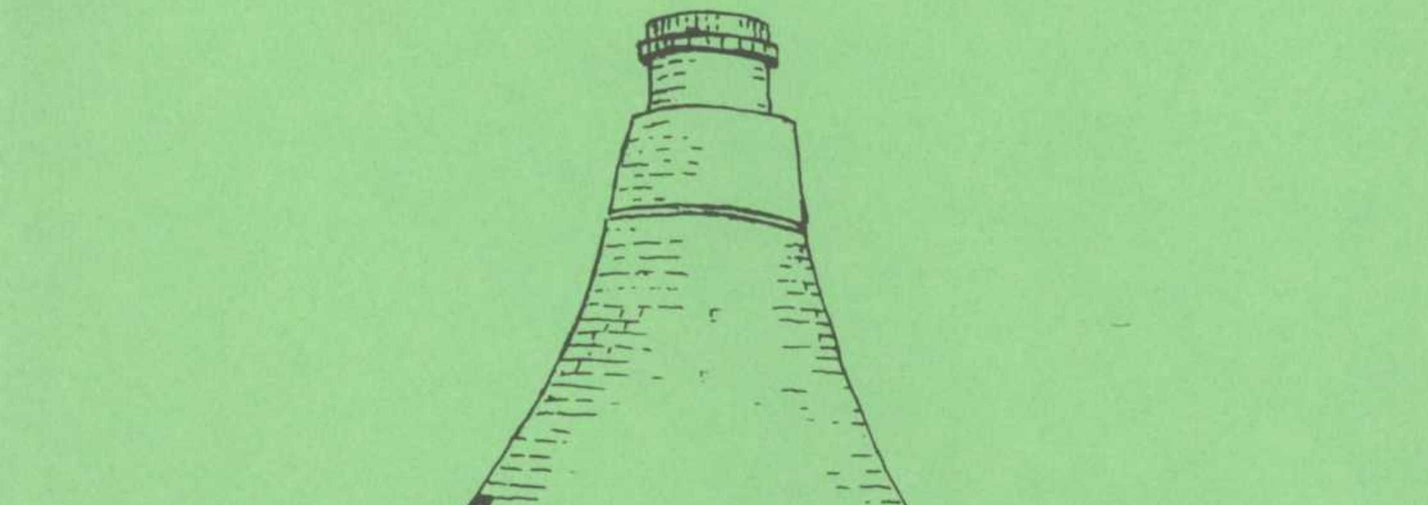
SUSSEX INDUSTRIAL HISTORY

No. 12

1982



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SUSSEX INDUSTRIAL ARCHAEOLOGY SOCIETY

Founded, as the Sussex Industrial Archaeology Study Group in 1967

Cover Picture
The Piddinghoe Kiln after Restoration (E. W. O'Shea)

The Annual Subscription to the Society is £3.00, payable on 1st April. Life Membership is available for a single payment of 15 times the current annual subscription. Annual and Life Membership includes the annual issue of 'Sussex Industrial History' and the quarterly 'Newsletter'.

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SUSSEX INDUSTRIAL HISTORY

Journal of the Sussex Industrial Archaeology Society

No. 12

CONTENTS

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EDITORIAL

The years 1981 and 1982 mark the Centenaries of various events connected with the inauguration of public electricity supplies: publicity has been given to the names of a number of famous Sussex engineers and much has been learned by studying their methods of achieving undoubted technical successes. Less is known, however, about the working procedures and day-to-day lives of the skilled craftsmen who supported the activities of the famous and this issue of Sussex Industrial History contains two articles particularly relevant to this aspect of the subject.

The article on the Piddinghoe Kiln gives a very detailed description, based on expert surmise, of how and why particular methods of construction were adopted, while that on the Hillman's Brickyard describes the actual work of a brickmaking craftsman based on a tape-recording taken from a long-retired employee. The latter procedure, using sound or video tapes, provides a very powerful method of obtaining and preserving first-hand, but fast disappearing, information on this important aspect of Industrial History and it is hoped that full use of its possibilities will be made before it is too late.

Published by the Sussex Industrial Archaeology Society.

THE RESTORATION OF A TILE KILN AT PIDDINGHOE, EAST SUSSEX (TQ 432632)

By E. W. O'Shea

This paper is the story of the restoration of a kiln by a group of amateurs whose determination and dedication made it possible. It is primarily a technical paper dealing with the structure and the work involved in restoring it. It is not intended as an historical record of the Piddinghoe brick and tile industry as records available to us are meagre; however Mr. Bruce Osborne is attempting, through his family history described in the next article (1) to fill in the gaps and any further information that comes to hand will be recorded in the survey of Sussex Brickmaking being prepared by the Sussex Industrial Archaeology Society.

Decisions on Policy

Of the several reports prepared on other kilns, none, in my opinion, deals adequately with the structural details or function of the component parts with the exception of Dobson's splendid account (2). The only kiln that I have been able to trace in the south of England is that at Nettlebed, Oxfordshire (3 & 4). This is a bottle kiln for burning bricks and had a capacity of 18 000 bricks. Neither of the reports give any dimensions but it would appear to be about 18 m high compared with 7 m at Piddignhoe. The kiln was restored by a firm of highly skilled building contractors who stabilized it with a cement spray, probably using a method known as "guniting" which incorporates a light steel reinforcing mesh. External brickwork was repaired with second hand bricks. The cost is not given.

Every brick that we took down had something to say, every one that we relaid posed a problem, but through the whole of our forty-four weeks of hard work, with winter winds howling round the scaffold and brick dust filling our eyes and choking our throats, I never heard a word of complaint. It was a rewarding experience.

Travellers on the Lewes to Newhaven Road (A275), on approaching the village of Piddinghoe, would have noticed a weed-covered structure projecting above the wall of Kiln Cottage. This is in fact the kiln from which the house gets its name and is the last recognisable structure of the ceramic industry that flourished here in the last century. The location is shown on the 1:2500 Ordnance Survey map of 1873 reproduced as Fig.1.

In June, 1979 I was approached by the owners in my capacity of Chairman of the Lewes Archaeological Group to see if I could give some advice on the possibility of preserving the kiln. The ownership of an ancient monument can be a mixed blessing; if it is a house of managable proportions it can be a source of pride and enjoyment, but an industrial building with no means of revenue or practical use can be an embarrassment in the extreme. Such was the problem that faced Mrs. Phyllis and Mr. John Wilkinson, joint owners of this kiln, who had expressed a desire that the kiln should be preserved or re-erected at an open-air museum. The latter choice was unacceptable to museums on a matter of policy and of cost.

It is a simple updraught bottle kiln, one of a number of different types that had formed the basis of the local ceramic industry. When I first visited it in 1977 it was in very poor condition, but my second visit on 12th June 1979 showed quite serious deterioration and although a close scrutiny was not possible I was of the opinion that it was in real danger of collapse. The cracking of the cone seemed to have increased and quite a number of the outer bricks had become dislodged. With the agreement of the owners and after discussion with Mr. Brian Dawson, the architect responsible for conservation for Lewes District Council, a meeting was held on 9th November, 1979, with all of the interested parties. I felt that the Sussex Industrial Archaeology Society would be the most appropriate body to sponsor the project and our Chairman, Mr. John Haselfoot represented the Society. Both Mr. Dawson and Mr. Norman Hutchins, conservation Officer for East

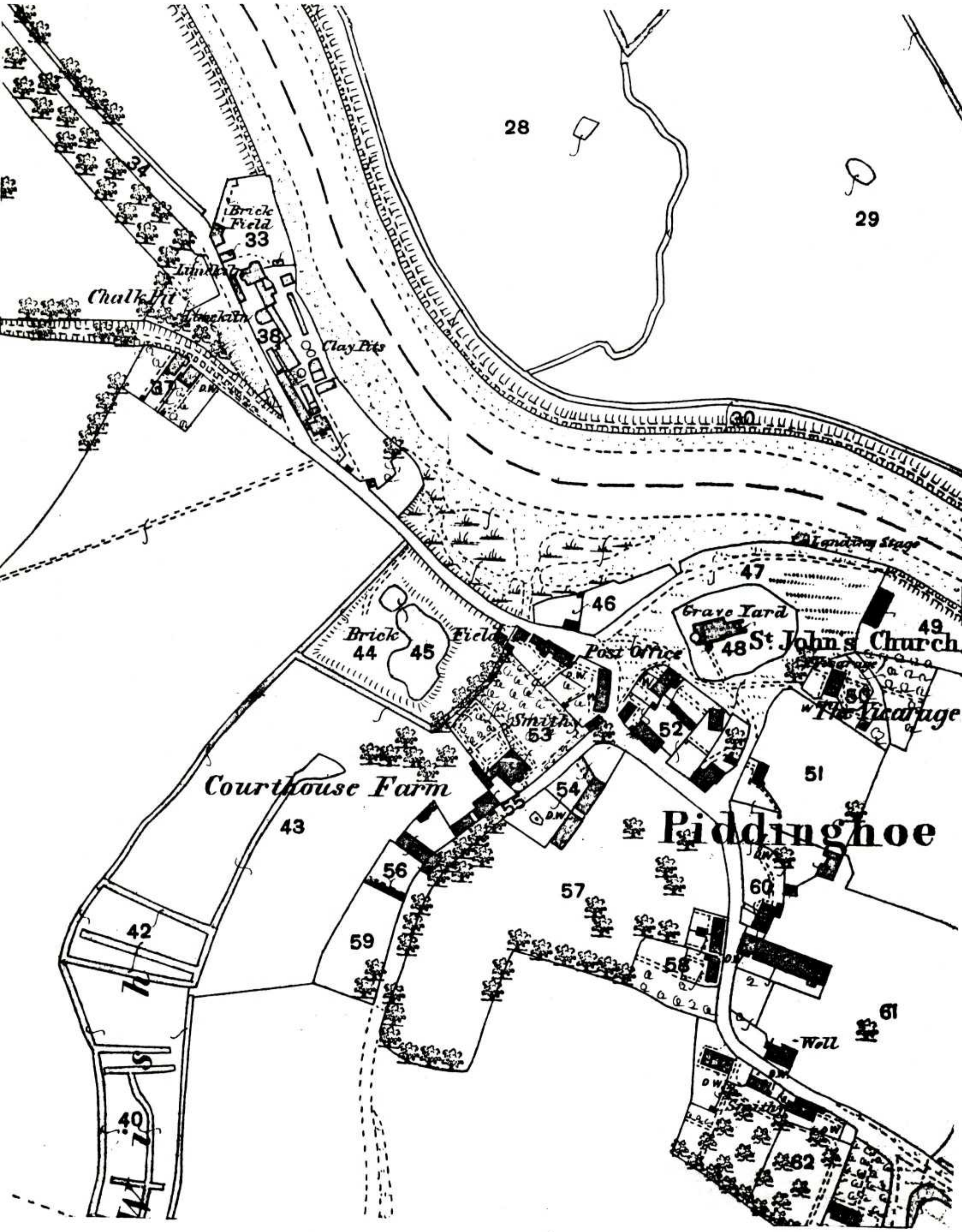


Fig.1 Piddinghoe Village and Brickworks, 1873
(from the 1:2500 Ordnance Survey Map)

Sussex County Council were in sympathy with the scheme, and I was requested to prepare an estimate of the approximate cost. Mr. Dawson offered to explore the possibility of raising funds.

Fig.2 Before Restoration.

In the meantime part of the flint rubble enclosing wall had fallen from the east end of the upper part of the kiln, causing a great deal of alarm to the resident of the bungalow only one-and-a-half metres from the back of the kiln. First-aid repairs were of immediate importance and measures were agreed upon, based upon my proposal that a double course of reinforced brickwork should be built to span the two brick piers behind the furnaces which supported the pair of arches over the stoke-holes. Following a serious illness, I felt it unwise to assist physically in this work, but I agreed to visit and advise when the work was due to commence. Because of their concern about accidents the owners decided to carry on with the repairs and my recommendations were not adhered to and in my opinion the result is most unfortunate, both structurally and aesthetically. A reinforced concrete beam had been substituted for the reinforced brickwork which was completely out of character with the rest of the work. With reinforced concrete, because of the varying co-efficients of expansion of steel and concrete, the corresponding cross sections of steel and concrete must be finely balanced. In this case the amount of steel was so great that it could be sufficient to cause the beam to fail under its own weight.

I had meanwhile prepared a budget estimate for the restoration work amounting to £1300 and Mr. Dawson negotiated agreements with the parties concerned so that the cost should be borne equally between the Lewes District Council, East Sussex County Council, the Civic Trust and the joint owners, although the latter stipulated that this would be the limit of their contribution. I had made it quite clear that because it was impossible properly to assess the amount of work required to be done until a scaffold had been erected and the vegetable growth removed, my budget figure could only be considered as provisional. The usual provision for a government grant is that the owners shall raise half of the cost, and as all of the labour, travelling expenses and supervision was being provided on a voluntary basis and all of the equipment being loaned free of charge, the owners were very fortunate. Had the work been put in the hands of a building contractor the probable cost would have been in the region of £8000.

It became evident that there was nobody available with sufficient technical knowledge and experience to organize and supervise the project, but further delays could prejudice the scheme, and I reluctantly agreed to take it over. Reluctantly at the time, but despite a lifetime of complex building projects it turned out to be one of the most interesting and enjoyable jobs I have ever done.

It is the policy of the Sussex Industrial Archaeology Society that members taking over work of this nature accept the responsibility for funding and for recruiting their own labour. Here I was most fortunate in my connection with the Lewes Archaeological Group who agreed to support the project and eventually provided 80% of the labour and most of the tools and equipment.

It was not until the end of May, 1980 that the negotiations were completed, ten months after my meeting with the owners and a start was made on 8th July 1980.

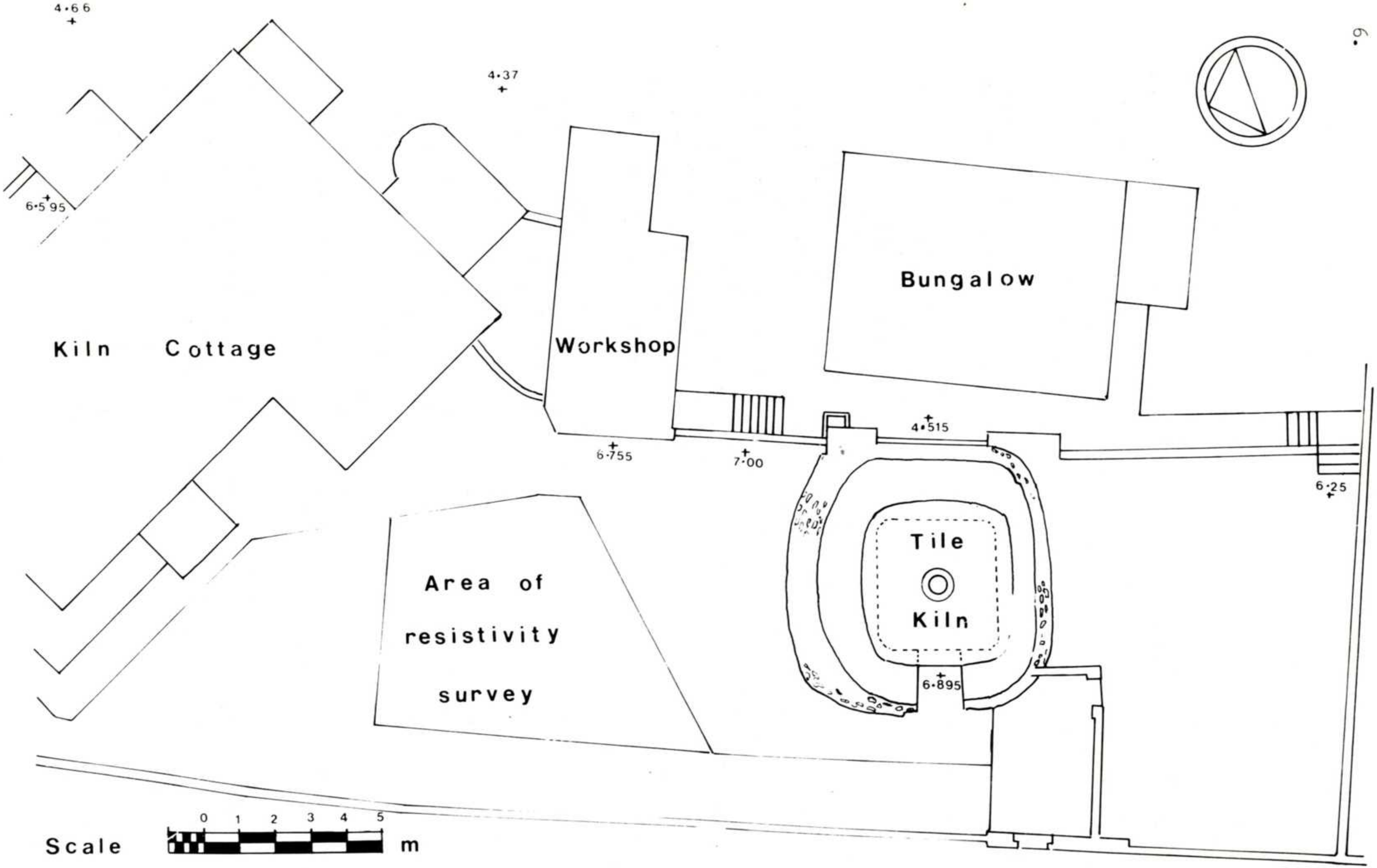
The Kiln, Its Design and Construction

Unlike other updraught kilns such as Fulham (5), Farnham (6) and East Grinstead (7) it is independant of other buildings with the result that almost the whole of the structure is exposed to the elements, which has influenced its design. It was without a doubt designed for tiles and pottery rather than for bricks. Details of the site and construction are shown on the five succeeding pages of drawings. The kiln consists of three vertical compartments, i) the furnace, comprising horizontal parallel flues, stoke-holes and ash pits, ii) the firing chamber and iii) the cone. Advantage was taken of the fall of the ground which allowed loading to be carried out from the upper ground level, which would correspond to the access road level, whilst stoking and clearing of the ash pits would be done at the natural lower level, a difference in height of 2.4 m. None of the structure below the cone had to be disturbed in the work of restoration so that some assumptions had to be made, such as thickness of walls, but from the author's experience there is little doubt that these were the methods adopted. The design of the furnaces could not be established until the scaffold had been dismantled and the rubbish removed from one of the furnaces.

One fact became clear at the earliest stage of demolition, namely that whilst the work was skillfully executed in so far as the bricklayers knew exactly what they were about no time was spent in exactitudes or wasted on things that were not absolutely necessary. Angles, lines and levels varied to a considerable degree but have been adjusted to bring them back on to course by tricks of the trade.

The internal dimensions of the body of the kiln are 3.2 m wide (north to south) by 3.5 m front to back (west to east). The internal shell is built of common gault bricks, two bricks thick (45.7cm) in lime mortar to a total height of 5 m. The structure seems to be founded on the river terrace of "clay with flints" on which a levelling bed of lime mortar had been laid. This brick shell was surrounded by a flint and chalk rubble wall to an average thickness of 1.8 m to its full height and extending above it to seal the bottom brick courses of the cone. The object of this surrounding wall would be two-fold, to withstand the thrust of the cone and to insulate the firing chamber.

The walls are built to a slight batter internally (approximately 4cm in 3 m) but as it is inconsistent - the four internal angles being quite vertical - it is probably by accident rather than design. The external flint rubble walling would have been laid in layers simultaneously with the brick shell so there would have been no likelihood of overturning. Up to ground level it would have been filled into open excavation but above ground it would have been built as a wall rising with the brick shell. The irregular curve and inconsistent thickness would have prevented the use of a face board and the fair face and batter would have been determined by eye. Whilst the north and south walls are level across the kiln



PIDDINGHOE KILN: Site Plan

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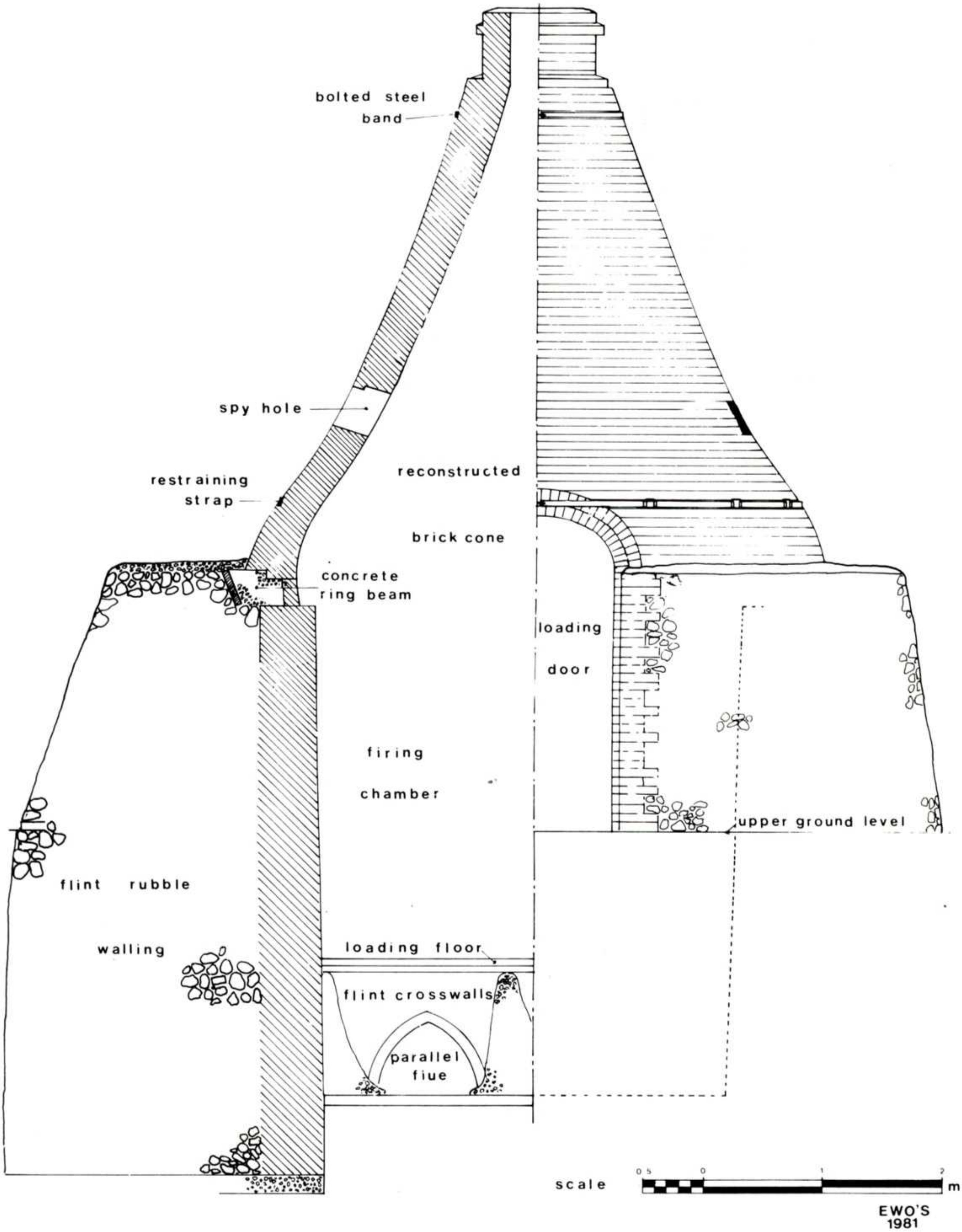
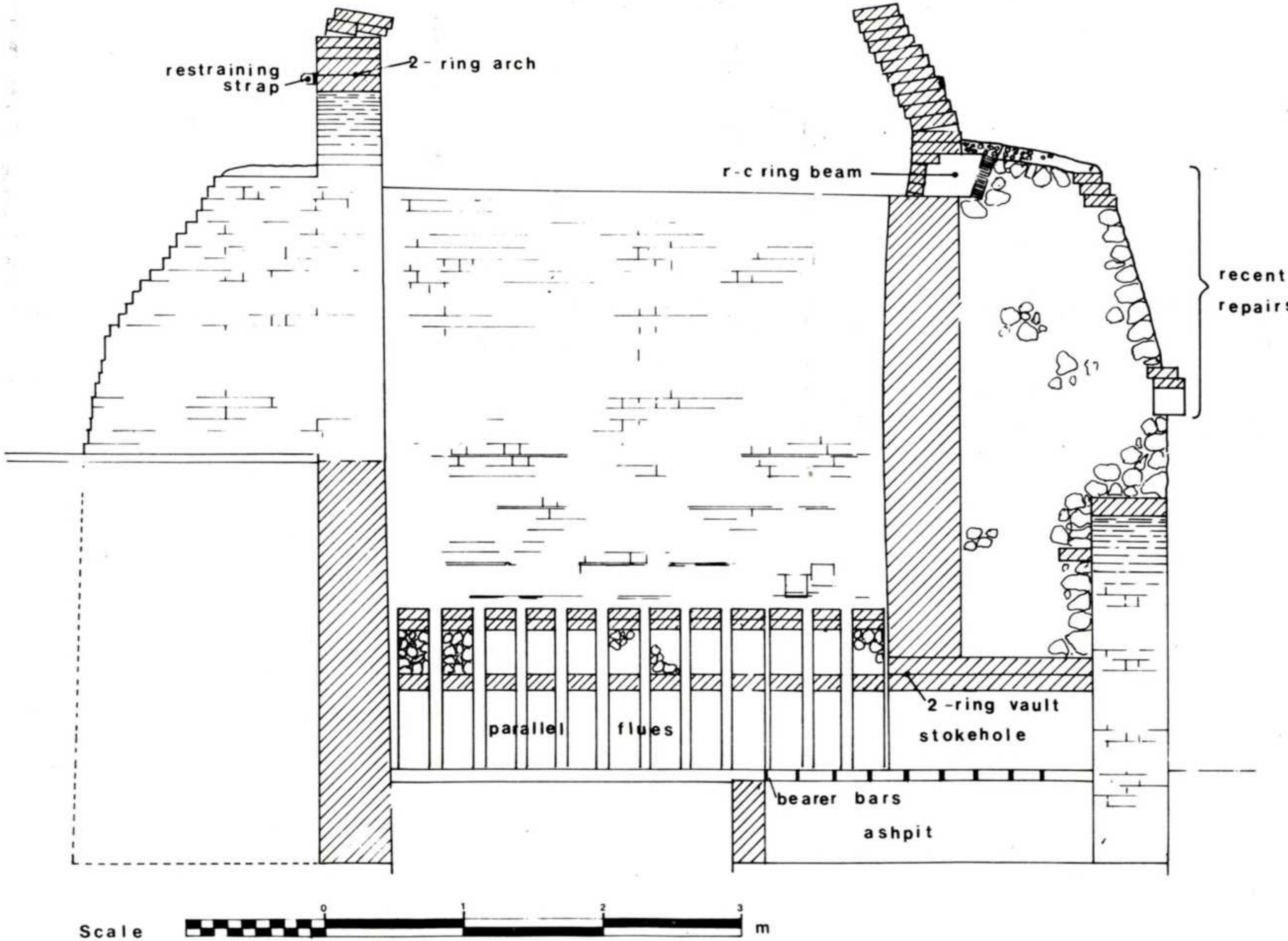
1981



Cross section West elevation



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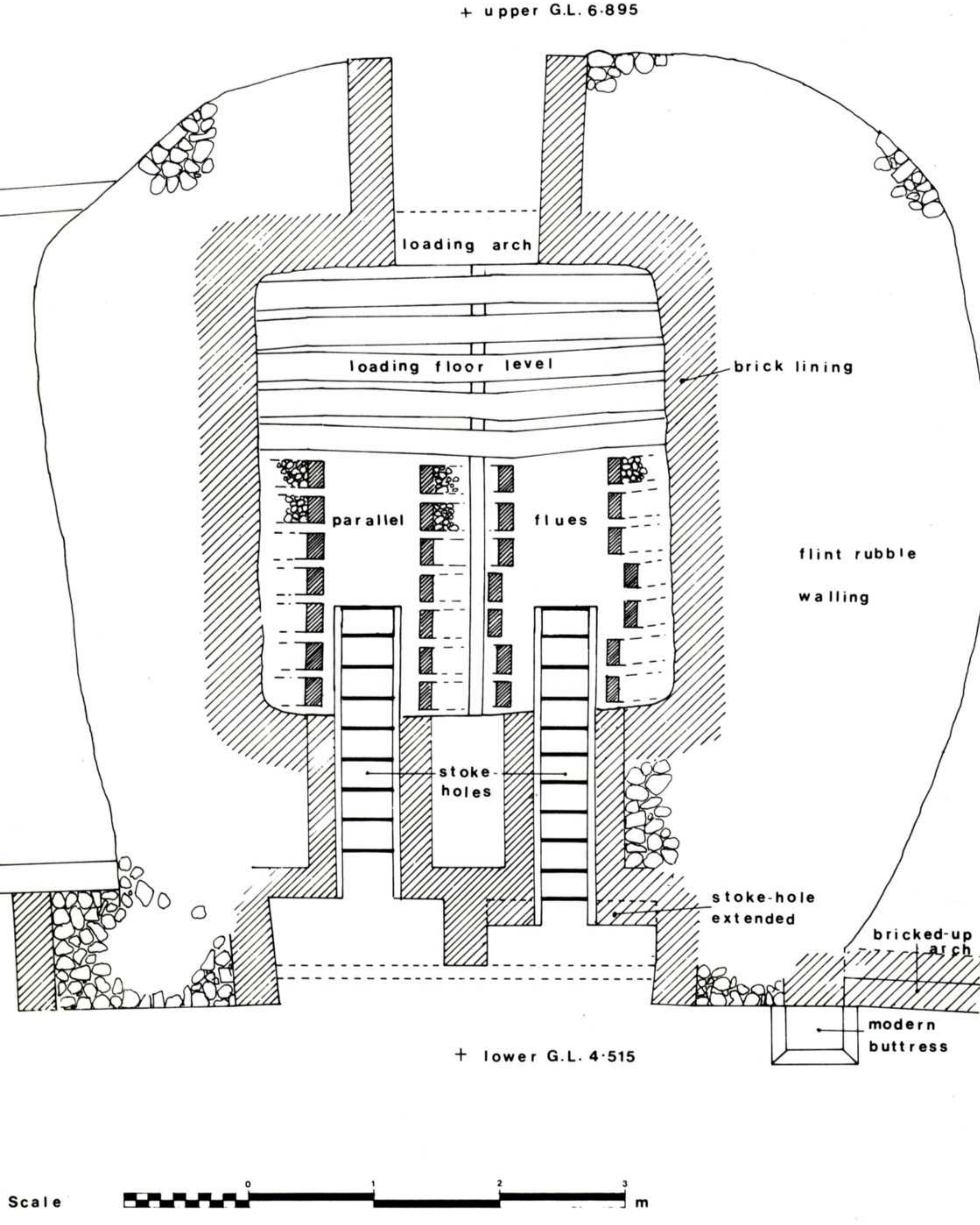
Section through firing chamber and flues



Plan of firing chamber

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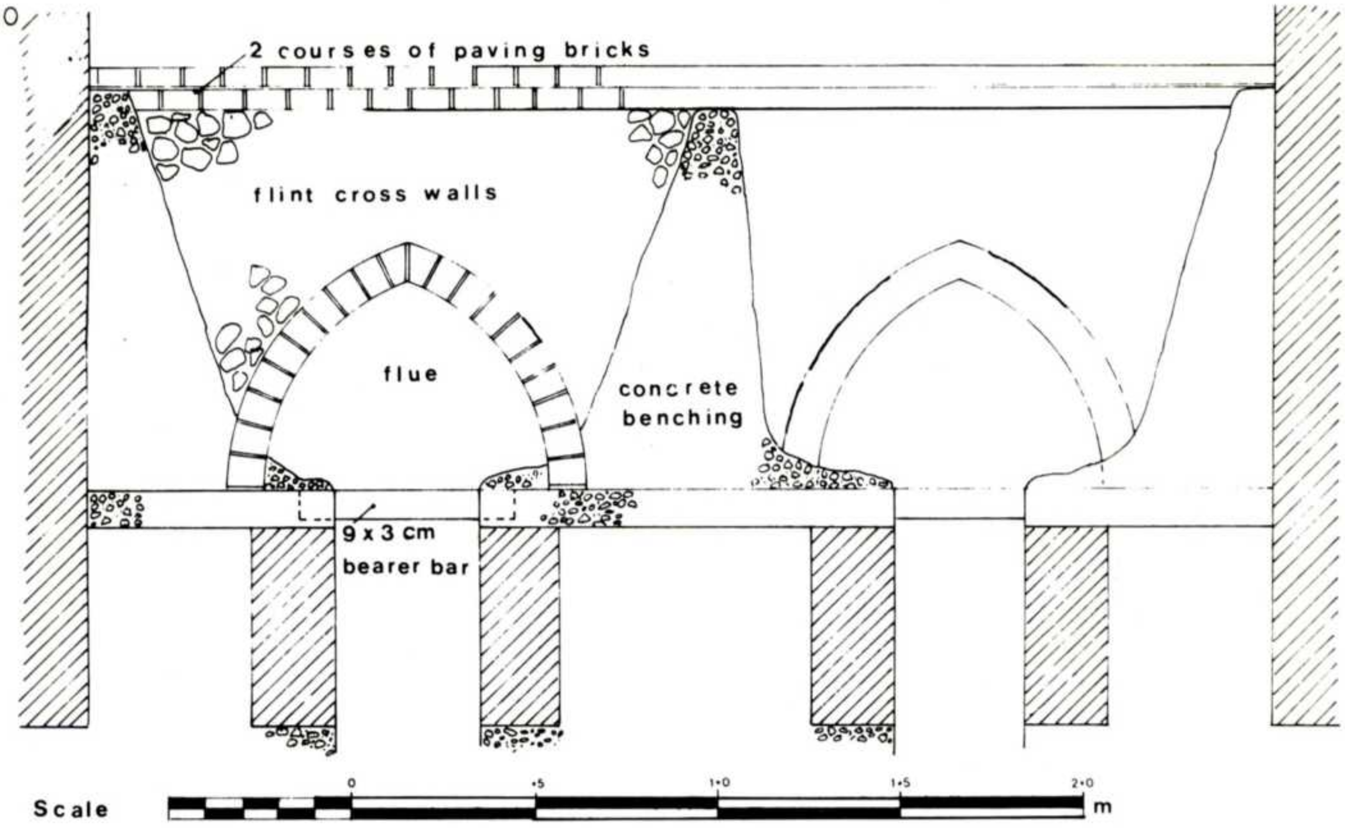
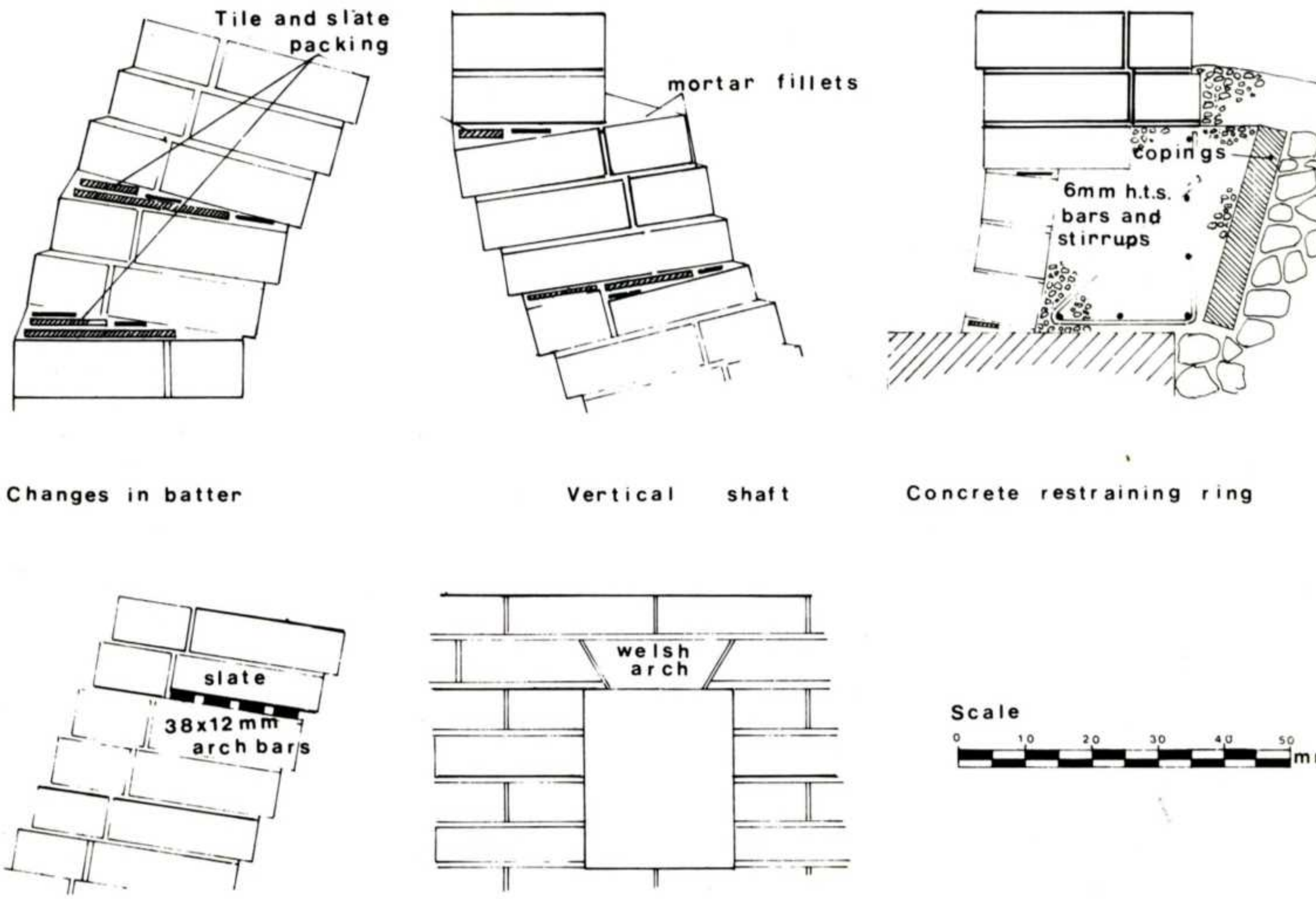


Section through flues



Structural details of brick cone

EWO'S
1981

they both have a fall to the back of the kiln, which is adjusted periodically by inserting a course or two of plain creasing tiles on the north wall. This is the normal practice on this structure to adjust levels and it occurs frequently in the cone. The cause of the irregularities and the need for constantly adjusting is because these walls, like the cone, were built of reject bricks. These vary by as much as 15 mm in any or all dimensions and opposing header faces were distorted through 30° and great difficulty would have been experienced in maintaining regular courses. 150 x 150 mm tile blocks have been inserted in some of the walls in a haphazard way. Whilst no money has been wasted in unnecessary finishings considerable skill has been employed in using reject materials for a very functional structure.

At the base of the shell are a pair of parallel flues and the loading floor. This comprises 12 cross walls of flint in lime mortar averaging 8 cm apart and 22.9 cm thick to a total height of 1.2 m, capped at the top with two courses of 4.5 cm paving bricks. Each wall is pierced with a pair of openings having a one-brick pointed arch about 80 cm span and 56 cm rise to form the flues. It is interesting to note that whilst the setting of the arch centres appear to have been accurately done, the walls have been built in a very haphazard way, the spacing between the walls and their line being very inaccurate. The third and fourth arches to the northern flue are both wider and higher than the other arches but the reason for this is not understood. To eliminate cold pockets and to reduce the volume of the void below the firing chamber, concrete benching was packed in between the cross walls to trail the flames across the full width of the firing chamber, the central benching acting as a barrier between the two parallel flues. As the two stoke-holes described below must be exactly in line with its corresponding opposite flue, and because of an irregularity in the width of the chamber, the flues are asymmetrical in plan with the consequence that one of the benchings cannot be accommodated for its full width and is consequently very much steeper than its three partners.

The method of building the flues would have been to stop off the chamber walls at loading floor level and bring up the outer flint and rubble encasing wall on three sides; because of the complications of the construction of the stoke-holes, the east wall would have been left down for the time being. The pair of two centre-pointed arch centres would then have been set in position with a pair of folding wedges to facilitate removal and the first pair of brick arches constructed. The first of the flint cross walls would then be built, It is not possible to say if the walls were cast between shutter boards as a concrete wall. There would almost certainly have been a back shutter and in all probability the wall would have been built against this from the open side. This would allow more regular bedding and a more even distribution of mortar and thus help to reduce cracking through expansion. This could also possibly explain the unequal spacing of the walls caused by the riding of the back shutter against irregularities in the face of the previously constructed wall. The back shutter would then be removed and the benching filled in in the void between the walls. As the width of the space is as little as 5 cm in the worst instances, the benching has been very crudely finished and has slumped in front of the bottom of the arch. This operation would have been finished wall by wall, using the same pair of centres throughout and the back wall that had been left down would make it possible to withdraw the centres from the last pair of arches. There is no obvious reason for the arches being pointed instead of semicircular except that they give a larger area for the passage of the flames for a similar height.

The two courses of paving bricks would then be set. These have been laid in a header bond across the walls with staggered perpends. This would have been a single operation with the courses bonded in both ways to obtain the level surface of the loading floor which is essential to avoid the disturbance of the products during firing.

The next operation would be the construction of the stoke-holes. These comprise a pair of tunnels each consisting of a two-ring brick vault 54 cm wide and 54cm high, passing through the brick chamber wall and its flint rubble encasing wall, out to the face of the stoking point. The tunnel is built on the corresponding alignment and at the same level as the opposing parallel flue. Whilst the radial joints of the two arch rings are staggered the soffit joints are not so that the vault comprises a series of abutting arches one brick thick on soffit. The arches are carried on one-brick walls which go down to the same level as the main chamber walls, approximately 68cm below the level of the base of the parallel flues.

The void between these pairs of walls is utilised as the ash pit. Spanning across the pits at 21cm centres is a series of 9 x 3cm wrought iron bearer bars on which the fire bars rested. The ash pit extended 90cm into the body of the kiln thus bringing the fire nearer the centre which also facilitated the removal of the ash. Unfortunately the one remaining fire bar that had been left in the kiln has been lost. They were probably 42cm long so that they would butt at mid-span and would have been cut away to allow the draught to rise and the ash to drop down. The depth of the ash pit cannot now be ascertained. When the investigations for recording were carried out the whole of the furnace area was choked with rubble and no base can be recognised. The lime concrete bed to the ash pit walls would probably have been carried over as a bottom to the pit.

Sometime during the working period of the kiln the northern stoke-hole had been extended outwards by building a one-brick skin on the face of the stoke-hole wall. This was taken down to the level of the main wall and to a height of 1.15 m above the ground level and finished on top with a splayed brick on edge course. The bearer bars to this flue are very much more distorted by heat than its companion. The reason for this extension is not understood, but this is the flue that has the two larger arches in its cross walls and it may be that this adaptation was made to increase the temperature of the kiln. Built into the face of both stoke-holes is an unrecognisable tangle of ironwork. It is not heavy enough to have been hooks for furnace fire doors but it could have been some form of fastening for drop doors illustrated in Woodforde's sketch of a Victorian kiln (8).

The battered face of the encasing flint rubble wall brings it in front of the stoke-hole which is arched over the entrances with a pair of brick arches, and the projecting ends are strengthened with a pair of brick battered buttresses.

The firing chamber is a vertical continuation of the brick shell and flint encasing wall, the only intrusion being the loading door. This is a vertical opening 1.35 m through the chamber wall and continues four courses above into the shell of the cone, terminating four courses above with two-ring three-centre arch two bricks wide on soffit. The object of using this shape of arch is that it reduces the height of the arch by four courses compared with a semi-circular arch, allowing the corbelling-in to start that much earlier. Generally the arch is constructed with standard bricks with tight joints at the intrados, with some splayed bricks particularly on the two shorter radii, where the soffit shows no bonding between the inner and outer courses. On the flatter soffit over the central radius back and front are bonded together by alternating two stretchers with two three-quarter and one half brick. The whole of the front wall including the arch is two bricks thick, continuing the line of the chamber wall, which created several problems to the geometry of the cone.

The cone is built of reject bricks throughout to a thickness of one and a half bricks (34mm). The bricks are of varying shape and size and of very poor quality and were laid in brick dust to which no matrix had been added and which is used as a levelling and filling agent to master the differences in sizes of the bricks which are held in position by gravity and wedging.

The geometry of the cone is interesting. Starting from an almost square base it diminishes in 68 courses to a circle of 50cm internal diameter, but it passes through various deviations in profile on its way for functional reasons. To help ease the brickwork around the tight radii of the corners, the walls are built as a regular curve by setting back in the centre approximately 15cm and sweeping round to the intersection of the curve at the corners. The lower courses are on plan of similar shape to a television screen. The general principal is to convert towards a circle by oversailing the courses, increasing the amount of the offset towards the corners. At the same time the bricks are laid to an inward fall or cant. As the bricks will tend to slide inward they wedge themselves together, and this is the one and only factor controlling the stability of the cone. Generally the inner ring is laid in header bond and the outer in stretchers with no bond between the two skins, but in twelve of the courses this is reversed and the external headers bond into the inner skin. As the cone rises and the curve becomes tighter the outer stretchers are cropped and at the top consists of all three quarter and half bricks.

Much use has been made of tile and slate slips for wedging and adjusting levels. Where the perpends of the headers radiate outwards they increase in width and this is taken up by upright tile slips in the void, and similar action was taken at corners to adjust the sharp radius. The voids were flushed up with brick dust. Other functional considerations had to be given. The success of a kiln is a constant dissipation of heat and, to obtain this, cold air pockets must be eliminated and an even up-flow maintained, at the same time providing maximum firing capacity and the profile of the curve has been designed as an elongated ogee curve.

To trail the heat over the edge of the chamber walls the lower three courses of the inner skin were laid to an outward cant by slate wedging; to stabilize this the outer skin is brought down with wide batter, leaving a wide gap which was filled with pieces of brick and other packing. This is further reinforced by the restraining strap referred to later. The inner face then rises vertically for another three courses after which the inward gathering commences by oversailing and canting. The angle of cant varies from 9° to 22° according to the batter and the oversail 1 to 2cm at the 90° radiants and 2 to 5cm at the corners. The variation in the cant was effected in various ways, the most common being a course of flat creasing tiles at the inner or outer edge according to whether the cant was to be increased or reduced. Slate wedging was also used separately or in conjunction with tile and in extreme cases using 4.5cm paving bricks for the internal header course and normal stretchers for the outer skin. The gathering-over is most rapid up to the spy holes at the 20th course, and above the spy hole arch course the batter gradually reduces to the top. The near rectangular plan continues to this point but upwards from here the plan is gradually adjusted to an elipse and reaching a true circle at the top course. The inner one-brick skin of the spy hole is carried on four wrought iron bearer bars sealed over with a bed of slate and the brick course above is in paving bricks to balance the standard brick outer ring.

The cone terminated with a broken course of tiles and as the shaft is conjectural it will be dealt with in the section on restoration.

Dismantling and Recording

Two vital factors had to be considered before anything was disturbed, the first being safety.

Whilst from my personal knowledge of the volunteers, most of whom had worked with me on archaeological excavations, they were responsible and intelligent people, none of them had any experience in building operations or working off a scaffold, and could not be expected to understand the many pitfalls. Because of the tapering circular shape of the cone the scaffolding was extremely difficult and I am indebted to Brighton Scaffolding Ltd., for their co-operation and skilful work (Fig.3). To maintain head room at the lower level and to fly over obstructions, good use was made of lattice girders and we were provided with a supply of cantilever brackets to span the diagonals. Toe boards, guard rails and extra boards for double sheeting were also provided. An internal staging was also set at the top of the firing chamber and building safety regulations were strictly complied with. It was pleasing to note how quickly the volunteers picked up the requirements of the regulations. The ladder was always properly tied and boarded over when work finished each night, the scaffold was left tidy and clear of obstruction and safety helmets were regularly worn. During the whole of the dismantling and re-erection no dangerous incident occured and the only call for first aid was minor cuts and blisters. The greatest risk was the old bricks breaking in half when lifted but as the rule of not passing under a working area was observed no accident happened.

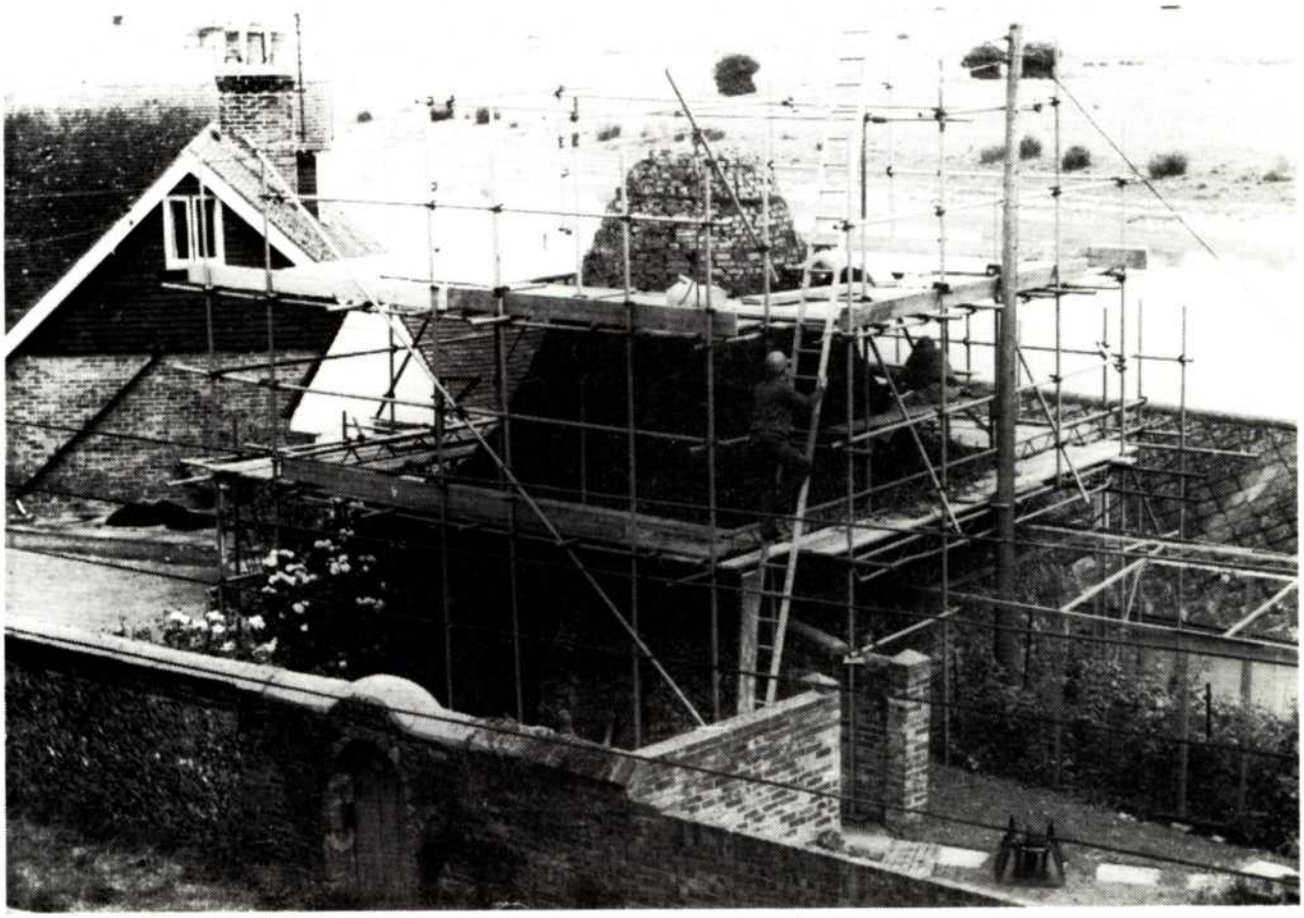


Fig. 3 Scaffolding

The second important consideration was accurate recording. Because of the growth of vegetation we were completely unaware of the method of construction or of the function of some of the features. Once removed our evidence had gone for ever and it was therefore essential that every detail of construction was recorded. We had to design our own special recording equipment, particularly the trammel and clinometers, and it is wothwhile recording their design and function (Fig. 4). The trammel was constructed as follows:
The base comprises a pair of bearers 2mm long with three cross bearers 40cm long housed together, the centre one to carry the pivot. A 50cm square platform was screwed across the centre and a 25cm circular protractor set over the platform, orientated 0 to 180 degrees to the bearers. A pair of hardwood swing arms with overlapping ends were glued together staggered to give a continuous leading edge to which a 1.5 m dressmaker's tape was stuck to each arm, measuring outwards from the centre. A pivot bolt with locking thumb screw was bolted through the centre bearer, the platform, protractor and the swing arm so that it would rotate or could be locked over the exact centre. A pair of extension arms 2 m long with similar tapes but reading inwards, were attached to the swing arms by a pair of aluminium housings consisting of flat strips bolted together with wing nuts for clamping. By dropping a plumb-bob and sliding in the extension arm a radial reading to within one millimetre could be obtained by adding together any two opposing dimensions and at the same time the angle off the base line could be taken within a half degree.

The clinometers for reading angles of the horizontal, such as the cant of the brickwork, consisted of a pair of hardwood arms half a metre long pivoted at one end with a locking screw bolt. A bubble level and plate was fitted to the top edge of one arm, and half of a semicircular protractor was fixed to the other and centred on the pivot and aligned to a slot in each arm so that the vertical angle could be read when the lower was set on the brickwork and the upper raised to a level reading on the bubble.

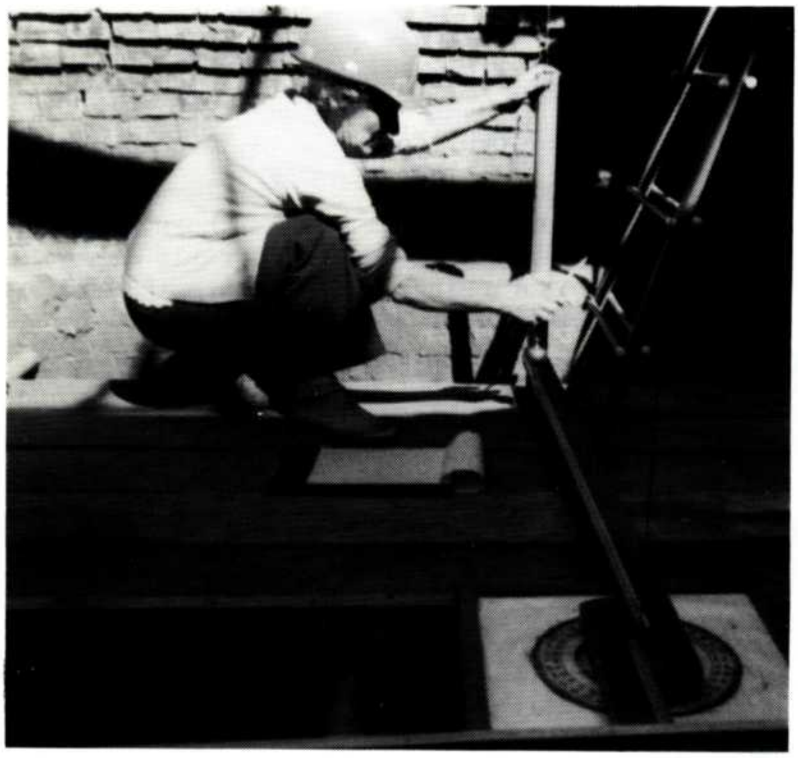


Fig.4 Recording

The trammel was set on the internal scaffold platform and locked in position with scaffold clamps. A plumb-bob was dropped from the calculated centre of the top of the cone, which was found to be 5cm off centre to the west and 12cm to the north through discrepencies in building. It was decided to use the centre of the chamber as the control point and the trammel was moved over. A wire was secured from a short scaffold tube locked over the centre at the top of the pivot of the trammel providing a control point at any height.

A standard record sheet was prepared for each course giving the following information. (This was before we had realized the significance of some of the features and additional information was added from time to time)

Course No: (Numbering started from the top downwards)
Date recorded: No. of bricks per course: (No. of rejects:-This was never used)
Bond: Height above datum:
Radius: Provision was made for reading at each 45° and the offset at each angle.
The bottom of the sheet was left for observation on other features.

Before recording commenced the vegetation had to be removed (Fig.1). The roots had penetrated so far into the brickwork that they had to carefully cut away so as not to disturb the outer ring. A hawthorn bush which was flourishing five courses from the top had its roots entirely within the joints of the brickwork which zig-zagged down to and into the chamber wall, the length of the root exceeding 7 m. By good fortune a resident of the village and a member of the Lewes Archaeological Group, Mrs. Eileen Howard, is a professional biologist and botanist and she prepared a schedule of the plants, which is now the standard practice of the Group. Although a lot of stripping had been done before Mrs. Howard was called in, the following is believed to be a complete schedule.

Shrubs.

Hawthorn	Crataegus monogyna
Elder	Sambucus nigra
Rose	Rose sp
Bramble	Rubus sp

Flowering plants

Ivy	Heder helix	) most frequent on S aspect
Red Valerian	Centranthes ruber	)
Ivy Leaved Toadflax	Cymbalaria muralis	most frequent on N aspect

Ribwort	Plantago lanceolate	common
Dandelion	Taraxacum officinale	occasional
Forgetmenot	Myosotis sp	"
Nipplewort	Lapsana communis	"
Spear thistle	Cirsium lanceolatum	"
Willowherb	Epilobium spp	"

Grasses
Including cocksfoot   Dactylis glomerata.

The bricks were then removed one by one. A trowel was all that was necessary in most cases although a bolster had to be used in extreme cases. The bricks were lowered in a plastic dustbin by jenny wheel and fall rope and stacked separately as whole usable standard bricks, usable bats, specials comprising splays, paviors etc., packing pieces and tiles and slates.

Fig.5 Top of Kiln Before Restoration

Apart from the hawthorn, bush ivy had also caused considerable damage establishing roots in large clumps around the base of the cone. Some of the weeds had penetrated the full thickness of the wall and as the vegetation was removed so the full extent of the damage was revealed. Cracking was most extensive within the lower third of the cone adjacent to corners and where the batter was at its greatest extent, the south side being the worst affected. Close to the south-east corner, cracks from 2 to 6cm wide followed the perpends up for a distance of 1.5 m and a panel about 1.5 m square had dropped forward 3cm and was likely to collapse at any time. All corners were affected to some degree, undoubtedly due to the poor bonding which could not have been avoided with the very tight radius. Daylight was visible in a number of cases.

The top course consisted of nothing but a half circle of creasing tiles and from our later experience it was reasonable to suppose that this was the original top of the cone, the tiles being there to change the batter to produce the vertical shaft. It was not until five courses had been removed that a complete circle of work could be examined. The inward cant was now definable and whilst the cone remained a near circle this remained constant, but as it widened out the cant varied, particularly on the corners. Parts of a broken strap was found at the fifth course and was preserved and recorded.

The two spy holes varied in so far as one had arch bars 2.5cm thick which necessitated the outer arch course being reduced to 4.5cm pavoirs, whilst the other had bars only half as thick and standard bricks could be used. The bars had almost completely rusted away and only the built-in ends gave any idea as to size. Whilst from normal observation the cone appeared to have been scientifically and accurately executed, our precise measuring proved this not to be so. The inner periphery of each course varied because of the difference in size - in some cases there were more bricks in one course than the one below it and to get a tightly wedged course bricks must have been eased round to produce an eye-cheating curve, a method that we found necessary when rebuilding.

Despite the cracking and displacement at the lower part of the cone, no bricks fell during removal. There was considerable suction because of the tight packing of the brick dust in this area and the greater weight of the brickwork and it was in this area that a bolster had to be used, but for the whole height the outer skin seemed only to be held in position by the roots.

The bottom four courses came below the level of the concrete flaunching capping the flint enclosing wall and here some recent repair work was exposed. Presumably with the object of sealing the exposed edge of the flint rubble, a course of clay coping tiles had been set on edge, sloping outwards at an angle of about 75° with plain creasing tiles to ease it round the corners. This left a triangular void between the tiles and the brickwork which had filled with soil and become a breeding place for weeds. Embedded in the concrete flaunching was found the remains of a kiln restraining strap. This was made of a series of lengths of forged iron straps, from $\frac{1}{2}$ m to one metre long, out of 50 x 12mm metal. Each end was cut and shaped, and bent over to form a hook to connect to a buckle made out of round steel bar. There had not been sufficient of the strapping salvaged and it had been made up with two lengths of chain fitted with elongated hooks, obviously waggon furniture. The strap is a common feature in bottle kilns where it is fitted where-ever the cone is subjected to outward thrust, but here it served no useful purpose.

At the level of the top of the spy-hole a brick had what appeared to be 1906 scratched on one of its built-in sides, which suggests that the cone could have been rebuilt during that year.

About 6000 of the original 8000 bricks were salvaged for re-use.

Reconstruction

Before reconstruction could commence, a firm policy had to be agreed upon on the options open to us. We could rebuild as originally constructed with brick dust bedding and jointing and the irregularities in levels, but as the cone had probably been rebuilt several times during its lifetime, it was not certain that it had originally been built in the way we found it. As brick rubbing is now a dead craft and modern methods do not create a dust supply of about ten tonnes would be hard to find, even if we could acquire the skill to rebuild a stable structure without the use of mortar.

Secondly we could do a reconstruction on the Italian style, accentuating the restoration with contrasting materials to differentiate between old and new and emphasising the cracks.

Thirdly we could reconstruct in the manner that we believed it was intended to be built, using as far as was practicable the original components, and this is the policy we adopted except that a weak mortar would be substituted for the brick dust. The object of the restoration was to demonstrate its construction and function and there was no intention that the kiln would ever fire again; after seventy years of neglect, and much of the structure being in contact with saturated ground, evenly drying out the kiln would be almost impossible. Furthermore, the adjoining timber bungalow was too near to make stoking possible, and it would be a fire risk.

When stripping off the vegetation and during the course of dismantling, one thing became evident and this must be emphasized; the building was a practical industrial building with no concessions to fashion or adornment and any aesthetic charm could only come from its functional craftsmanship and no attempt should be made to improve upon the original, even if we had the skill to do so.

We had two alternatives to the brick dust as mortar. One was a mixture of fine loamy sand mixed with a puddle clay. This would have given a similar result and is the method commonly used for temporary bricking up of doors during firing. It is however subject to the effects of frost and damp. It was decided that a weak mortar in the proportion of one part normal setting Portland cement, two parts of hydrated lime and eight parts of washed sand (all by volume) should be used. This decision has resulted in some critisism, and we have been accused of creating a travesty. Even if it had been practicable to reconstruct the cone in brick dust, the cone would probably have had to have been rebuilt in ten to fifteen years and professional conservation officers have agreed with my judgement in this matter. There comes a point when commonsense has to overrule impractical idealism.

All of the sound bricks were to be re-used, but in dismantling many of the bricks broke in hand, and it was found that flint pebbles up to 4cm diameter had been left in the clay through bad screening but the number that could be re-used was at that time unpredictable. Matching gault bricks were in short supply and we were being quoted six to nine months delivery period. I had the good fortune of being put into touch with Mr. Catchpole of the Milton Hall (Brickworks) Ltd., of Southend, Essex, who invited me to the works and he offered me a batch of 2350 mild stocks at a very nominal rate and we had them on site within fourteen days. The new bricks were mixed in with the old and are in no way intrusive, and as they were very much easier to cut, were used for the splays at corners and other cut work.

The removal of the cone had made it possible to inspect the walls of the firing chamber, and some cracking and opening of joints was evident. This was not of a serious nature but to decrease the possibility of failure it was decided to put in a concealed reinforced concrete restraining ring beam partly to distribute the load more evenly and also to help withstand the outward thrust of the bottom of the cone. There is no known formula for a beam of this type, taking into account the irregular plan and the ring being broken by the loading door. I had to rely on experience and with the opinion that several small-section high-tensile steel rods were better than a few heavy mild steel ones I designed the beam as shown on the detail drawing. I was able to procure some reinforcing fabric with main bars of 6mm high-tensile steel bars, which were cut into strips, with four main bars set to reinforce the outer face which would be in tension from the outward thrust. The remaining bottom bars were cut from the sheets and five sets of cages were made up to go round. The bars overlapped at the end by sixty diameters. The stirrups made up of similar material were cut and bent and wired to the rods at 60cm centres and the reinforcement was packed up clear of the brickwork with tile slip spacers.

By now a clear picture of the labour force had established itself. During the dismantling stages a total of twenty volunteers had come along to help us as and when they could, generously giving up their limited leisure, and from these a regular team had evolved who were prepared to take on any of the tasks that came along, and the reinforced concrete is a typical example. When George Rowell retired, he had no idea about building crafts, but he took on the job of bending and fixing the reinforcement. A cutting and bending bench was rigged up from two scaffold boards on a pair of trestles, with 15cm nails knocked in in the required positions. A length of iron tubing was slipped over the reinforcement which was bent to the required shape and a most creditable set of steel cages was produced.

Three courses of bricks were set as permanent shuttering in stretcher bond to the beam to a reverse cant to provide the profile of the barrel shape of the bottom of the cone and was filled in behind with concrete to a mix of five parts of 18mm graded shingle to one part of normal setting Portland cement. A course of headers was set on the concrete and similar concrete was filled in behind this to act as a rebated stop. This made a solid rebated beam to act as a restrainer against thrust from the cone which then proceeded to rise as before described.

Two difficulties had to be overcome. For a reason that we had not at that time realized, the courses at the east side tended to fall away. This was because we were using the same angle of cant all round, whereas the corners being measured across the diagonals were wider than at the 90° radiants, and the cant should have been correspondingly flatter. This was overcome by gradually adjusting the levels course by course with tile slips until the error was rectified, the same procedure that had been used by the original builders. The other problem was that by using mortar instead of brick dust our joints were about 6mm thicker which slightly increased the width of our oversail. This would have meant that in our total height of 68 courses we would have reduced our top opening by 25cm. The oversail had therefore to be slightly reduced.

From the experience gained on our first few days of bricklaying we found that it was best to set up the inner course from the record sheets dry, eye in the work from the top scaffold and then bed and wedge the bricks in mortar. The same eye-cheating method was adopted on the outer ring and the perpends and other voids then packed out with tile or slate and flushed up with mortar. The most efficient team worked out to be six, the general arrangement being that I would set up the corners or other salient points whilst two of the ladies distributed the bricks around the scaffold, whilst two of the men would be knocking up the mortar and the other lady would be flushing up the previous course, after which everyone went laying. It was a very fine example of teamwork. As each volunteer finished his or her task they would drop back on to brick humping or knocking up mortar and at no time did we run out of material, nor, once the routine was set, did I have to give an instruction.

Fig. 6 Checking Levels

To form the arch a timber centre was made up from surplus shelving, the cross lagging being short slats. Using the standard formular for a three-centre depressed arch, the old and new arches did not vary more than 1cm from each other. As the centre was set on a tubular scaffoldframe no wedging was necessary. Selecting the bricks from the old arch, one member, laying bricks for the first time made a very exact copy of the original. In all other respects the work was copied from the original, using our copious records, the only real difficulty being in reducing from two to one-and-a-half brick thickness above and to both sides of the arch, where optical judgement had to be relied upon. The gathering-in and flairing of the cone was achieved with full rings of tile wedging and in extreme case using paving bricks on the outer ring. The two spy holes were made identical with each other, with four 38 x 9cm iron arch bars supporting the inner ring. To obviate the cantilevered bricks with a perpend at mid-span a welsh arch was cut to span the opening, with paving bricks internally over a slate lintel. Above the spy hole the work proceeded with a very slight sweep in the profile which it was able to control by the oversailing, and the cant was not adjusted until the last few courses to bring the top course level. At the time of our maximum oversail it was noticed that we were gathering in too rapidly and this was found to be because of the greater thickness of the mortar bed joints as against brick dust, we were gaining 6mm per course. We had the option of steepening our batter and thus increasing our height or reducing the number of courses and retaining the original profile and we decided that the latter choice was the more acceptable.

On reaching the top of the cone we had to decide how we should finish it off. The top course of tiles that was exposed when stripping had suggested the brickwork above it would have been vertical. Mr. John Manwaring Baines' "Sussex Pottery"(7), gave an excellent description with a number of photographs of the East Grinstead pottery kiln which had been demolished in 1970, which seemed to follow the pattern of similar kilns, and it was decided to copy this. It had been enclosed within the building, the cone protruding through the roof and the external brickwork had been rendered. Our shaft was built completely of new bricks as they were easier to shape. It was built one brick thick, with alternate headers and a pair of splayed bats to maintain the profile. It was finished at the top with an oversailing course and a brick on edge capping. A cement and sand bed with an outward fall was rendered on top of the capping and the oversailing course and the ledge where the brickwork reduced at the top of the cone were covered with an outward weathering fillet.

One almost continuous operation was the pointing. This was done as the work proceeded with the same mortar as the brickwork. It was struck flush and no attempt was made to tidy it up or beautify it. The perpends varied in width as the bricks varied in size. As there was an inward fall on the bricks, a channel was left which would have held the water and this was filled with mortar and an outward falling fillet, splayed off at the top at 15°, was formed to drain the water away.

To maintain authenticity it was decided that the two iron straps should be retained. The top band, which had been fixed to counteract the outward thrust of the cone against the weight of the shaft had almost completely rusted away. This was replaced by a new mild steel strap 25 x 6mm made in two sections with forged flanges bolted together. Of the bottom restraining strap, previously described, about half of the original sections and buckles were salvaged and reforged to the kiln profile, and new sections made up by the local blacksmith. Although this form of strap is common on the Staffordshire bottle kilns, I could obtain no information of how these were connected and tensioned, and decided upon a pair of forged flanges with a long screw bolt over the entrance. The strap was fitted at the base of the cone where the brickwork turns inward into a reverse curve. The metalwork was given two coats of cold galvanising primer, two undercoats and two finishing coats of paint before fixing, and one coat of finishing paint on exposed areas after fixing.

The only other work required was the replacement of some of the defective bricks in the firing chamber, cutting out and making good settlement cracks in the chamber and filling in open joints externally. The concrete flaunching over the flint rubble retaining wall was also made good against the base of the cone.

Except for the purpose-made recording equipment, all tools were standard bricklayer's tools, although gauging trowels were preferred to full-size bricklayer's trowels.

Evidence of Other Buildings. Operation and Products.

Little information is available about other structures in the complex, nor on the products produced here, beyond that collected by Mr. Osborne, and local sources are both dubious and contradictory. The tithe map of 1843 gives the outline of the various buildings and one is indicated as residential. This is probably the living accommodation offered by Edward Baker in 1813 and is still occupied. The 1:2500 Ordnance Survey map of 1873 shows the complex more clearly, with little change from the tithe map. The surviving kiln, together with the one shown on the site of the modern Kiln Cottage are the only recognizable kilns shown, but other buildings could well be open top kilns. There were said to have been upwards of five kilns in the complex including two whiting kilns, but these cannot be recognized. Some of the outlines are almost certainly hacking sheds and three circles could denote pug mills; one of these is on the site of where the horse gin is said to have been located. An elderly visitor said that his father had told him that as a boy he used to sit on the edge of the quarry throwing stones at the horse to make him go round faster, probably the most reliable evidence that we have.

I have been given dates from 1805 onwards for the construction of the kiln, but at that time the first Edward Baker is described as a bricklayer. There is no evidence of any previous brickmaking here and whilst it was not unusual at this time for bricklayers to make their own bricks, they would almost certainly have been made in clamps or open top kilns. The surviving kiln was almost certainly built for burning tiles and course pottery and although bricks, tiles and coarse pottery were sometimes burnt together in the same kiln, a maximum capacity of 12 000 bricks, having regard to the difficulty of stacking and unloading in this type of kiln, would not have made its use for this purpose economical. When firing tiles, they would have been stacked to near the top of the firing chamber and the "fittings", ridge, valley and hip tiles, finials and the like, would have filled the void in the bottom of the cone up to the spy holes.

A brick wall pierced with arches still exists which appears to be part of a structure connecting the two kilns and could have been a fuel store, with a moulding shed at the upper level.

A resistivity survey carried out by the Lewes Archaeological Group to the upper lawn to try to identify post-1873 buildings was hampered by a large area of paving. Using a Martin-Clarke meter on an one by a half metre grid, there was considerable variation in the resistence readings, suggesting that the remains of a structure existed, but because of the disturbance of the ground this can only be considered as speculative without the evidence of excavation.

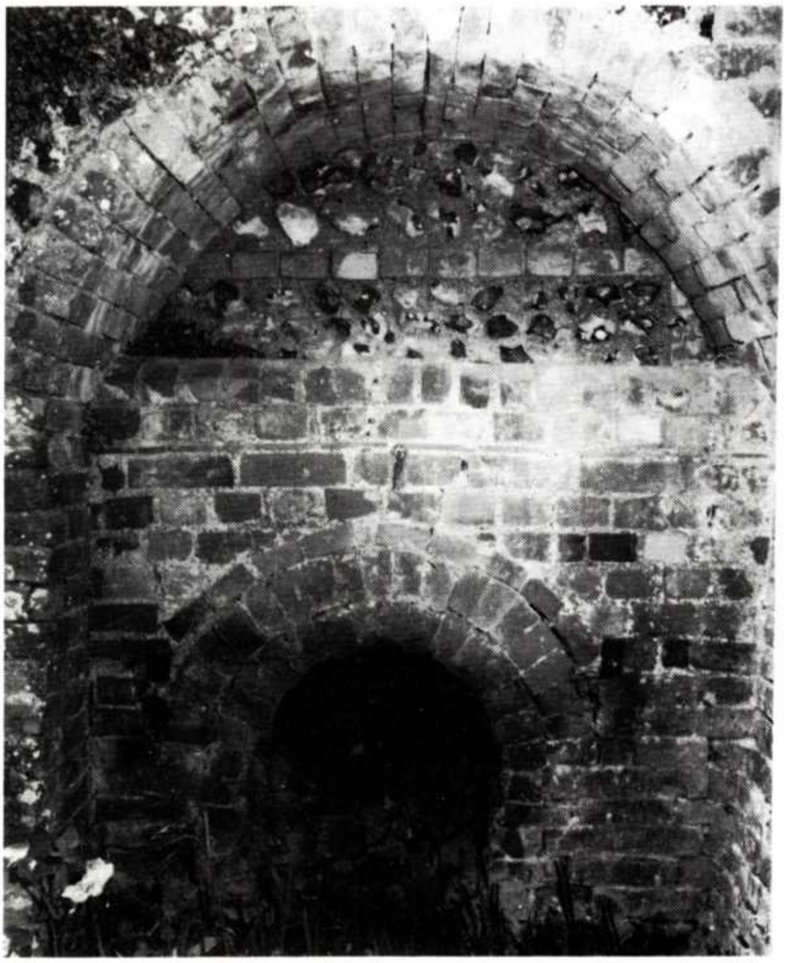


Fig. 7 Stoke Holes

The design of the stoke holes suggests that coal was used for firing, although bavins might have been used for the initial warming up. Being so near to Newhaven, coal would have been readily available. Firing would have been between 950 and 1100 degrees centigrade on a twelve to fourteen day cycle.

Evidence of the products chiefly comes from the kiln itself. The use of reject bricks, tiles and damaged coping stones suggest that these came from the residual of the products and similar items have come from a dump in the nearby old vicarage garden. A socketted drain pipe of yellow gault clay, now in the Newhaven Maritime Museum is said to have come from the last firing, although there is no evidence to support this. Turned pedestals or balusters of red clay have been used to support the porch roofs of 1 and 2, Church Cottages and broken ridge finials have been used in wall cappings.

Initially clay seems to have been dug from the river bank which would have been suitable for the "white" bricks, which would have been augmented by chalk from the adjacent quarry. Edward Baker also exploited the field at the west end of the village, which would have been suitable for tiles and red pottery.

It is claimed locally that bricks were taken by barge up the River Ouse for the building of the Balcombe viaduct made from the clay from the large pit east of the village, subsequently used for the clay for cement making at Southerham, but the Ordnance Survey map of 1873 still shows this as virgin ground, eighteen years after the viaduct was in use.

Fig. 8 Completed Project

Counting the Cost: Acknowledgements.

As the work progressed problems involving additional work which could not have been anticipated at the budget stage became apparent and it was obvious that we were going to exceed the original budget of £1300. This had been prepared in January, 1980 and six months had elapsed before we were able to commence work, during which time there had been massive increases in the cost of materials. It also brought a great deal of out work into the winter months of inclement weather and shorter working days. Working only two days a week, one lost day meant the equivalent of half a week of additional scaffold hire. The reinforced concrete retaining beam added two weeks to our working time and the materials for it were more expensive than the salvaged bricks. The iron straps cost very much more than I expected, based on my experience of recent similar work and was my most serious financial worry.

On the credit side I must gratefully acknowledge the very generous support that I received. Apart from their original commitment, Lewes District Council and East Sussex County Council both increased their grant by a further £160 and the Civic Trust by £100. Mr John Wilkinson donated another £50 and from my appeal to local business houses the Rugby Portland Cement Co., Ltd., gave £120 and Harvey & Son (Lewes) Ltd., our local brewers, gave £50. A casual visitor to the kiln gave a donation of £1, a kindly thought. Through this help we were

able to cover the cost of the project with the exception of publication which is being borne by the Sussex Industrial Archaeology Society.

Income and Expenditure Account

	£	p
Income		
Lewes District Council	485	00
East Sussex County Council	485	00
The Civic Trust	425	00
Mrs. P. Wilkinson) Mr. J. Wilkinson) Joint Owners	375	00
Rugby Portland Cement Co.Ltd.	120	00
Harvey & Son (Lewes) Ltd.	50	00
Anonymous	1	00
	£1941	00

	£	p
Expenditure		
Postage	12	16
Stationery, photo-copying, etc.	15	89
Scaffold hire	1177	88
Bricks, including cartage	156	81
Cement, lime and sand	232	90
Steel and paint	26	30
Blacksmith	239	20
Materials for trammel & clinometers	36	90
Equipment and consumable stores	39	27
	1937	31
Surplus to publishing account	3	69
	£1941	00

Nor must the other concessions be overlooked. Brighton Scaffolding Ltd., held their prices stable despite the delayed start and also made a deduction of £120 on their legitimate charges and the reduction of the price of the bricks from the Milton Hall (Brickworks) Ltd., showed us a saving of nearly £200. The steel reinforcement was given us by Walter Llewellyn & Sons Ltd., of Eastbourne.

All of the non-mechanical plant, that is barrows, hand tools, additional scaffolding and safety equipment was loaned by the Lewes Archaeological Group or its members, the concrete mixer was loaned by Mr. Colin Rose when it was available, and Mr. John Upton loaned us a brick-cutting machine for making our splayed bricks for the chimney shaft.

I am indebted to Mr. Brian Dawson, whose initiative at the start of the project made the work possible, and to Mr. Hutchins, Conservation Officer and Mr. Andrew Woodcock, Archaeological Advisor for their encouragement and support.

It is, however, to the volunteers that the greatest praise is due. Altogether some twenty of them took part, not one of whom had ever dreamed of tackling such a task. They gave up something like two-and-a-half thousand hours of their valuable time, cheerfully and whatever the weather, travelling over six-and-a-half thousand miles at their own expense. Mr. John Haselfoot alone motored to and from Hastings 53 times, a total of three thousand miles. Over eighty percent of the work was done by members of the Lewes Archaeological Group, but Mr. Haselfoot was my greatest pillar of strength; he, at a spritely 75, acted as my deputy director and apart from his efficiency, his great warmth won him many friends. When I spent the final few weeks in hospital, he kept things going without a hitch and it is probably the only occasion that the ward in our local hospital has been converted into a site office, whilst we struggled with brick templates for topping out.

George Rowall, a retired legal advisor added bar cutting and bending to his other newly-acquired skills. Mrs. Eileen Howard our botanist became our regular pointer, and Alan Howard, Colin Rose and Ron and Ivan Lloyd made very useful contributions whenever they had an opportunity.

The very fine photographic record was contributed by John Upton, a member of the Royal Photographic Society.

But the accolade must go to Mrs. Pat Garcia and Mrs. Mary Simon. They were with us throughout the whole of the programme including the final survey and drawing sessions. Pat is a retired school-teacher and so tiny that she was put on all of the awkward jobs such as clearing out the flues, where she had to wriggle through 3 m of vaulting 54cm radius and the same height to remove 1½ tonnes of rubble with the aid of a hand shovel and washing up bowl. Despite assisting her architect husband, teaching art to deaf children and running a home, Mary was one of our most ardent supporters and a star bricklayer. If there was to be a dedication to this paper it would surely be "TO PAT AND MARY, FOR THEIR FAITH".

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See also the references to Mr. Osborne's paper (No. 1 above).

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To comply with the conditions of the grants, the kiln is open for inspection at reasonable times and by prior appointment. Those wishing to visit should apply to Mr. John Wilkinson, Kiln Cottage, Piddinghoe, Newhaven, East Sussex. Telephone: Newhaven 4148.

THE BAKERS - BRICKMAKERS OF PIDDINGHOE

By B. E. Osborne

The recent restoration of the conical up-draught brick kiln in the village of Piddinghoe has prompted further research into the Baker family. This report follows an earlier document prepared by the author and published by the Sussex Industrial Archaeology Society (1).

The Baker family were long established in Piddinghoe before evidence of brick-making becomes apparent. Parish registers show Bakers in profusion throughout the 17th, 18th and 19th centuries in the village (2). On 11th May 1616 the burial of Robert Baker is one of the earliest entries in the registers.

Brick-making however is not mentioned in the registers until the early 19th century. On the 13th February 1814 is recorded a baptism of Mary Ann, the daughter of Edward Baker a bricklayer. By 1817 Edward is recorded as a brick-maker on the 12th January, when a daughter Sarah was baptised. In 1813 Edward Baker was advertising for brick-makers to come and work at Piddinghoe where he was in a position to offer accommodation as well as employment (3). It seems likely that serious brick-making in Piddinghoe commenced about this time. There was to follow a period of brick-making and allied activities stretching over 100 years and three generations of Edward Bakers.

The genealogical background of the first Edward Baker is still to be determined. He was born in or about the year 1773 as can be ascertained from his grave which is in Piddinghoe churchyard. One can speculate that he was probably the son of a Mr. Baker who rented the Manor of Piddinghoe for £21 p.a. from 1783-1794 (4). This Mr. Baker may be the John Baker referred to in the parish registers between 1790-1802 when several children were baptised. Further research is being conducted to verify this hypothesis.

By 1811 it is known that Edward Baker was well established in Piddinghoe when he was listed as an overseer of the poor (5). From 1814 to 1827 he is also listed as a churchwarden.

A significant event for Edward Baker about this time was his marriage on 12th April 1812 to Winifred Banks of Southover. She was born in Framfield in 1780 and was not Edward's first wife. In the registers he is described as a widower (6).

Between the years 1814-1822, Edward Baker 1. and Winifred had four children: Mary Ann 1814, Sarah 1817, Edward 2. 1819 and Stephen 1822. All were baptised at Piddinghoe.

By the 1820's local directories were describing Edward Baker 1. as a brick-maker and potter with the first reference to a brickyard appearing in the Land Tax returns of 1817 (3). In the 1819 baptism entry in the parish register, Edward 1. is described as a builder, this indicating that the activities of this local industry were already diverse. Piggot's directory of 1839 describes Edward Baker 1. as a brick-maker and brown potter and scrutiny of the 1843 Tithe Maps shows clearly the premises involved in the brick-making which by now was flourishing.

Edward Baker 1. is listed as owner and occupier of a brickworks, shed, meadow, garden and shaw chalk pit bank at the northern end of the village. In addition he is renting from the Earl of Chichester a shed and ground on the river bank near the church. The positioning of the premises adjacent to the river no doubt facilitated water-borne transport both from the clay pits to the south of the village and for bricks which were despatched both upstream to Lewes and downstream to Newhaven.

Although brick-making was the principal activity of the Baker family it was not their only commercial venture. By 1841 Edward 1. is classified as a publican living in Rodmell with his family (7). Edward 2. the son and now 22 years old was obviously taking an interest in the business and is described as a potter in 1841.

About this time another Baker appears on the scene. William Baker, an enumerator in the 1841 census died in 1851. His wife Elizabeth is listed in the census of that year as the widow of William, brick-maker. William and Elizabeth had two children in Piddinghoe, Sarah Ann 1831 and William 2. 1836 and at that time William is identified as a shopkeeper. His precise relationship to Edward Baker is still to be ascertained, however it is known that following William's death in 1851, the son William 2. was living at the Abergavenny Arms at Rodmell with Stephen Baker, son of Edward 1. It is reasonable to assume that they were closely related.

Stephen, the younger son of Edward 1. was married to Jane, sister of Ann Kiljoy of Framfield. They had a son Stephen in 1842 and appear to have taken over the family interest in the Abergavenny Arms (now The Holly) at Rodmell.

It is interesting to note that in 1835, Mary Ann the sister of Stephen Baker and Edward 2. married John Corner of South Heighton. In the 1851 census (6) Ann Corner, also of South Heighton, is listed as living in the village. She is identified as mother of Elizabeth Baker who was of course in turn the widow of William Baker previously brick-maker.

The implications of this link are open to speculation. Tragedy was to befall this line of Bakers unfortunately with the death of the only son William in 1853 at the age of 16. Monumental inscriptions to both William senior and junior can be seen in Piddinghoe churchyard. They are adjacent to those of Edward Baker 1. and Winifred, the latter dying in 1858. Also in the churchyard is the monumental inscription of Elizabeth, wife of William senior - she dying in 1871.

Edward 2. assumed full responsibility for the brick-making activities following his father's death in 1845. In June 1851 the Sussex Agricultural Express advertised the business for sale. It was described as "a very desirable brickyard with a small cottage and a most valuable brook containing about $1\frac{1}{2}$ acres and affording an excellent supply of earth for making white bricks". Three kilns, sheds etc. are also mentioned. Edward 2. did not in fact succeed in disposing of the business but instead diversified into whiting and burnt lime. The site is unusual in Sussex in having a supply of white firing clay and a supply of chalk. Kelly's directory of Sussex for 1857 describes Edward Baker 2. as a white and red brick, tile, drain-pipe and whiting manufacturer and coal merchant. This indicates the extent of his diversification doubtless as the competition brought about by improved transport placed pressures on his business.

1845 the same year that Edward Baker 1. senior died also saw Edward 2. the son marrying Mary Ann Souter Osborn. She was the daughter of William Osborn, a yeoman farmer from nearby Telscombe (1). The author is a direct descendant of this William Osborn. Edward 2. amd Mary Ann were married on 11th June 1845 in Telscombe church and subsequently had five children, Winifred 1847, Elizabeth 1848, Sarah Jane 1850, Mary Ann 1858 and a son, the third generation of Edward Bakers, Edward 3. was born in 1854.

By 1861 Edward 2. was employing 6 men and by this time the workings south of the village were equipped with a tramway to assist the extraction of clay.

The fact that Piddinghoe was the centre for the manufacture of chalk whiting provided an opportunity to create a joke about Piddinghoe folk. They were reputed to "hang fields out to dry" this being a reference to the spreading of chalk to drain on sloping shelves (9). Such accusations of stupidity were typical rural wit and appear to have been particularly directed at Piddinghoe folk.

Another Baker appears on the scene in the second half of the nineteenth century. This is Robert Baker a partner in the firm of wheelwrights at Rodmell, Jefferey and Baker (10). The genealogical relationship between Robert and Edward 2. has still to be ascertained but it is unlikely that they were closely related. The ledgers for the wheelwrights for the years 1878 - 1882 still survive and scrutinity of Edward Baker's account for the brickworks reveals many interesting items. Goods supplied include tile moulds, loading cart, brickboard, body for whiting cart, etc. Amusing entries include £2.12.0. for a new mahogany W.C. seat and riser in 1881 and a sad entry in 1878 for a full trimmed coffin for deceased Ann Baker aged 60 years. This was for Mary Ann Souter Osborn, Edward Baker 2's wife who died in May of that year.

Stephen baker also had an account with the wheelwrights for the Marquis of Abergavenny public house. This was situated immediately opposite the wheelwrights in Rodmell and entries include a whole range of building and decorating items, nails, paint, barge boards, cement, etc.

Throughout the 1880's directories for Piddinghoe continue to list the business of Edward Baker 2. as brick and whiting manufacturer. In 1888 Edward

Baker 3. the third generation had a son by his wife Lucy. Walter George was baptised in Piddinghoe on March 21st but this son was not destined to have a long active involvement with the business. After the turn of the century the brick manufacturing was dropped from the directory listings. By 1913 no reference to the Baker business was given in local directories following the last firing of the kiln in 1912.

A Mrs. Baker was headmistress of Piddinghoe village school about 1905 and a picture exists of the school assembled at this time. With the closing of the business the Bakers finally left Piddinghoe in 1915, although the Baker's house still stands mainly unaltered at right angles and adjacent to the road to the north of the village.

Visiting Piddinghoe today there are many traces of this former industry still visible. One of the specialities of the kiln was decorative pillars for a variety of uses on buildings and various items can still be found in gardens in the village. The wharf adjacent to the brickworks can be identified and a watercolour exists of the brickworks site done in the early 20th century. The chalk cliff can still be seen opposite the brickworks and the clay pit is now a boat marina. The most outstanding reminder of the Bakers is without doubt the sole remaining kiln recently restored by Ted O'Shea and a team from the Sussex Industrial Archaeology Society, a fitting memorial to 100 years of brick-making in Piddinghoe.

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In addition I am grateful to the following:-

Mrs. M. Beswick, Frank Dean, Mrs. Woolgar, K. C. Leslie, all who have assisted in the preparation of this document.

The author is continuing research on the Bakers of Piddinghoe and the Osbornes - Sussex farmers, and would be grateful for details of any further material that may come to light.

LITTLEHAMPTON SWING BRIDGE

By A. G. Allnutt

The demolition in 1980 of this dominating feature of Littlehampton Harbour calls for a record in SIH

John Farrant (1) describes proposals for an earlier bridge 1821-22 and the covers of SIH 2, 1971 bear a drawing of the proposed design.

H.F.J. Thompson (2) gives the history of the bridge project from that time up to the construction in 1973 of the prestressed concrete bridge up stream of the harbour built to relieve the swing bridge of vehicular traffic. In passing he quotes a Littlehampton Gazette report in 1905 stating that there were 175 licensed cars and 234 motor-cycles in West Sussex compared with 60 cars and 47 motor-cycles a year earlier. The personalities involved and the parliamentary proceedure are dealt with in detail.

Thompson (2) also deals with the history of the ferries across the harbour. A rowing boat plied between Littlehampton and Clymping from the middle of the 16th century or earlier (3) until after the failure of the first bridge scheme (Horses had to swim tied to the boat). This was replaced by a hand-operated timber pontoon chain ferry with machinery by Joseph Bramah, the site having been near the bridge position; a coach and four could easily be carried.

By the 1870's the pontoon was becoming waterlogged and was therefore replaced by a steel pontoon, also hand operated, in 1873. During the 19th century the ferry contributed significantly to the increasing prosperity of Littlehampton by opening up the west bank of the river for shipbuilding. The need for a bridge thus became more pressing.

Fig. 1 East (Movable) Span of Bridge

After the Bill was passed little time was lost. J.J.Webster, MICE. was appointed as Consulting Engineer and Duke and Ockenden of Littlehampton were employed to put down test bores in the river bed. By July 1906 the Council were able to accept a tender from Alfred Thorne & Sons of Westminster for construction of the bridge; the final cost being about £26 000 (2).

By August 1907 work had proceeded far enough for the Duke of Norfolk to lay the foundation stone in the E.Abutment, and in May 1908 as Lord Lieutenant of Sussex he performed the official opening by unveiling a bronze plaque giving the names of all concerned, except the designer. It has subsequently disappeared. These events are also described in detail by Thompson (2).

The bridge had two spans, both open lattice N girders; the eastmost was a balanced cantilever swing span and the west span was fixed. Thus the navigable channel in the centre of the river was to the west of the main pier supporting

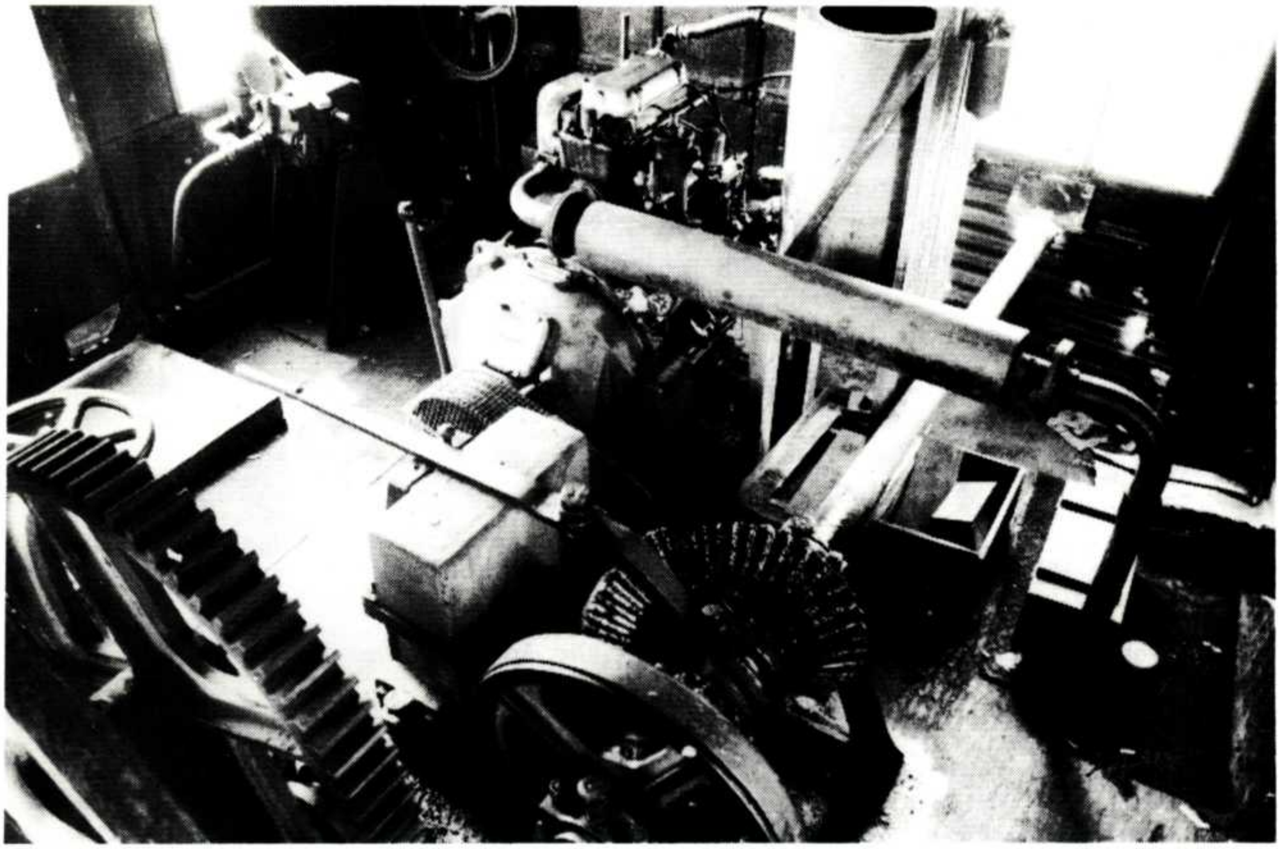

Fig.2 Drive. Through clutch, V-belt and worm drive to the bevel wheels that control the direction of rotation. At the top of the picture is the hand wheel that operated the mechanism for locking the mechanism in the closed position. At the bottom left is the gear train for manual operation with the band brake alongside.

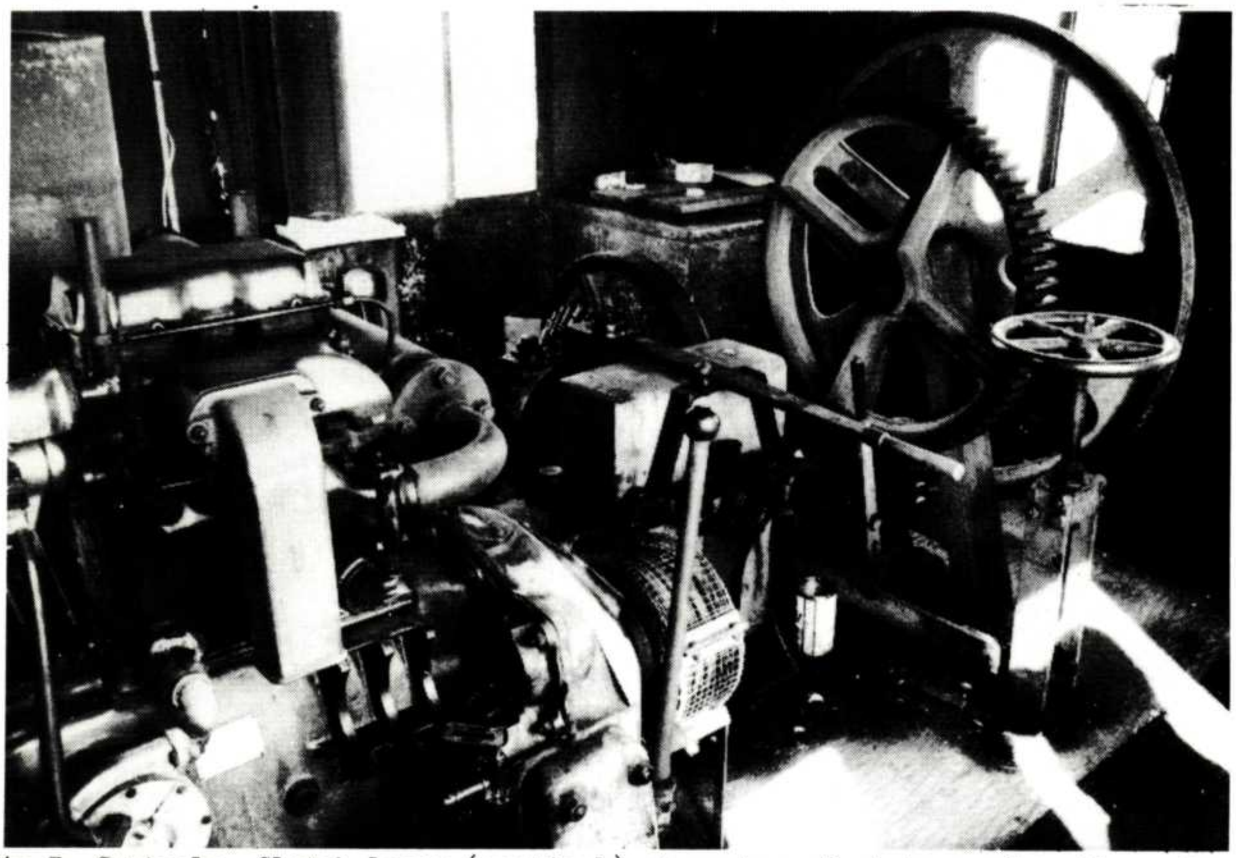

Fig.3 Controls. Clutch lever (vertical) at centre of picture; direction of swing lever (horizontal); lever for engagement of hand mechanism behind. Large wheel in background for emergency manual operation.

the swing span. The structural steelwork design was on orthodox lines (using rivetted rolled mild steel sections) at a time when little attention was given to avoidance of corrosion by eliminating corners and recesses where damp would remain. The result was that in the salt atmosphere of Littlehampton corrosion could not be kept in check and the bridge gradually deteriorated.

In 1953 Littlehampton UDC handed over responsibility for the structure to West Sussex County Council and it was freed from tolls.

An interesting feature of the bridge was the all mechanical drive using an IC engine. This demanded judgement from the operator as to when to disengage the power and apply the brakes to bring the swing span to rest which would have been affected by wind conditions. Other forms of power or drive could have avoided this need for skill. The time taken to open or close the bridge was one-and-a-half minutes.

The old wooden hut with tiled roof on the town (east) side of the bridge used for collecting tolls has been put on show at the Chalk Pits Museum, Amberley, with a display of relics and photographs of the bridge inside it. Also now at Amberley is the 20 hp Gardner diesel engine that powered the bridge from the 30's. It will be used in the future.

Technical information is set out in the Appendix, and see ref. (4)

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Acknowledgements

I am indebted to the County Surveyor of West Sussex for information and drawings which will in due course be deposited at the Chalk Pits Museum.

Appendix

Dimensions

Main Swing Span:	198ft long overall 23ft deep at centre 16ft wide with 9ft roadway and footway on either side.
Fixed Span:	104ft long 13ft deep 25ft wide 18ft road width with two footways.

Foundations

Main piers under centre of swing span, 4 N^{o} cast iron cylinders 8' diameter sunk to rock at -36ft OD and filled with concrete.

River pier of fixed span, two groups of 4 N^{o} cast iron screw piles 14 ins. diameter with 48" diameter wings screwed down to -40 OD.

Navigable Channel

Width 72ft clearance at HWOST when bridge closed 7ft. Tidal range 13ft spring tides. Depth of water at LWOST approx. 8ft.

Deck

Road made of corrugated steel flooring plates with wood blocks set in concrete. Side walks of timber planking.

Opening Mechanism

Direct mechanical drive from Gardner petrol engine (replaced in 1930's by 20 hp Gardner diesel) through dog clutches gearing and shafting to pinion engaged with 17ft diameter gear rack on centre pier. The swing span revolved on 24 N^{O} 14" diameter rollers running between 16ft diameter upper and lower roller paths. Provision was made for manual operation in the event of engine failure. Road safety gates were interlocked with the controls.

The ends of the swing span rested on adjustable wedge blocks actuated from the engine house, being locked when the bridge was in position for road traffic.

Gates were provided across the road at each end of the bridge interlocked with the swing mechanism. The whole of the wedge locking and gate gear was operated by the engine room attendant.

RECOLLECTIONS OF HILLMAN'S BRICKYARD. PARTRIDGE GREEN.

By H. J. Paris

This article was compiled by J.F.S. Blackwell from a tape recording of an interview with Mr. Paris made by Messrs. Blackwell and R.G. Martin.

My father became manager of Hillman's brickyard next to Partridge Green railway station in the early 1900's, I was born there in 1906, having, moved from Catford in London. Father was manager there for nearly 30 years and the brickworks closed in the 1930's, a couple of years later he retired.

Brickmaking was only carried out in the summer, clay being dug in the winter, there would have been about ten workers in the summer and six in the winter. The hours and conditions of these workers were vastly different from today starting at daylight in the summer, when the bricks were being made and 'knocking off' about 5.30 pm. They were all local people and probably earned not more than £1 per week although a brick moulder may have worked on payment for the number of bricks he turned out.

The clay for the bricks was dug by hand from the sides of nearby ponds which were extended each year and filled with water during the later part of the winter. The clay was dug at a low level, put into a wheelbarrow and wheeled up a long plank arrangement with a steel plate in the middle so that the traction of the wheel was easier. Mid-way there was a platform where they'd stop, and the chap who was bringing the empty barrow down would then take the full one up to a clamp of clay several feet high; I don't know whether they called it a clamp.

There was a short railway siding into the yard from the Steyning-Horsham line on which 10-12 ton railway trucks brought household refuse from London, in which, in those days would be a lot of clinker and ash from coal fires. This was sifted three times by throwing against a long screen on a slant, supported at the back, into a coarse grade used in the bottom flues under the clamp, a fine grade on top in the clamp, and a very fine grade used in the bricks themselves.

This very fine grade was put in a layer on the clamp of clay, then the whole was wetted down and well mixed together by hand using a 'hummocher', I think it was called, which is a long hoe about 18" long and 3" wide. The mixed clay was then tipped into a large pan mixer inside which were a number of blades and two large heavy rollers to crush the lumps out. The clay, then ready for making bricks was churned out by a large coarse-threaded screw.

The brick moulders' benches surrounded the mixer and were placed as close as possible leaving only sufficient room to operate long slatted barrows known as hack barrows. The brick moulder took the clay from the mixer put it on his bench and cut a piece off using a crescent shaped tool a little bigger than a brick and rolled it in a layer of sand sprinkled on the bench. The frog, which was fixed to the bench, and the mould, were also dusted with sand and the clay slapped into the mould and smoothed off with a piece of wood. A pallet, a piece of wood the size of the brick about 3/8" thick was placed on the top of the brick, the mould was removed, and another pallet placed against the bottom (frog) side and slid down the hack barrow. These pallets were only used for handling the bricks which were very soft. A full hack barrow used to hold about 60 bricks in two rows and was wheeled down to the drying area. There the soft bricks were laid in rows on edge, using the pallets, with a gap all round for circulation of air, the second layer was then stacked over the 'joints' of the first.

Wooden hack caps were put on top of the rows of bricks and 'loos'(horizontal boards with an upright link and a space of about 3" between each horizontal) placed against the sides, leaning outwards so that any rain did not touch the bricks. The bricks dried naturally and when sufficiently dry to handle were re-stacked in zig-zag rows. With drying complete the bricks were put on to another barrow with a board at the back, and I believe that took about 60 bricks, ready for making the clamp. On occasions we had to get up in the middle of the night when a row of bricks was ready to go into the clamp because if it rained hard it would wash the arisses off. The site was on a slope where possible from the moulders' benches to the hacks and then to the clamp, so that they always went downhill with a loaded barrow.

The sides of the clamp were laid out with overburnt bricks from a previous firing and then flues were formed right through the length with bricks on edge, again using burnt bricks. These flues were filled with the coarse sifted ash and a layer of finer ash spread on top before stacking the new bricks. The whole was then cased in, again with overburnt bricks. There were between fifty and one hundred thousand bricks in a clamp, I don't think father went over one hundred thousand. The clamp would be alight three weeks or a month. There was only ever one clamp alight at a time and during the summer four or five clamps were burnt thus producing about half a million bricks a year. The clamps were built near the railway siding so that the finished bricks were handy for loading on to the railway trucks or carts.

The bricks were hand made multi colour Sussex facing stocks all selected for first quality, any below standard were sold as seconds and used for interior work to be plastered. A lot of the bricks used to go to London but as Mr. Hillman built houses in Abinger Road, Portslade, near Brighton it's possible he used his bricks there.

BRICKYARDS IN PARTRIDGE GREEN.

Kenshall's Yard

Entrance from South Street through Kensett's secondary yard. Only red facing bricks, also squint and purpose made bricks. Flower pots, mainly large ones, bread and other crocks, ornamental caps to brick piers, capping bricks for walls, ornamental chimney pots and finials to gable ends of roofs etc., all kiln fired.

Hillman's Yard

Entrance by lower cul-de-sac road to railway station, railway siding to clamp site. Bricks were sent by rail or collected by horse and carts, later lorries.

Bricks were hand made multi colour Sussex stocks, mainly facings selected for first quality. (Second quality sold for interior work only).

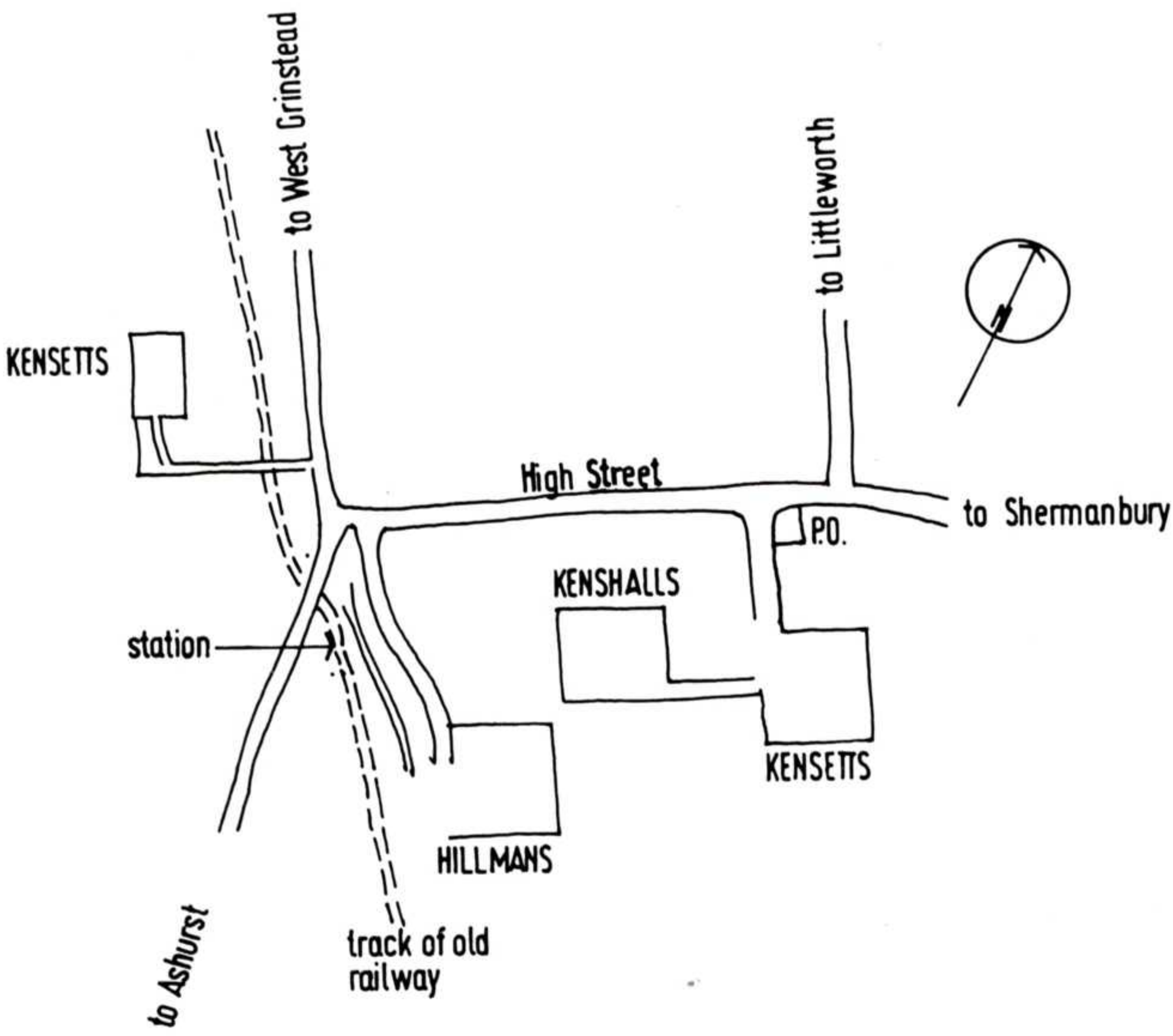
Kensett's Yard

Entrance from main Partridge Green road to West Grinstead near Station Hotel, over a level crossing.

Bricks were facings and seconds clamp burnt.

All the above sites have now been built over.

BRICKYARDS IN PARTRIDGE GREEN



TRAMS IN HASTINGS 1905 - 1928

By K. S. Donaldson

The conversion of the Hastings Tramways Co., to trolleybus operation was outlined in Sussex Industrial History No. 11.

The modernisation had taken place over the year 1928/1929 under the auspices of W. Vincent Edwards AMIEE., General Manager and Engineer of the Company. G.L. Gunday writing in Tramway Review about ten years ago states that the Company was quite prosperous, charging higher fares than many municipal tramways and citing the 6% dividend paid in 1917 from a profit of £12 992. Nicholas Owen in "The History of the British Trolleybus" also about ten years ago states that it was clearly a penny pinching system and that the general manager was known as a martinet with an unforgiving nature! Whichever view is correct, and in more than fifty years of operations there is ample scope for both prosperity and penny pinching, the Company was no stranger to controversy. The change from trams to trolleybuses had been preceded by intense public argument, followed by similar debate, and a 'save our trolleybus' campaign, thirty years later on the introduction of motor buses. The birth of the Company in 1897 had been heralded in like manner with a poster worded as follows:-

Ratepayers! Beware!

"Will you allow Hastings and St. Leonards to be disfigured by trams? Never were you threatened by a more insidious foe. Picture to yourselves St. Helens Road disfigured by trams. Think of four lines of trams running over an exchange line in front of the Public Hall. Imagine your beautiful sea front invaded by trams. Picture the danger of overhead wires during our annual gales, and all the miseries of a tram-infested Borough.... those who are opposed to Mr. Murphy's scheme should attend and state their objections at the inquiry to be held before the Light Railway Commissioners at the Town Hall, on Tuesday next June 7th at 9.30 a.m. (here there follows a sketch plan of the proposed tramway). The lines run from the Albert Memorial to Bexhill, right along our beautiful frontline!! and continue from the Memorial as far as West Street-also from Ivyhouse Lane, Ore to St. Andrew's Archway via Priory Road, Mount Pleasant Road and Elphinstone Road, with their steep gradients!!! Also from St. Helens Hotel to the Memorial via St. Helens Road!!! Through the Archway and along Queen's Road also from Victoria Inn, Hollington to Grand Parade, via London Road, St. Leonards with its steep gradients".

The dreaded gradients were brought into play again in 1927 as being too steep for double decker trolleybusus and thirty years later as an indication of the superior qualities of electric, as opposed to diesel traction. It is perhaps worth noting in passing that the Public Hall is now demolished, the frontline illuminated by coloured lights all summer, St. Andrews Archway replaced around the turn of the century and the Albert Memorial demolished a few years ago following a more insidious form of vandalism.

Campaigns, in any event are often undertaken from mixed motives and the poster should not be taken entirely at face value. There was already a motor bus service operating Hastings at the time of the tramways construction and it would be naive to suppose that its owners were unconcerned about the introduction of trams.

The story really begins some 20 years previously at an industrial exhibition in Berlin where the German Company of Siemens and Halske had given the first public demonstration of the pracitcal application of electricity to passenger transport. They used a section of standard tram track (electric trams were preceded by horse and steam trams in many parts of Europe and the U.S.A.) with a third rail in the middle to supply current. A primitive - by today's standards- dynamo energanised the system and the small passenger carrying train was hauled by a locomotive fitted with a simple electric motor.

It is difficult, I think, for many of us whose memories are limited entirely to the second half of the twentieth century to make the mental jump required to understand the importance of the railway, in its broadest sense, to the nineteenth century where it was the motorway, the Juggernaut, the airline, the fork lift truck and bus service rolled into one. It is, therefore, quite natural that for urban transport systems people would look to an iron road rather than a tarmacadam one, and the combination of electric traction with the light railways concept made an obviously practical mass transit system.

Development of the electric tramway then passed from Europe to the United States, where tramways systems were known as street railways. In 1883, four years later, two passenger carrying lines opened in the U.K.-The Volks Electric Railway in Brighton and the Giants Causeway Tramway between Portrush and Bushmills in Northern Ireland. The first of Britain's electric tramway lines to be constructed on a public highway opened in Blackpool in 1885 and the route is still served by electric trams. One of the original tramcars has survived and is exhibited at the Tramway Museum at Crich in Derbyshire.

Within a few years most industrial cities had tramways systems and other seaside towns were following Blackpool's trend setting lead.

The poster referred to above was in reaction to the registration of The Hastings, Bexhill and District Light Railways (Electric) Co., Ltd., by the Provincial Tramways Company Ltd. The Chairman was W.M. Murphy, Secretary

J.R. Glenn and Messrs. Kincaid, Walker and Manville were consulting engineers. There were a number of objections, including the London, Brighton and South Coast Railways, to the proposed tramway and an inquiry had to be held by the Light Railway Commissioners in 1898 by which time a rival application had been made by The British Electric Traction Co.,Ltd.,(later withdrawn). Further objections took place and at least one parliamentary bill was promoted. General delaying tactics also seem to have been adopted but eventually the Provincial Company obtained the Hastings Tramways Act 1900 incorporating The Hastings Tramways Co., and authorising routes in Hastings. A further Act three years later authorised routes to and from Bexhill. Compulsory municipal purchase was allowed after 25 years with further options at seven year intervals thereafter. The later Act also stipulated because of opposition from frontages, and the local Council, that the line along the seafront must not be worked on the overhead system, with the necessary wiring, but must be self-propelled cars or some other approved system. Yet further regulations were made later in respect of frequency of service, fares, advertisements on trams and land purchase. In the meantime, the Company had been sold and a new Company was registered in 1904 at 1, Queen Victoria Street, London E.C. as a member of a group with tramways interests in, amongst other places, Calcutta and Buenos Aires.

Work on the construction of the tramway commenced at the end of 1904 and the contractors were Dick Kerr and Company of Preston who employed around 400 men on the initial tracklaying. Some six thousand tons of rails were required for the first eleven miles and the men were paid sixpence per yard completed, earning up to four shillings and sixpence per day if they worked from 0730 to 1630 with a half hour break at mid day. Fig.1 shows tracklaying in Mount Pleasant Road, Hastings, and one can today stand in the spot chosen by the photographer and recognise it without difficulty-even the pub is still there, and further down the

Fig. 1 Track Laying in Mount Pleasant Road (Courtesy of Hastings Museum)

road some of the original traction poles are still standing, serving as lamp standards. The illustration probably dates from December 1904 or January 1905, as the section shown was evidently completed by February 1905. Tramrails were manufactured by the North-East Steel Company, and points and crossings by Hadfields.

Great excitement was caused in the Town early in July 1905 when the first three tramcars arrived by train from Preston. Delivery took place in Hastings Goods Yard, beside the station where the tramcars arrived on flat trucks. The sequence for unloading went like this:- each was lifted by large jacks, the flat car removed and a motor truck provided by Pickfords backed underneath. The tramcar was then lowered and the motor truck took it to Cambridge Road, a short distance away, where the tramway was complete. The jacks then lifted the tram from the Pickford's truck and lowered it onto its track. From here each tramcar was towed to the depot at Silverhill to await official opening on 31st July, 1905. Construction of the Company's power station had also been undertaken and this was sited off Parker Road, Ore, near the then South Eastern and Chatham Railway. A siding had been constructed between the power station coal store and Ore Station to give direct rail access for fuel supplies. The generating station was built of brick, was 96ft. long, 113ft, wide and 50ft. high. The chimney was constructed of steel plate by Babcock and Wilcox and was 175ft high. The boiler room was 94ft long by 46ft wide and contained Babcock and Wilcox marine type hand-fired boilers, three in number.

Four Deltis engines rated at 540 bhp at 375 rpm were fitted, two of them to drive Dick Kerr alternators, one a d.c. generator and the fourth to drive an alternator and a generator as a reserve. Some parts of the system were fed direct with 550 volts d.c. and 6600 volts a.c. was supplied to Silverhill and Bulverhythe depots via high voltage lines underground. Rotary convertors at the two depots then used the high voltage alternating current to produce 550 volts d.c. and feed it into the system. The Company power station continued in service until 1935.

By mid July 1905 the power station could energise enough of the system to enable testing to begin and the tramcars, now about 30 in number, were receiving their final fitting out at Silverhill depot. After comprehensive tests and Board of Trade inspection the system opened to the public on Monday 31st July, 1905. One car was derailed, a painter received a mild electric shock and some tramcars filled with smoke as varnish burned off the electrical control gear and motors. Twenty two tramcars were in operation on the circular route that first day and a staggering 18 663 passengers were carried. The population of the Town at that time was not too far different from the Borough of Hastings today-around sixty thousand or so-indicating that July 1905 was a particularly good month for holidays or that about a third of the townspeople turned out for a tram ride. On the last weekend in August, 102 958 passengers were carried and frequency of the service on the circular route was increased to one tram every 12½ minutes in either direction at whichever stop you happened to be waiting. Service indeed.

Work continued on the Bexhill routes from the depot in Bexhill Road (Bulverhythe) and on the spur line from Ore down to the Market Cross at the top of the Old Town (Fig.3).

The route to Bexhill was inaugurated on 9th April 1906 from West Marina, St. Leonards, along Bexhill Road to Pebsham, via a section of private right of way to cut off the steep and wide corner at the Bull, along De La Warr Road into Bexhill and terminating at the Metropole Hotel. This route was extended to Cooden in July that year. The route of the private right of way may still be traced from the entrance of what is euphemistically called the Civic Amenity Site (but known to most of us as 'the tip') in Bexhill Road, along the backs of some of the houses at Pebsham. Some people still know it as 'the old tram road'. The track was lifted after conversion to trolleybuses-they took the long way round. At this point we see the emergence of two distinct systems-one serving

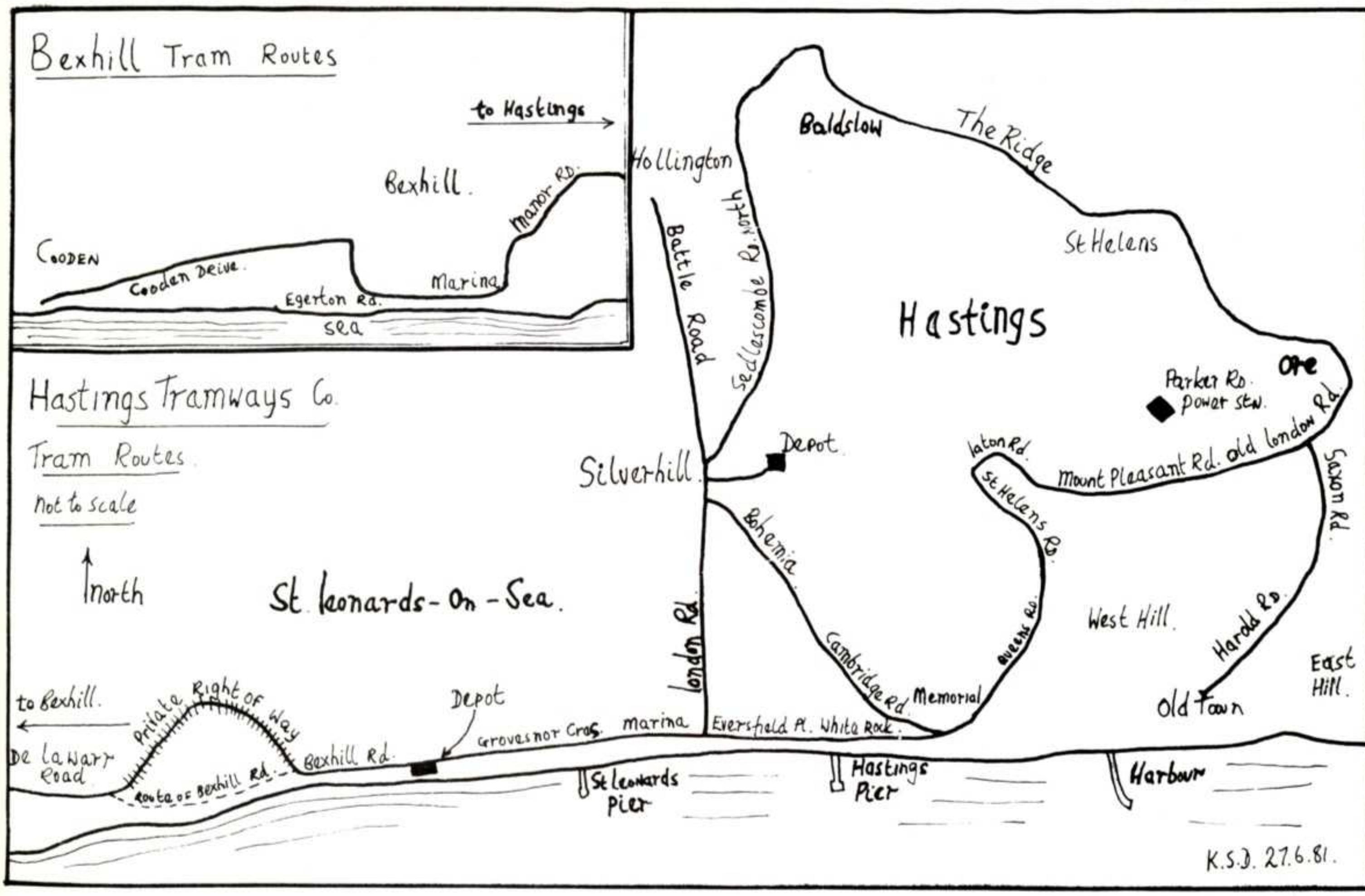


Fig.2 Hastings and Bexhill Route Map

Hastings and St. Leonards but not the sea front, and the other serving Bexhill from West Marina. The link along the seafront was still the subject of discussion and planning because of the ban on overhead wires from West Marina eastwards into Robertson Street, Hastings. The obvious alternative was a conduit system, where current is supplied through a conduit buried in the road and fed to the vehicle by way of a pick-up underneath the tramcar which fits into a narrow slot along the length of the conduit. Although a system extensively used in London, the feeling was that the continual lashing of salt-water and sand would block and damage the conduit and it would be ineffective-the extensive

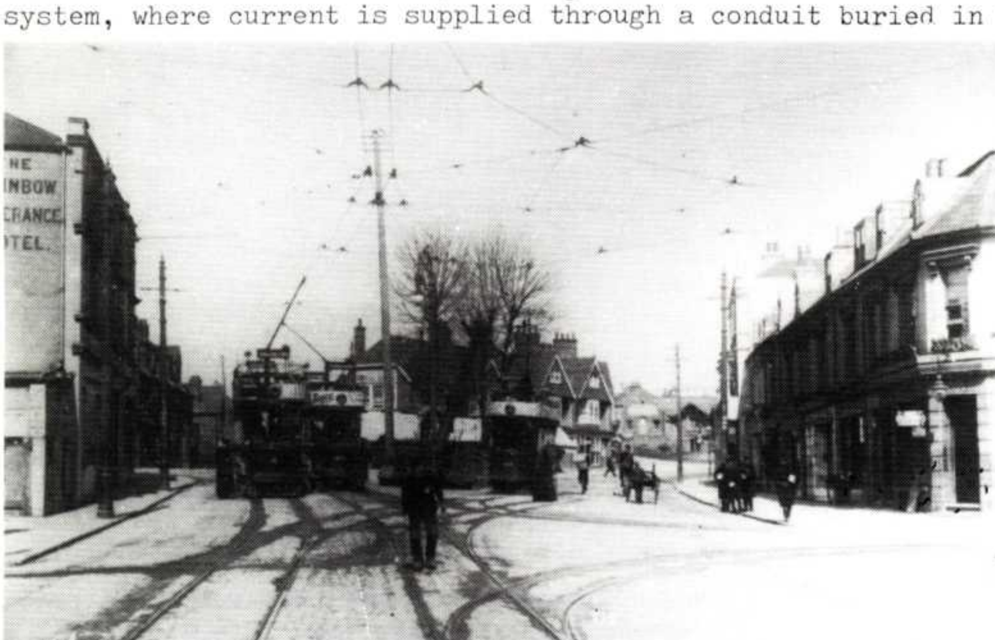


Fig.3 Trams at Silverhill, corner of Beauford Road and Sedlescombe Road North (Courtesy of Hastings Reference Library)

sea defences at Hastings are a product of the late 1920's/early 1930's and did not exist in their present form during the tramway era. In other words, the sea was a lot closer than it is today. The Company opted for a French system-the Dolter surface contact system, named after its inventor-which consisted of sliding studs sunk in the road at intervals of around nine feet to be lifted by means of an electromagnet mounted on a twelve foot skate carried under the tram-car. The lifting brought the stud into contact with its power supply under the road and through the skate supplied current to drive the car onwards. The electro magnets on the skate were supplied by onboard batteries recharged as the vehicle moved along. If a stud remained in the raised position-poking out of the road and energised, in theory, at 550 volts d.c. it was brushed by a safety brush on the rear fender of the tramcar, an alarm bell rang on the vehicle, which was stopped and the conductor had to get off the tram and hammer the stud down with an insulated hammer. This final part of the system (London Road and Battle Road already having been completed) commenced operation of 12th January 1907 and the Dolter stud system was retained for seven years until 1914, apparently proving troublesome all that time.

The tramcars which used this route were specially adapted and were kept at Bulverhythe depot, the weight of their additional equipment making them inefficient in more hilly parts of the Town. There is a record of a strike by the tramwaymen in 1911 against the use of the Dolter system which was troublesome and unsatisfactory, and in 1913 the Board of Trade instructed the Company to find a new method of working this section. The trams on this route were then fitted with a Tillings Stevens 24 hp petrol engine under the stairs coupled to a dynamo under a seat on the lower deck which then fed current to the controller and motors. This equipment was manufactured in Maidstone and the system lasted for six years until 1921 when the Hastings Corporation relented and allowed overhead wires along the sea front thus unifying the whole system.

A strike lasting three days or so took place in 1921 over the unfair dismissal of an inspector and records exist of occasional accidents during tram operations, although none recorded seems to have been particularly serious.

This brief survey now brings us to the conversion of the system to trolleybus operation which took place in 1928 and has already been described in Sussex Industrial History No.11.

So far as is known, no tramcars survive from the Hastings system but a few wall fittings for the overhead conductor can still be seen and many traction poles are still in use as lamp standards. Odd sections of tramway are occasionally unearthed by roadworks and Mr. David Padgham, who works for Maidstone and District Motor Services has a substantial collection of photographs, tickets, timetables and other records. I am very grateful to him for his assistance and to Mr. Powys at Hastings Reference Library. Miss Victoria Willams, assistant curator at Hastings Museum has also been most helpful and I have drawn heavily on contributions by J.Gillham and G.Gundry to the Transport Press.

IRON WORKING IN WESTFIELD

By Simon Kamer and John Bell, William Parker School, Hastings.

A slightly abridged copy of the Prize-winning Essay submitted for the Sussex Industrial Archaeology Society's Schools Essay Competition of 1981.

The readily available iron ore natural to the Wealden clays, which provided the essential raw material, and the dense woodland, which provided fuel in the form of charcoal, are the two major reasons why, in the past, there was a successful iron industry in the area.

The industry seems to have flourished in two main periods, Roman and post Medieval although there is also some evidence from preceding, intervening and succeeding times. In Westfield there is evidence from both the main periods although domestic needs may have been fulfilled at other times without leaving traces.

The village of Westfield has been, and still is, largely a farming community stretching back to the Norman Conquest and the Domesday Book. It lies about 5 miles north of Hastings (Fig.1) and is today centred on the A28 behind the Ridge, the prehistoric trackway running from Fairlight to Battle and beyond. Geologically Westfield is on the Hastings Beds and iron ore occurs naturally in the Wadhurst clay of the valley causing streams in the area to run a rust orange colour.

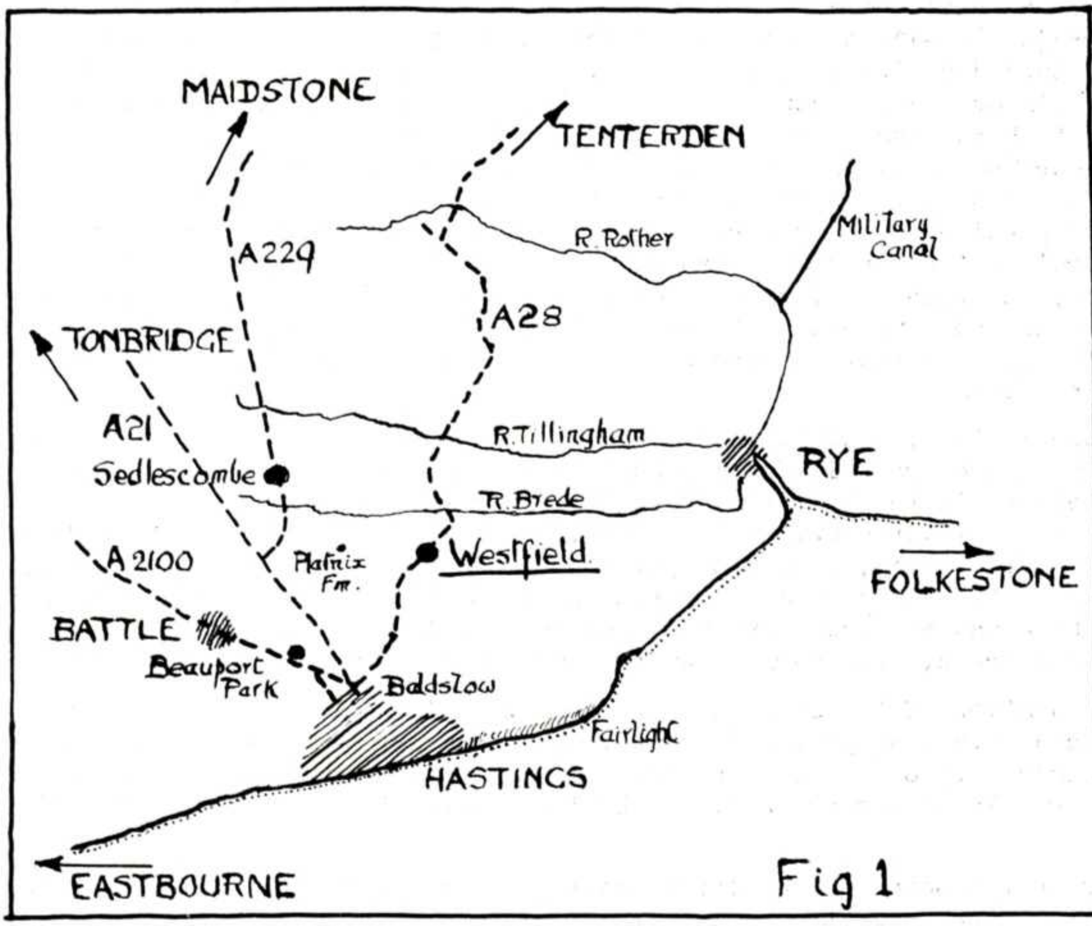


Fig. 1 Location of Westfield

The earliest known archaeological site in Westfield is a prehistoric settlement close to Stonestile Lane. Here flint finds, pottery sherds and the post holes for what would appear to be two huts have been discovered and dated to Iron Age times. In 43 AD when the Romans invaded Britain under Emperor Claudius the iron industry was already well established and is mentioned by the Roman geographer Strabo as one of the factors that made Britain a desirable addition to the Roman Empire. Although there is no evidence of iron working on the Stonestile Lane site it could be that the people who lived there were the first in Westfield to use iron tools.

Julius Caesar, in his account of his invasion of Britain, made no observations of iron working activity when he raided in 55 and 54 BC but during the Roman occupation the British iron industry became very important to Rome. Apart from domestic needs the occupation army would have been the largest consumer of iron goods, presumably for weapons and armour. The Weald became one of the foremost iron producers of the Roman world along with Noricum in Austria and areas in Spain and one of the sites in Westfield has signs that its produce was exported.

In the parish of Westfield is the large Romano-British iron working site at Beauport Park and, just outside the boundary is another such site at Oaklands, Sedlescombe. Little exploration has been made, or at least publicised, concerning these sites although enough is known to provide bare outlines. There is also a Roman road that passed through Westfield and the connection between this and the iron industry cannot be overlooked. There is, however, no contemporary documentary evidence concerning either of these sites and no place or field names to mark the locations.

At Beauport Park discovery of the site was due to the extant remains, mainly those of a large cinder heap; this apparently reached 50 feet in height and covered two acres but during the second half of the nineteenth century much of it was used to build road. Some pottery and coins were found-a coin of the Emperor Trajan (98-117 AD) and one of Hadrian (117-138 AD)- which suggest that the site started a little before 140 AD. A bronze ring and an iron statuette were also discovered and could be the earliest example of cast iron in Britain. An elaborate bath house and evidence of living quarters has been found close to the iron-working site; the bath house seems to have been roofed with tiles having the CLBR stamp of the Classis Britannica which have been found in great profusion on this site (also found at Bardown). This would seem to imply some sort of military control as the Classis Britannica was the Roman fleet that acted as a support to the army in Britain. The bath house indicates a sizeable settlement and was discovered in the same action as that which destroyed the bloomeries-the construction of the golf course. Future work on the site will no doubt reveal further interesting finds.

Little is to be seen at the Oaklands(Sedlescombe) site, now on private property although several field names such as Cinderbanks, Stone Heaped Field and Musket Field indicate the sites where the Romano-British bloomeries once produced iron. A large cinder heap, no longer extant, yielded several coins of Hadrian's period as well as tile, brick and pottery sherds and cinder, the coin finds suggesting that the site was in operation at about the same time as that at Beauport Park and may even have been connected with it. The site is very close to the River Brede, coal barges having come up the River as far as Brede.

The question of transport is important when the large amount of iron produced in the Weald, its transport and the difficult countryside are considered. There is the possibility of water transport while the presence of the Roman road from Rochester via Maidstone and Sedlescombe to Hastings hints at some iron going by land.

Thus in the Roman period large amounts of iron were produced in the Westfield area but when the Roman troops withdrew from the province of Britannia in 410 AD Britain sank into the mists of the Dark Ages. The following centuries saw barbarian invasions and Britain split up into small belligerent kingdoms and the flourishing iron industry of the Roman period declined into local practices supplying domestic needs. There are thus few 'Blooma ferri' mentioned in the Domesday Book.

It was not until several factors combined that the iron industry was able to revive. The first was the consolidation of Government in the Middle Ages; Richard III fell at Bosworth Field in 1485 putting an end to the Wars of the Roses and after years of civil unrest the country became unified. Peace paved the way for stable industries with opportunities for trade while industry was given a chance to catch up on the innovations that had taken place abroad. The first blast furnace was fired in England in 1492 although such furnaces had been used in France several years previously. The means had thus been achieved to make much more iron than the bloomeries had managed. Methods of warfare had begun to change and the cannon and musket were soon to replace the bow and arrow so that ordnance was to be one of the major products of the Weald in times to come. For the same reasons that the Romans had made iron in the Weald, namely plentiful ore and fuel, the iron-making tradition was revived in the area on a larger scale than hitherto.

Two processes, bloomery and blast furnace, were connected with Westfield. In the bloomery process the ore, a grey-green carbonate, was roasted in an open hearth using charcoal and converted into a maroon oxide, this was placed in a clay 'bloomery' with plenty of charcoal to reduce the iron oxide to form a 'bloom' of iron, the many impurities being tapped off as slag. Bloomery sites tended to be close to water as at Westfield either as a ready supply for drinking or because of the accessibility of the clay and ore near streams. The process was laborious and produced only a limited amount of iron.

The blast furnace could produce more iron and could maintain production continuously so long as it was topped up with ore and charcoal; a high temperature was reached in the furnace using power-driven bellows. Both the iron and the slag became molten and could be tapped seperately, the iron being cast into sand or clay moulds to become 'sows' and thence into 'pigs'. The resulting 'pig iron' was sent to a forge for conversion into wrought iron. There is no evidence of a blast furnace in Westfield although the presence of slag, referred to later, could indicate that one might have existed.

There are, however, two bloomery sites at Platnix Farm and Claremont School, formerly Baldslow Place. The former is near the Roman road and on the same stream as the Beauport Park site while the latter is on a tributary of the same stream. All evidence at Claremont was destroyed when Baldslow Place was built, much of the cinder from the bloomery having apparently been used to make drives and paths.

There are several place names at Platnix Farm to suggest that iron-working went on there-Sinder Banks Field, Sinder Banks, Pond Field and Marlpit Shaw. There is some cinder in the fields and also some signs of digging, namely several small ponds; the name Marlpit Shaw tends to support this theory as marl was dug from the same pits as ore. The most likely explanation of both sites is that they were able to produce enough iron for the villages of Baldslow and Westfield that had been established in Saxon times and that their use continued until well into the medieval period.

The most important iron-working site of the medieval period in Westfield is Westfield Forge. During the summer of 1980 the site was exposed as a result of work by the Water Authority to prevent the River Brede and its tributary, the Forge Stream, from flooding the surrounding area. This was probably the first time the field had been exposed since the site was deserted and the work, while unfortunately destroying the remains of the pond bay, presented an opportunity for a small excavation which prompted further research.

The site was well known before it was exposed because of documentary evidence and visible remains. Place names such as Forge Stream, Forge Field, Forge Wood and Forge House were indicative and a forge was shown on Budgen's map of 1724. There is also a letter of complaint from the Mayor and Jurats of Rye who claimed that the damming of Forge Stream to make a hammer pond deprived the Brede, a tributary of the Rother, of much of its water thus adversly affecting the harbour at Rye. A survey of levels has shown that this was not the case and as the 1724 map and a statement in 1664 that 'the site was continued in hope' show that the complaint had no serious implication for the forge.

On the actual site, before the Water Authority work, the remains of a pond bay spanned the valley and a depression in the ground showed where the stream had been diverted to run a wheel (Fig.2) By looking up the valley of Forge Stream the high-water mark of the pond can still be seen. There was much slag, brick and tile lying in the field and in the present-day stream there are several larger timbers that could be the remains of a sluice gate. Some pits on the eastern side of the stream are signs either of ore diggings or the building of the pond bay. Unfortunately the site was not surveyed before the bull-dozers moved in.

Several cannon balls have been found and a piece of cannon, reputedly cast at Westfield, is in the Anne of Cleeves house at Lewes. When the bay was destroyed a sow of iron 11 feet long, about 8 inches wide and rounded at the ends was found. A small hammer head has also been discovered.

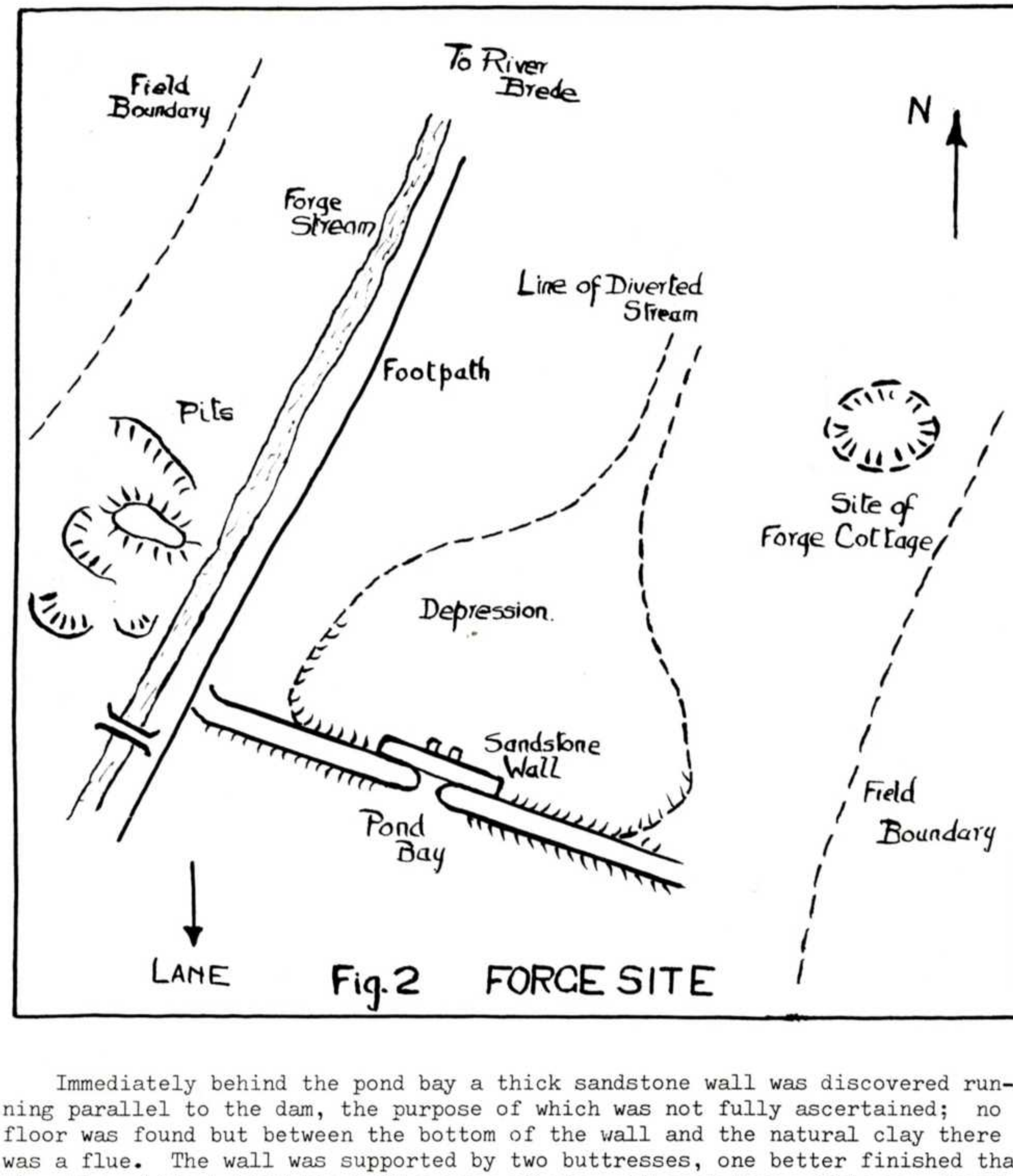


Fig. 2 FORGE SITE

Immediately behind the pond bay a thick sandstone wall was discovered running parallel to the dam, the purpose of which was not fully ascertained; no floor was found but between the bottom of the wall and the natural clay there was a flue. The wall was supported by two buttresses, one better finished than the other while behind the wall a mass of slag and sandstone rubble was found and also, close to the bay a piece of shaped sandstone with bricks attached to one side and a lump of slag fused to the other (this was destroyed by the bull-dozer).

The wall seems to have housed an undershot waterwheel which could explain the above mentioned flue under the wall. The wheel would presumably have driven the hammer. Out of a pit dug during the excavation were taken several nails, a large hook, some pipe stems, a piece of green medieval pottery and many pieces of tile.

The term 'forge' implies the site of a power hammer, the term 'hammer pond' being used for ponds on either a furnace or a forge site. This could mean that hammer ponds were powering hammer forges before water power was needed for blast furnaces. This does not, however, seem to have been the case at Westfield as the forge is not mentioned in the list of iron-working sites drawn up in 1574 although documentary evidence suggests that it was established shortly after this date. There is a possible series of charcoal-burning sites near the forge

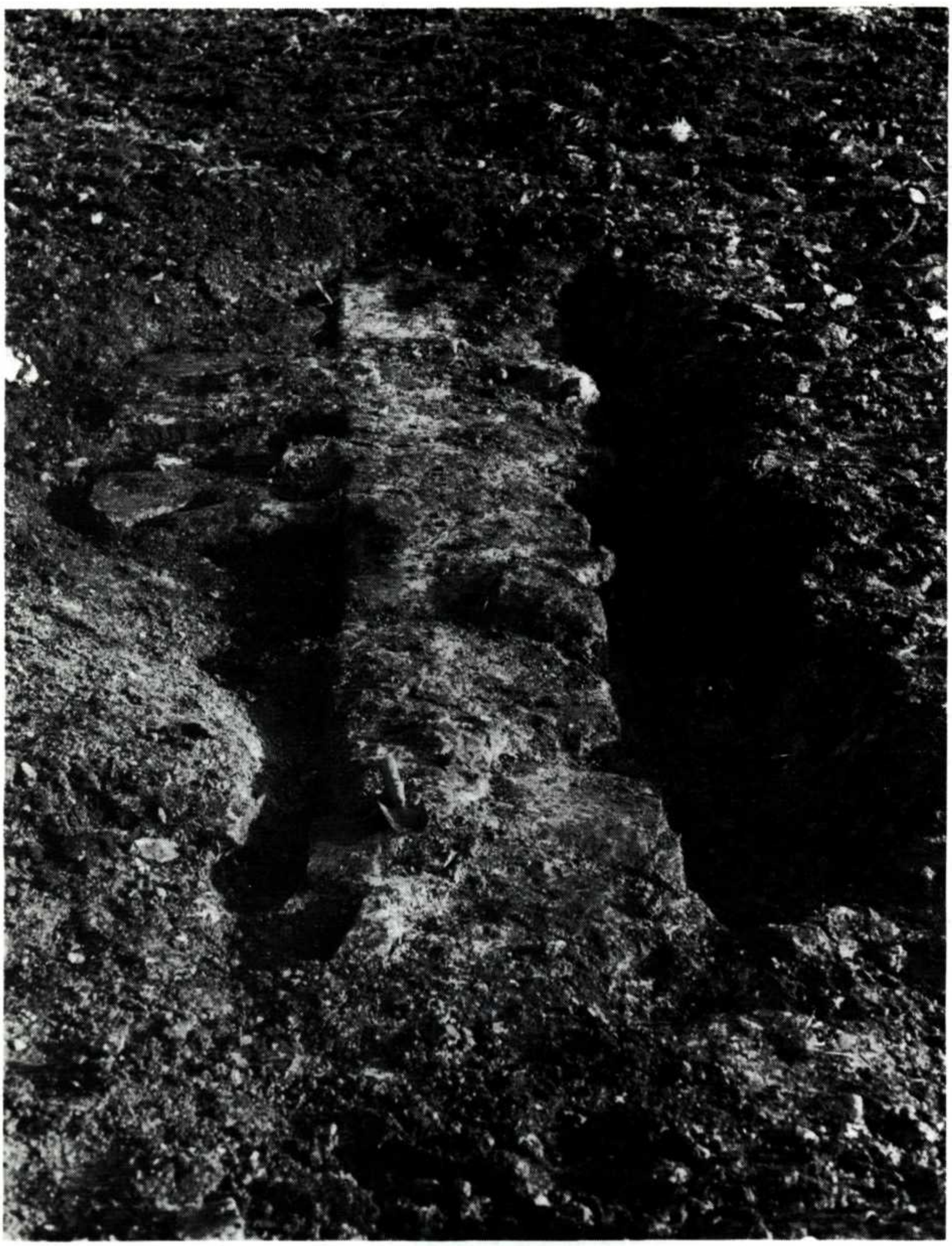


Fig. 3 The Sandstone Wall at Westfield Forge.

which may have preceded it. There is also a lot of slag on the site which one would not have expected from a forge so that this may be evidence that iron was actually made here at some time. There are two black layers in the bank of the stream suggesting two periods of activity separated by about 100 years. It could be that the former was a bloomery that went out of action and that the site was later used as a forge with a pond being built. The Forge House stood until recently.

Until it became easier to make iron in the industrial North and where there were ample supplies of the new fuel - coal - Westfield thus played an important role in the Wealden iron industry.

FIELD PROJECTS.

Piddinghoe Kiln (TQ 432033)

Completed and fully described in this issue (p.2).

Coultershaw Bridge Water Pump (SU 972194)

The pump itself is now fully restored and operational and the 100 year-old barn presented by Lord March has been re-erected and is weathertight. Work is proceeding on floorboarding and internal fittings preparatory to its use as a Museum and Information Centre.

Clayton Mills, 'Jack and Jill' (TQ 204134)

Contractors have completed their work on the main framing and weather-boarding, painting and floorboarding is progressing.

Ifield Mill (TQ 245365)

The first and second floors have been completed and handed over to the Crawley Museum Society. The wheel is also being restored and prepared for operation.

Other Projects

Work has also been carried out, or is in progress, at High Salvington Mill, West Blatchington Mill and Oldlands Mill, Ditchling.

Chalk Pits Museum, Amberley.

This is the only open-air Industrial Archaeology Museum of its kind in the South of England and exhibits are continually being added. The work of assembling these and arranging for their display is larely voluntary and the Director, Mr. Ian Dean, would welcome any offers of help in this field.

Brick Study Group

In some parts of Sussex work on recording the sites and tracing the history of former brickworks is now nearing completion. These include Hailsham, East Grinstead and Burgess Hill as well as the Worthing area, covered by the recently issued Victoria County History of Sussex Vol.6 Part 1. In other areas work has hardly begun and volunteers are still urgently needed for the task.

The interest in mathematical tiles was given added impetus by the recent TV programme on the buildings of Lewes. Two members of the Group participated in a national symposium on the subject. A survey of the distribution of mathematical tiles in Sussex has been made, but attempts to discover where and by whom they were manufactured have not so far met with much success.

A bibliography of brickmaking in Sussex has been compiled, This includes articles and shorter notes which have appeared in various publications in addition to those printed in Sussex Industrial History and the Society's Newsletter. The amount of published material has doubled in the last two years and this must be seen as an encouraging sign. Copies of the bibliography may be obtained from the Secretary of the Brick Study Group on request.

M. Beswick.

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