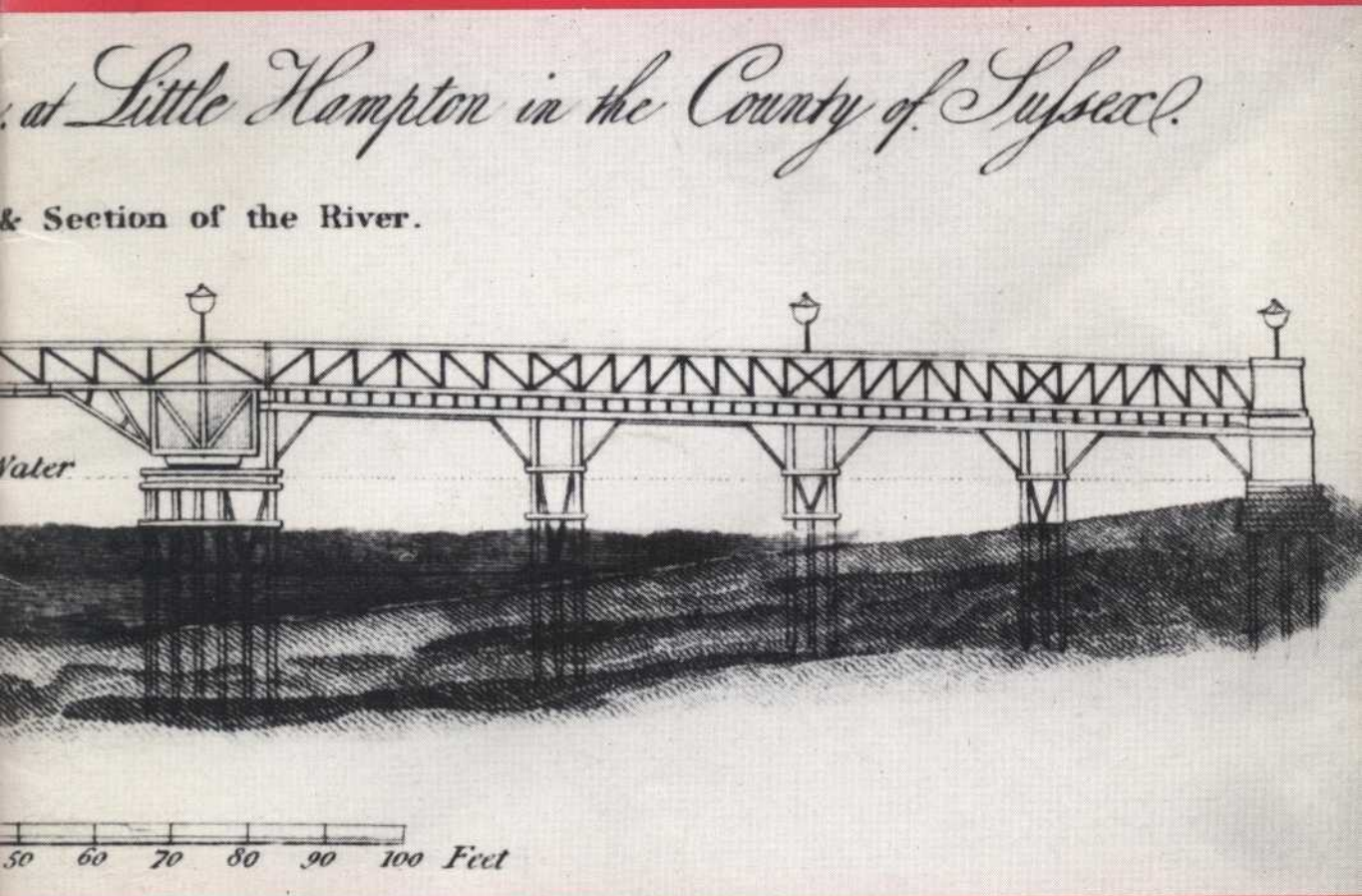
SUSSEX INDUSTRIAL HISTORY

Winter 1970/71



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SUSSEX INDUSTRIAL HISTORY

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Edited by John Farrant, Arts Building, University of Sussex, Falmer, Brighton, BN1 9QN. *Sussex Industrial History* has as a principal objective the publication of the results of recording, surveying and preservation of industrial monuments and processes done under the aegis of the Sussex Industrial Archaeology Study Group. But its field is not narrowly defined, for it aims to integrate the findings of industrial archaeology into general historical thinking and writing, by studying the impact of industrial change, principally during the past two centuries, on a rural county. The Editor is very interested to hear from prospective contributors. Future issues will include short articles; and the 'Notes and News' section will include work in progress, recent publications, conferences and similar information.

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KIM C. LESLIE

The Ashburnham Estate Brickworks 1840-1968

INTRODUCTION

The Ashburnham Estate brickworks, which ceased production in November 1968, is situated a quarter mile NW. of Ashburnham Forge, (National Grid reference TQ684161), the property, until July 1970, of the Reverend J.D. Bickersteth, a great grandson of the fourth Earl of Ashburnham. The Ashburnham estate also formerly owned works for two other important extractive industries. In 1808 the Reverend Arthur Young noted that the limestone mine and works in Dallington Forest achieved for the second Earl the distinction of being 'the greatest lime-burner in all the kingdom'.[1] Better known is that the family had its own iron workings, the Ashburnham furnace and forge being the last of the Wealden iron works to operate in the early nineteenth century. The factor shared by these three estate industries is that they were all based on wood fuel.

Although on a more limited scale of production than either of the other two works, the brickworks possessed some outstanding features. In Sussex it was the last of the small rural works of its type to operate, probably being one of the most primitive commercial undertakings to survive in the county into the 1960s. Even in the country as a whole it was a survival of a method of production rarely, if ever, seen today.[2] Brickmaking was by hand, by methods that have been passed from generation to generation. Perhaps more unusual than this was that the bricks were burnt in an open kiln fired with wood. Until 1961, when tiles were last made at the yard, a pug mill for grinding the clay was driven by a horse. This mill is the last recorded instance of a stationary horse engine (a horse gin) to have worked in Sussex. In other words, until its recent closure, the Ashburnham brickworks continued to demonstrate the state of brickmaking as it was before the brickmaking revolution of the nineteenth century. Indeed the methods and equipment employed at Ashburnham have remarkable resemblances to those evident in some of the earliest known illustrations[3] and descriptions of the industry.[4]

HISTORY

The working of clay at Ashburnham can be traced back at least to 1362 when there was a 'building called a Tylehous for baking tiles'.[5] References as early as this have not been investigated for brickmaking, although it is quite clear that brickmaking was established before the opening of the new brickyard in 1840,[6] the subject of this paper.

The Ashburnham brickworks began on its new—and last—site in 1840, in what was formerly an arable ten-acre field, attached to Court Lodge Farm, called Lower Spring Field.[7] Before this date the estate had its brick and tile works adjacent to the Forge, where today scant remains set in the side of an earth bank may be traced (TQ687160). There are two reasons, perhaps related, which may be advanced to account for the removal of the site in 1840. Ten years earlier, Edward Driver, having surveyed the estate and observed that too many of its buildings were of timber,

made the recommendation that future building work should be carried out in brick. His recorded comment was that brick would 'last for ever'.[8] If Driver's report was acted upon, then expansion of the brickyard was inevitable to meet the new demands, but any expansion on the earlier site would have clearly disfigured the area immediately around the north entrance to the Park (i.e., by Forge Lodge). This would have hardly stood as an attractive proposition, more particularly as plans were being made in the 1830s to reconstruct Ashburnham Place with a casing of locally made brick. Expansion then might have been one reason for the move. That the move was made in 1840 possibly introduces the immediate reason for change. It is said that the fourth Earl, Bertram, came to order its removal when he was about to marry, as he feared to offend his new bride with an unsightly industrial appearance to the entrance to the Park. So relates oral tradition, still a very strong feature of an estate where in some cases the same families have been settled for centuries. Whatever criticism there might be of the validity of oral tradition, it is perhaps significant that the year of both the marriage and the removal of the brickyard is the same. Nevertheless, although the cause might be disputed, the fact of removal is clear: the Steward's Account Book for 1840-1[9] records the transference of sites, the building of the new yard and the stocking of it with fuel:

1840		PAID	£	s.	d.
October	12	Jas. Colman labor to new brick kiln	2	14	0
,,	,,	Jno. Winchester labour in new yard	3	16	1½
Novr.	14	Jas. Barden do	2	12	6
,,	,,	Jno. Billings building Clayhouse	2	2	6
,,	,,	Brick Duty	7	13	1½
,,	,,	Jno. Sinden for Kiln Faggotts	2	5	0
,,	,,	Richd. How carrying matrl. to new brickyd.	5	8	6
Decr.	7	Brick Duty	3	13	6
1841					
January	7	Saml. Cornford Arch Bricks	3	12	0
,,	11	Thos. Hobday Carrying Clay sand & c.	9	4	0
,,	14	Thos. Croft for Kiln Faggot	1	2	6
,,	,,	John Shaw for Bricks	1	14	6
,,	15	Jno. Isted Carrying Kiln Faggots	12	10	11
Febry.	8	T. Harvey Pulling down old brick kilns and building new lodges	7	16	0
March	1	Hy. Barden Brick and Tile Making 1840	83	5	10
May	14	Geo. Geering Smiths work	2	11	7
,,	,,	T. Dray Bricklayer to new brick kilns	12	0	4
,,	,,	J. Baker Carpenters work	11	16	3
,,	16	Brick Duty	1	10	7½
,,	,,	Alfred Dawes Bricklayers work	8	2	6
			185	12	3½

Probably significant is that the building of the new brickworks took place between October and May; it was normal practice in a traditional brickyard such as this–using open top kilns and air drying–to reserve the autumn and winter months for site maintenance and fuel stocking preparatory to the burning period, mainly concentrated in the drier months of the year.

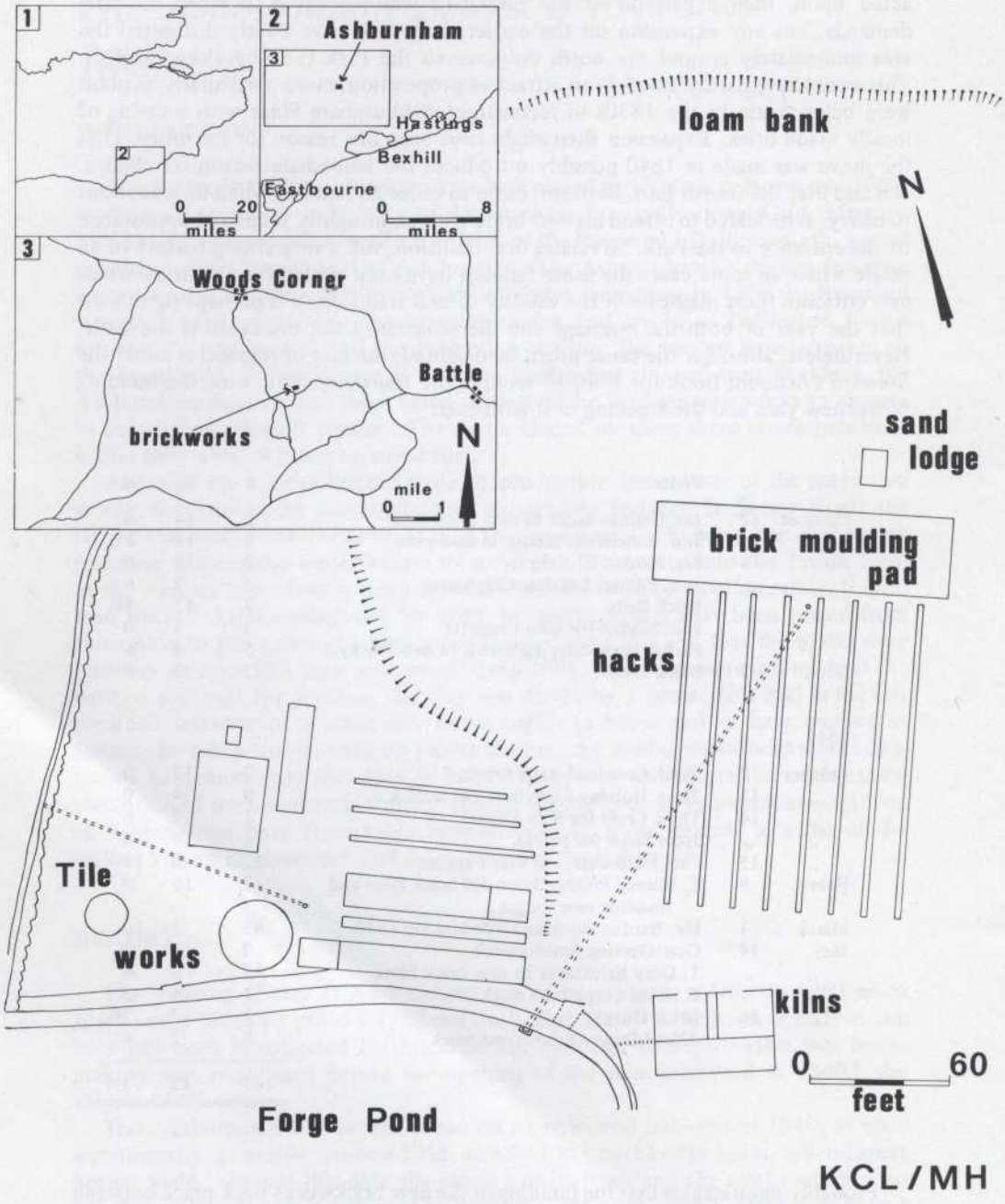

Fig.1 Location and site plan

The subsequent history of the brickworks to its closure in 1968 can be divided into five distinct periods.

1840–5	Mainly estate production, with small commercial sales
1846–55	Ashburnham Place restoration and enlargement
1856–96	Expansion of commercial sales
1897–1927	Estate repairs and building
1928–68	Expansion of commercial sales

In its first few years of working, the yard was producing mainly for the requirements of the estate itself, rather than for sale in any significant quantities to private builders. This policy may well reflect the recommendation made by Edward Driver in 1830 about the need to use more brick rather than timber on the estate. However, there is no doubt that the major supply of bricks in the early years was for the refacing of Ashburnham Place.

Although Ashburnham Place had been clad in a Regency-Gothic casing of cement for the third Earl in 1813 by Francis Bernasconi, it soon proved so unsatisfactory by cracking and flaking, that the fourth Earl commissioned a new face for the mansion, and at the same time decided on certain enlargements. The work was to be in red brick pointed with black mortar which was then popular.[10] As wood fired kilns produce grey-headed bricks, these were conveniently worked into the overall design to form decorative patterns, one of the most distinctive features of the building. It is this work for Ashburnham Place that represents by far the most ambitious single building project carried through in the history of the brickworks, and was the time when it was at its peak of production, a level that it never subsequently attained. The expenditure recorded by the steward would seem to suggest that the major work for the rebuilding was affected between 1846 and 1855. Figure 2 shows income (which in the early accounts refers only to sales

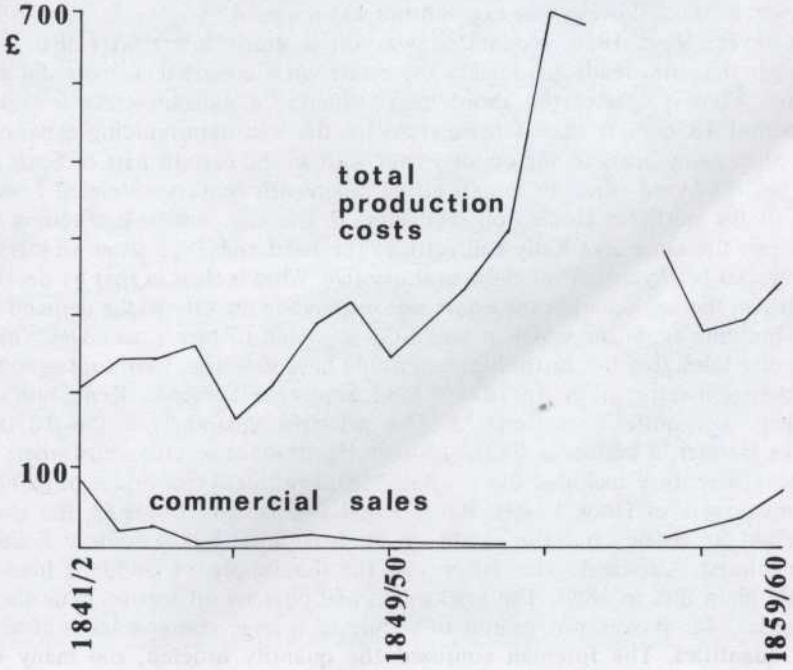

Fig.2 Income and Expenditure, 1841–1860

outside the estate) and expenditure incurred incorporating the yard between 1841 and 1860, as derived from the steward's accounts.[11] This indicates that sales to outside purchasers declined progressively between 1841 and 1853 (although there was a minimal increase in 1847-8), and that there were no sales at all between 1853 and 1855. It will be noted from the graph that it is precisely during this two year period that brickmaking was at its peak, according to the production costs, the 1853-4 figures representing just over 400 oer cent increase over those for 1845-6. This can only be accounted for by increased brick production as there is no evidence at all to indicate that basic production costs were rising. The increased production was organised solely for internal consumption, for work on Ashburnham Place.

Another indication that it was necessary to increase the level of production for the reconstruction is shown by the purchase of an Ainslie's Brick & Tile Machine in June 1847 for £37 9s. This would have been one of two machines patented by John Ainslie in either 1845 or 1846.[12] Thus the latest mass production machinery then on the market was bought, (the Ainslie machines being amongst the earliest of the successful machines), and further, bought at a time when their use was still not extensive.[13] The later history of the brickworks, however, shows that machinery did not become a feature of production, though there is no record when the Ainslie machine was last used. Investigation at the brickworks has failed to locate any surviving machinery. That the restoration was complete by June 1855 is suggested by two terse references in the accounts: in the period 1 June 1854 to 1 June 1855 appear two very human touches in the steward's accounts:

James Barden – a present from his Lordship	10	10	0
Beer for makers		18	0

Then production seems to have ceased as the accounts make no reference at all to any work on the site in the following year 1855-6, this possibly because of over-stocking. In the following year expenditure was resumed.

However, from 1856 production was on a much lower level than before, although the sales made to outside the estate on a commercial basis did in fact expand. What is noteworthy about the commercial expansion which is evident in the period 1856-96 is that it correlates with the Victorian building expansion so marked in many areas of the country, not least in the eastern part of Sussex. The area the brickyard came to supply in the nineteenth century extended from Burwash in the north to Hollington (Hastings) in the east and to Eastbourne in the west. For the same area Kelly's directories for 1855 and 1895 show an increase in commercial brickyards from eight to thirty-five. What is clear in that by developing its sales on the open market the estate was responding directly to the demand of the local building trade, of which it was fully prepared to take advantage. Within its triangular sales area the furthest orders would have therefore been to Eastbourne, a distance of twelve miles. In 1877 a load went to Faversham, Kent, but such a distance was quite exceptional.[14] The principal customer in the 1870s was George Harmer, a builder at Gardner Street, Herstmonceux. Other customers in the nineteenth century included the Hastings Highway Board (for bridge building), the Commissioners of Hooe Levels, Battle Rural and District Councils, the Duke of Cleveland at Battle, and the estate of Thomas Brassey, the railway builder, at Normanhurst, Catsfield. The latter was for the supply of 365,000 bricks and 36,500 plain tiles in 1887. The brickworks had obvious difficulties in dealing with the order, for it was not geared to supplying a large commercial contractor in such quantities. The foreman confused the quantity ordered, and many of the bricks had to be returned from Normanhurst to Ashburnham because they were

PLATE I Brick moulding using the strike

PLATE II Mr. Will Beale and hack barrow

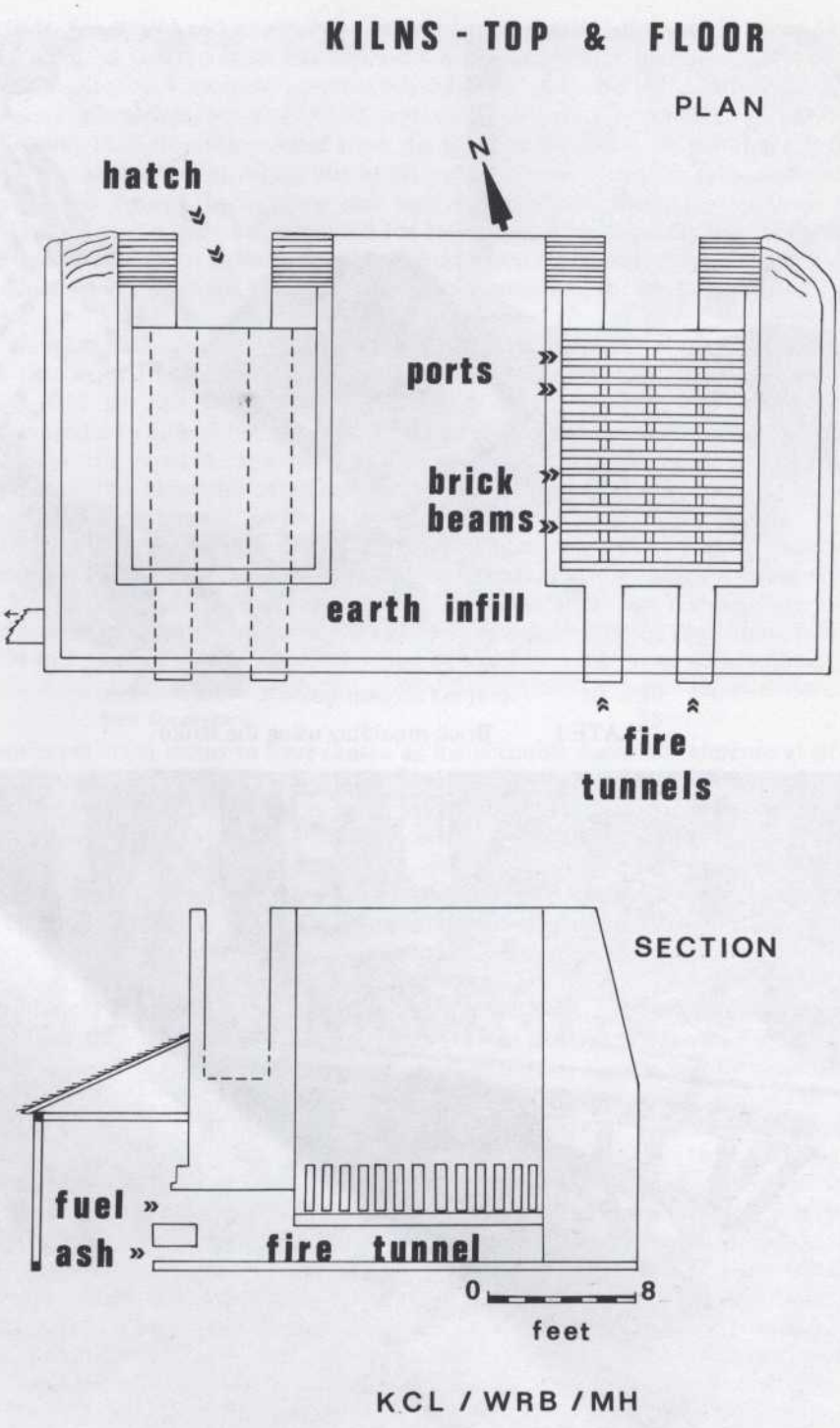

Fig.3 The Scotch Kilns

moss grown, discoloured and chipped.[15] There is the strong suggestion that in view of the enormous quantity ordered – by the yard's standards – it was found necessary to send old stock. From evidence such as this it is quite apparent that the brickworks never presented strong competition in the open market; however, the value to the estate of this trade was that it did ensure the works remained open when there was no great demand from the estate itself, and so always in a state of maintenance and ready availability should occasion arise.

The yard came to develop a wide range of products to offer the market. Although the earliest records in the 1840s merely indicate the manufacture of 'bricks and tiles', later records in the nineteenth century become more specific and precise. From the accounts it appears that the following were produced:

BRICKS
Building, Paving, Copin, Moulded, Squince, Chimney, Bureau, Cannon, Arch, Bindsmouth, House, 6 in., Cornish.
TILES
Plain, Drain, Hip, Ridge, Valley, Taper, Corner, Large, Paving, Weather, Angle.
DRAINAGE PIPES
Five sizes.
FLOWER POTS

During this century the range had been gradually restricted. Flower pots, most of which were made for Ashburnham Place gardens, were the first to be discontinued by the end of the First War. Drainage pipes then ceased to be made, and in 1961 the last tiles were made with an order for 10,000 reds. In recent years the yard came to concentrate on two types of brick, building and paving, although special types were made to order. In 1967, for instance, a small number of coping bricks were made.

With estate repairs necessary towards the close of the nineteenth century, outside sales declined from 1898 until 1927. For these years sales average less than £3 per annum, whereas apart from the war years the estate repairs account was annually debited with sums between £180 and £466.[16] Sales in other words became a mere fraction of the amount used for internal estate consumption. After Lady Catherine Ashburnham inherited the estate in 1924, the accounts suggest that she soon instituted a positive policy of once more entering the commercial market, a policy which, although never yielding substantial profits, does largely account for the survival of the brickworks for a further forty years. To 1941 when the works closed through blackout regulations, the best year was 1934 with profits of £281. Even in the post-war period the highest profit recorded was only £316 in 1954.

Figures such as this clearly emphasise that the brickworks was never a profitable investment of any consequence, in contrast to the earlier estate iron and lime works. Indeed, profit was obviously not the intention when the new brickworks was opened in 1840; rather it was to be a service industry to the estate. As a viable proposition its expansion has always been hindered by its low yield: the construction of only two kilns with a total carrying capacity of only 20,000 bricks each and the fact that the entire open-air manufacturing procedure from moulding to drying and burning has always been subordinate to weather conditions have been its severe handicaps. Particularly in this century such limitations have led to inflationary costs which can be indicated by the price at the kiln per thousand of a first-class building brick between 1858 and 1968:

1858	30s.	1918	40s.
1868	30s.	1928	85s.
1878	30s.	1938	90s.
1888	30s.	1948	240s.
1898	30s.	1958	360s.
1908	30s.	1968	540s.

Limited production, high overheads and insufficient returns increasingly underlined the brickyard's uneconomic position. By 1968 the last kiln was in a deteriorating and dangerous condition. The choice that faced the estate was either extensive modernisation and the introduction of machinery, or closure. The choice was for closure, and the last burn was in the week commencing 4 November 1968, the kiln being put out in the early hours of Saturday 9 November. The greater proportion of this last kiln were paving bricks for a car park in Storrington.

Not only has a centuries old tradition of clayworking now passed at Ashburnham; here has now ceased an ancient tradition of craftsmanship and primitive working no longer to be seen in this country.

PRODUCTION

The following account is based on personal observations during two brickmaking seasons (1967 and 1968), and conversations with the foreman, Mr. Jack Harmer, and his assistant Mr. Will Beale, the last two employees to work at the yard. It is important to re-emphasise that the methods were essentially no different from those indicated by the earliest known brickmaking engravings and descriptions.[17] What is perhaps even more important to consider is that despite the use of a most primitive technology, particularly at the burning stage, a high quality brick was produced, striking testimony to the skill in controlling both materials and techniques. It is perhaps one of the most impressive conclusions to be drawn from early technological practice that despite the use of the most simple and basic equipment a high level of control was attainable to produce a desired end. Possibly it is true to say that the mark of the craftsman is the degree to which he can freely relate and adjust method to produce a calculated objective without the use of sophisticated instrumentation and equipment. In this sense the more carefully one studies what was produced at Ashburnham in the light of the practices employed, the more it is possible to sense the level of skill achieved, a skill that has obviously only been acquired through patient, steady application during a lifetime's work.

The particular value of the record given in this section is that it embodies the recording results of the last two firings of the kiln, and an analysis of the bricks, through the co-operation and interest of Redland Bricks Ltd. It is thought this was the first occasion that a traditional type of brickyard has been recorded in this way in the country.

The plan of the yard was based on the need to ensure the most economic movement and smooth continuous production between the several processes involved, closely related to the topography of the site and the provision of raw materials. There is nothing haphazard about the layout, the design in fact providing a most efficient flow of production.

Briefly, the manufacturing process took the following form:

Loam cutting ——— loam
Sand winning ——— sand — preparation — moulding — drying — burning.

1. *Loam Cutting and Sand Winning*

The mould and topsoil having been removed, the clay, which was always referred to by the men as loam, was dug from within the brickyard area to a depth of about seven feet, using a tool called a graft. It was dug in strips about five feet wide, working from west to east across the loam bank. This bank is a substantial cross section through a narrowing tongue of Ashdown Sand (an inlier outcropping against the Wadhurst Clay caused by faulting) in which the brickmaking beds occur.[18]

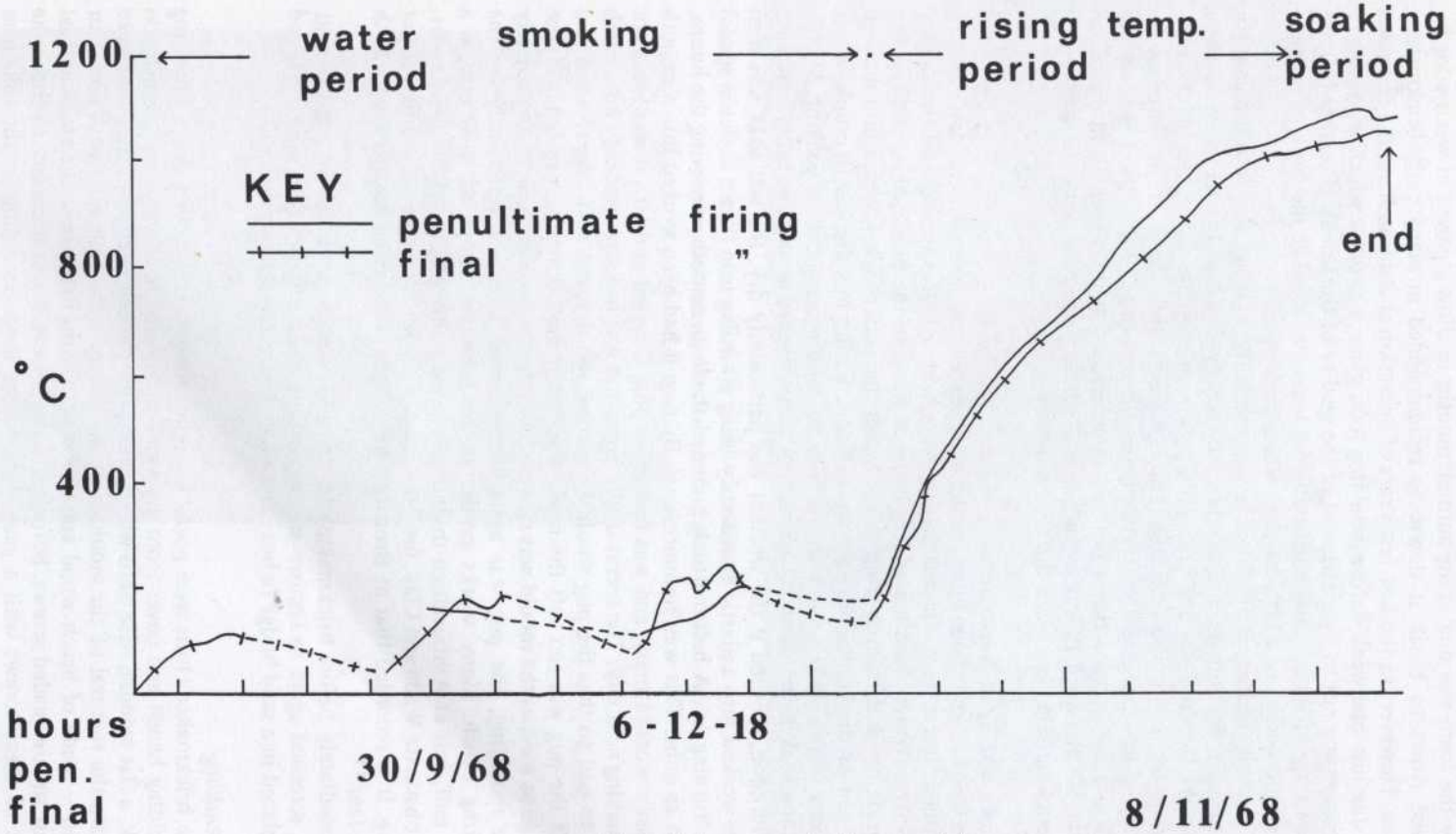

Fig.4 Firing curves for last two firings

(The dashed line on the graph indicates estimated temperatures, when no burner was present. Recording at the penultimate firing commenced late).

Ideally the loam was dug in the autumn months to allow a period of weathering by rain and frosts to break it down, as recommended in many early brickmaking treatises. However, in the last few years of operation at Ashburnham, the loam was often dug just one week before moulding took place, a practice which according to Mr. Harmer was not to the detriment of the quality of the bricks. He rather believes that the only effect of using non-weathered loam was to make the work of preparation and moulding just a little harder for the brickmaker.

Before brickmaking could begin it was necessary to bring sand into the yard for two purposes: for dusting the moulds and to provide a heat barrier in the hatch of the kiln. All the sand was dug from solid rock with pick and shovel at a small quarry known by the men as the sand hole. This is a quarter mile north of the Forge on the east side of the track leading to Ashburnham Furnace (TQ688163). The rock was broken and then passed through a scry (a screen) to make it as fine and smooth as possible. At the yard it was spread on a concrete pad in the sun, and stored in a little brick building known as the sand lodge.

2. *Loam and Sand Preparation*

The day before brickmaking, in the morning, enough loam for one day's making was pulled down from the weathering heap with a half-mattock, and thoroughly turned over. Water was then added, being at hand to the brickmaking area from a man-made conduit leading from Forge Pond; the bucket was lowered into the well at the end of the conduit using a water hook, similar to a shepherd's crook. Water and loam were mixed with a shovel, the procedure being called 'packing down a soak', the soak being the total amount of loam worked at any one time. Left until the afternoon, covered if the weather was particularly dry, the wet soak was then further worked into a plastic consistency using a turning iron (like a skeleton spade) called 'turning in'. A half-mattock pounded the loam smooth, removing the lumps, known as nubs. This was 'hummocking'. By now it had been worked into a smooth and easily worked mass, and was known as pug. Covered and left, it was ready for brickmaking next day. The secret of the operation was to know precisely how much water to add so that the pug would be neither too dry and stiff, nor too wet and soft. If the pug was too soft the brick would suffer by slumping, causing it to lose its shape as soon as the mould was removed. On the following morning, immediately before moulding, the pug was again turned, and then was quite ready for the moulding bench. Many works similar to Ashburnham tempered their clay in a horse mill, but at Ashburnham the horse mill was only employed for the heavier, more obstinate Wadhurst Clay, used not for bricks, but for tile, pipe and flower pot making. It is recorded that at Broadmayne, Dorset, tempering has been done with naked feet.[19]

Immediately before brickmaking started the dried sand was taken from the sand lodge, screened again to remove any superfluous waste matter (the sand grits) and then placed in a sand bodge (a box) and taken to the moulding bench.

3. *Moulding*

The brickmaker's huts were portable, eight foot square, wooden sheds, providing a moulding bench and cover from the weather. Secured to the moulding bench was a stock, a flat wooden base onto which the mould was set, the stock being hinged to facilitate the removal of the moulded brick. The mould – four sides with no top or bottom – made of beech wood and shoed with iron, fitted over the stock and sat on four square-headed screws. Before each day's work it was necessary to check the height of these screws with a gauge and to set them according to the thickness

PLATE III The brickyard

(*foreground* : empty hack covers; *background* : the two kilns)

PLATE IV

The hatch sealed

with 'skinkled' wall

required, depending on whether building or paving bricks were being made. At this stage the brick had to be made to a size in excess of that of the dried and burnt brick, to allow for shrinkage. Because of the high silica content (Appendix, table 2) the overall shrinkage from wet to fired state was in fact slight; shrinkage by width ranged between a quarter inch at the bottom (5.5%) to one eighth inch at the top of the kiln (2.7%). This is equivalent to an overall average shrinkage of 3.9%. In comparison the average shrinkage for a typical Wealden Clay brick is 9.2%.

With the stock adjusted, pug sufficient to make 36 bricks was placed on the bench, and from the lump enough to make one brick was separated by hand, or with a crescent-shaped cutter called a cuckle if the pug was stiff. The mould was then fitted on the stock, and both were sanded to prevent the freshly made brick sticking to the wood. This also had the effect of producing a slightly roughened surface, adding texture to the brick.

The art of moulding is to dash the pug into the mould with such force and at such an angle so that it will be spread evenly throughout the mould. The pug should strike the bottom centre of the mould, to ensure that air pockets do not form (in which water and frost would accumulate) and that the sand remains evenly distributed and not unduly disturbed in the mould.

The superfluous pug was struck off with an instrument similar to a rolling pin called a strike, lubricated by water (see Plate I). The stock was then hinged upwards, a thin pallet board being placed on either side of the mould, and the brick, now termed a green brick until it was burnt, was removed to a hack barrow, where the mould was taken from the brick and returned to the bench to make another brick. The average production rate at Ashburnham per brickmaker was between 500 and 600 bricks a day in 1967 and 1968, a relatively low rate as both moulders had also to perform all other brickyard operations. Until the last war when there had been more than a dozen working at the yard, there had been specialist division of labour, the moulder moulding bricks, nothing else, and thus the rate of production was much higher.

The hack barrow is a light framework supporting a flat latticework top to seat 36 bricks (see Plate II). As the green bricks had to be handled with great care at this stage, the barrow was so designed to provide the easiest of handling, being well sprung and balanced so not to require unnecessary force to drive. Its proportions were fundamental to its effective use. On this barrow the bricks were wheeled to the hacks along iron runways put down to ensure smooth movement.

4. *Drying*

The hacks are long narrow concrete strips onto which the green bricks were set off for the drying process, ideally to a height of seven bricks. The positioning of the hacks between the moulding area and the kilns accords with recommended practice for ease of movement within the yard. The drying process could take up to three weeks with favourable conditions in the summer, double if conditions were bad. As soon as the bricks could withstand movement they were re-arranged at an angle – called 'skinkling' – allowing them to catch the wind and so draw air through them to permit uniform drying. This was essential lest a differential rate of shrinkage in a brick should lead to shattering when in the kiln. There is also significance in the hacks running north to south, so that the bricks would receive an equal share of sunshine on each side for even drying. Wind, rain and frost had to be guarded against, and also excessive sun, and for this purpose wooden back covers were placed over the drying bricks when required (see Plate III). In earlier days this protection was given by straw. The bricks were ready for the kiln when bone dry to the touch and the colour had distinctly lightened.

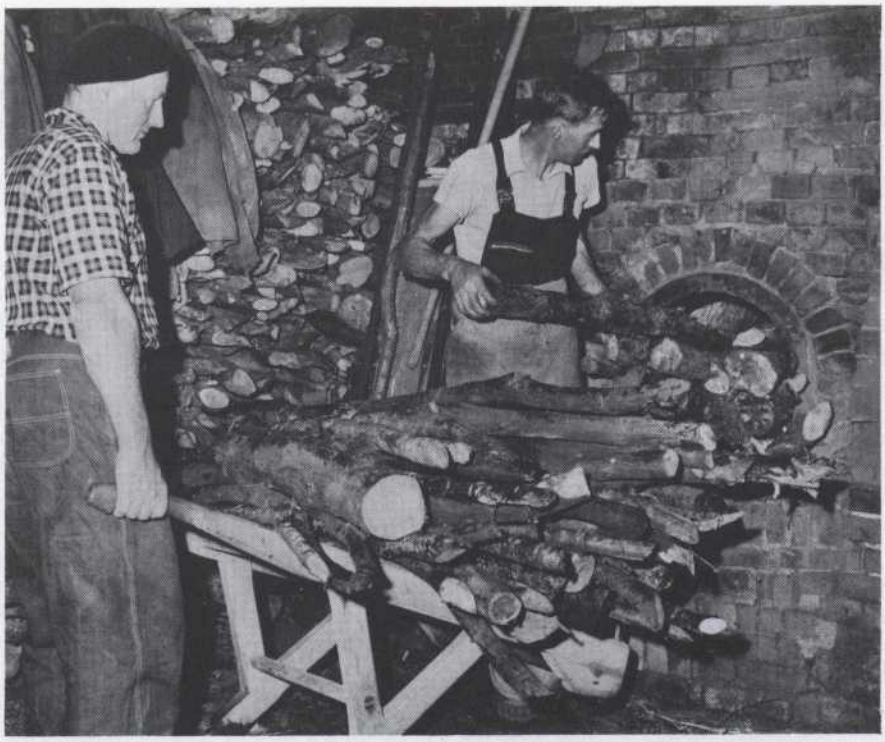

PLATE V Charging the fires with wood
(*left* : Mr. Will Beale; *right*, Mr. Jack Harmer)

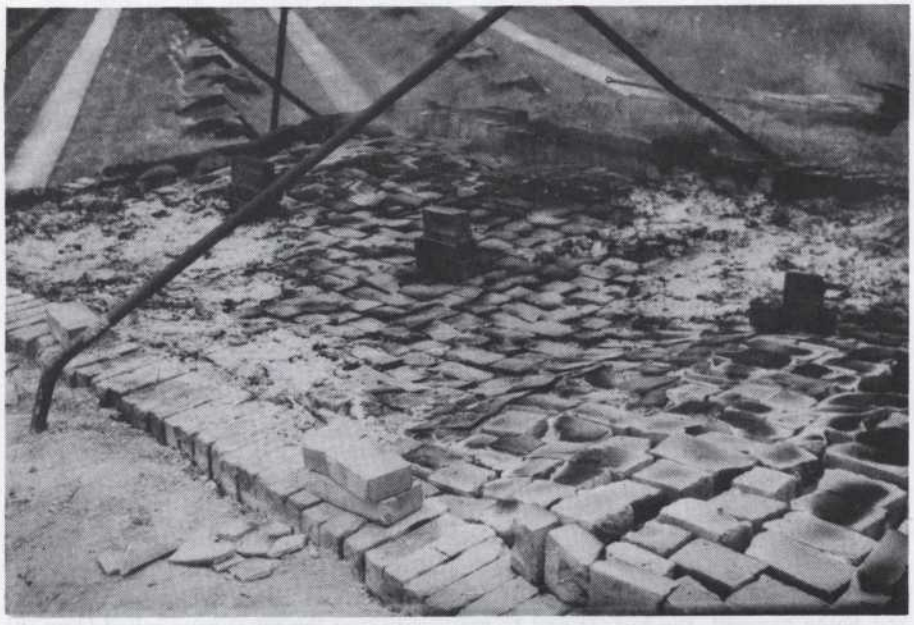

PLATE VI The Kiln top
(Note the bricks for the levelling procedure and the nine tiles on the left.)

5. *Burning*

There are two intermittent updraught kilns, originally constructed in 1840-1, the easterly of the two being the only one used during the last working years of the yard. They are both of the most primitive type, sometimes termed Scotch kilns,[20] or box kilns, each merely an open topped rectangular brick structure set in the side of an earth bank. This setting provides access at three levels; to the two fire tunnels beneath each kiln at the lowest level; to the kiln chambers with slotted floors through which the heat rises on the next level; and, by brick steps, to the top of the kilns so that various control procedures could be operated. Each kiln has an opening (a hatch) on the north side for loading and unloading, and on the south side is a low roofed covered shed (the hovel) to protect the men charging the fires, and also to prevent the wind urging the flames.

Each kiln was designed to accommodate approximately 20,000 bricks, although towards the end of the working life of the last used kiln the capacity was reduced to approximately 19,000. Kiln walls of this type have a tendency to lift themselves with the heat and this has been the cause of severe distortion at the top of the chamber, with consequent reduction in carrying capacity.

Setting (or filling) the kiln took up to three days, requiring considerable art to achieve two objects; first, to ensure continuous openings from floor to top for even heat distribution throughout, the second, to provide a firm, solid arrangement within the setting to prevent movement and thereby reduce the risk of severe damage.

When the kiln was full, the loading hatch was sealed to prevent loss of heat and minimise underfiring. This was affected by building a double wall of brick, with a cavity between, which was then filled with sand taken from the nearby sand hole. The upper half of the outermost wall was 'skinkled' to ensure a bond as no mortar was used (Plate IV). Sealing of the top of the kiln was by 'cladding down', that is by laying three courses of rough bricks to act as a heat barrier, but making sure that there were open spaces to allow an updraught. Unless the weather conditions were bad, the corrugated iron roof was removed before firing.[21]

Firing was necessarily preceded by a water smoking period using a slow, steady fire to both dry the kiln and drive off the remaining water content in the green bricks. The fires were lit at the far end of the fire tunnels with paper and brushwood faggots which flared immediately and gave maximum draw. It was necessary at this stage to see that the temperature did not rise too quickly, else there would be discolouring, or the bricks would twist, swell and lose shape. During the last two firings the maximum temperature recorded at water smoking was 240° C. (Fig. 4). In 1850-1 and 1853 coal was used for water smoking, presumably as an experiment which it was not considered worth repeating.

After four days of water smoking the temperature was gradually increased by stepping up the supply of fuel. Estate underwood was used, generally out in the winter: hornbeam, silver birch, willow, sycamore, alder, scots pine, and sweet chestnut. Preference, however, was for silver birch as it flares immediately, but failing an adequate supply most of the wood fuel was hornbeam. To increase and maintain the required temperatures the wood was continually fed to the fire tunnels, sufficient to fully occupy a burner for his entire six hour shift. Charging the fires (see Plate V) literally provided no respite, painfully experienced by the writer who worked through a full midnight to 6 a.m. shift in 1967! When the fires were not being charged, the burner had to make sure that the ashes were raked from the tunnels using a revel, a long wooden pole with a flat wooden board wedged on the end. The revel was soaked in running water for at least six months before use to

withstand the intense heat. In earlier days, until about 1930, it had been necessary to employ at least two burners at each kiln then used, as fiercer–burning brushwood faggots were used instead of cordwood.

Lots of plasticity and conversion to a rigid body occurs during the burning process; on the last two firings this took 50 and 54 hours respectively. On these occasions a pyrometric thermocouple connected to an indicator was inserted into the centre of the kiln to determine the rate of temperature rise. As will be noted the resulting firing curves (Fig. 4) the gradients during the rising temperature periods were steep, from 200°C. to 1,000°C. in 30½ and 34 hours in each case. This is a rapid rise when seen against comparable figures for a standard commercial brick.[22] The Ashburnham bricks could withstand this rapid increase on account of the high silica content–over 75 per cent–whereas many commercially made bricks would shatter were they subjected to such a sharp temperature rise. After about 40 hours, maximum temperatures were approached, and then maintained for a soaking period of approximately eight hours, which was essential in improving the evenness of heat distribution. The peak temperatures reached during soaking at the last two firings were 1,100°C. and 1,070°C. respectively. It is an instructive comparison to note that Redland bricks are soaked at peak temperatures–which are generally below 1,070°C.–from anything between 18 and 30 hours against the eight at Ashburnham.

What is remarkable about the Ashburnham procedure is that the kiln was controlled without the use of measuring equipment, but by the feel that comes of years of experience and the use of three simple devices.

Firstly, maintenance of the heat at a fairly level rate during the soaking period was gauged by observing the colour of the fire tunnel walls. Mr. Harmer says he was taught this by being given a gold sovereign to keep in his hand as he charged the kilns. Its colour had to be matched and maintained for a specific time.

Secondly, if the burning was overdone the bricks could be mis-shapen and mis-coloured. The critical problem, therefore, was to know exactly the right time to stop the firing. This was achieved by 'levelling', based on the principle that the total mass of burning bricks within the kiln reduces its height by shrinkage. The amount of shrinkage will indicate the amount of burning and make it possible to produce a calculated brick size to withing one-sixteenth inch accuracy.

On the rim of the kiln top three level sights lines were constructed. One of these sight lines is shown at two stages of the firing in the two cross sections (Fig. 5). Two bricks were placed on either side of the kiln, and on each pile nine pieces of broken tile were placed. In the centre of the kiln were then placed three bricks, the top most being on edge. With expertise the three points made a dead level sight line across the top of the kiln. See Figure 5 (a). Plate IV shows Mr. Harmer stooping to adjust the level of one of these sight lines. After about 40 hours the mass of bricks began to shrink as the maximum temperatures were reached, and thus the three centre bricks fell in height, thereby destroying the level of the sight line. The level could only be maintained, therefore, by removing, one at a time, the nine pieces of tile on each side of the top of the kiln.

With all the tiles removed at this stage the top brick on each of the piles on the kiln rim would be level with the brick set on edge at the kiln centre. This was being 'down to brick and edge'.

At this point the fires were left for one hour; the fire tunnels were not re-fuelled, and 'the tins were put up', that is metal covers were placed over the tunnel throats (the end through which the fires were charged) to exclude draught. The effect of this was to drive the heat to the top of the kiln away from the more well-cooked bricks at the bottom. This encouraged more uniform burning.

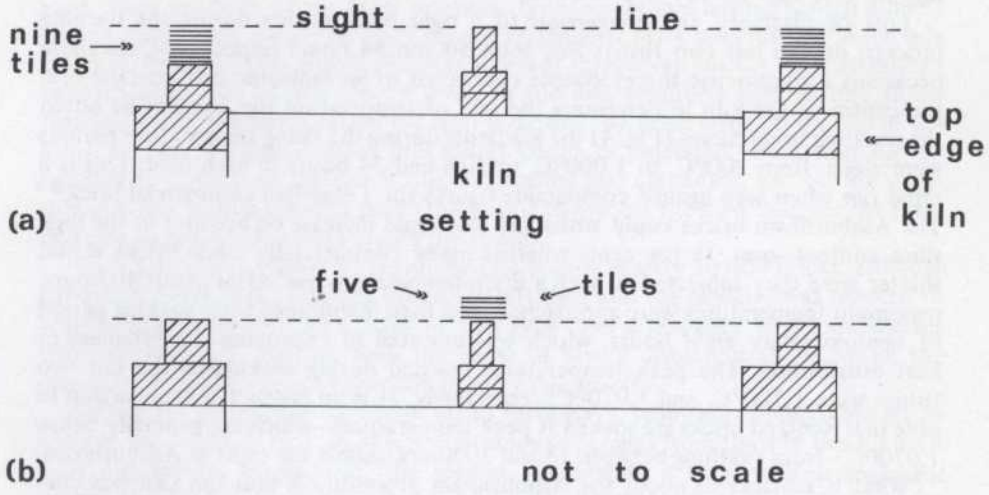

Fig.5 Levelling the Kiln

After one hour pieces of tile were placed on the brick on edge at the centre. See Figure 5 (b). Burning would then restart, and there was thus further shrinkage. When the topmost tile, through this shrinkage, was level with the top two bricks on the side of the kiln, the shrinkage that had been undergone was sufficient to indicate that the bricks were by now adequately burnt. At this point 'the tins were put up', i.e. firing ceased.

Thirdly, the other problem to be overcome was that the kilns have shown a tendency to concentrate heat on the south sides, due possibly to faulty reconstruction of the tunnel arches. The effect has been that bricks on this side have always shrunk faster than elsewhere, and it has been necessary to restrain the heat at this point and drive it elsewhere to achieve more uniform burning. A method of 'damping in' was used by digging clay, rather oddly but conveniently, from between the top of the two kilns, mixing it with water to make a slurry, and spreading it on the top of the kiln over the over-heating area to block the updraught. During the last firing a test was made to indicate the variations in temperature experienced at various positions throughout the kiln, and this clearly demonstrated this tendency towards unequal heat distribution (Fig. 6).

This test well underlines the basic problem of working such a primitive kiln, the problem of trying to guarantee the production of good quality bricks by a method which involves so many uncertain variables. The test took three sections through the kiln and within each level were placed nine Bullers Firing Trial Rings at positions indicated in the diagram below, (Fig. 6). These rings work on the principle of contraction resulting from heat treatment, their radial shrinkage being measured on a gauge which indicates the contraction in diameter as a number. Each number is associated in a table with a nominal temperature which shows the heat treatment over the full burning period. The diagram shows these numbers and their associated nominal temperatures. The results of this test demonstrate the following points:

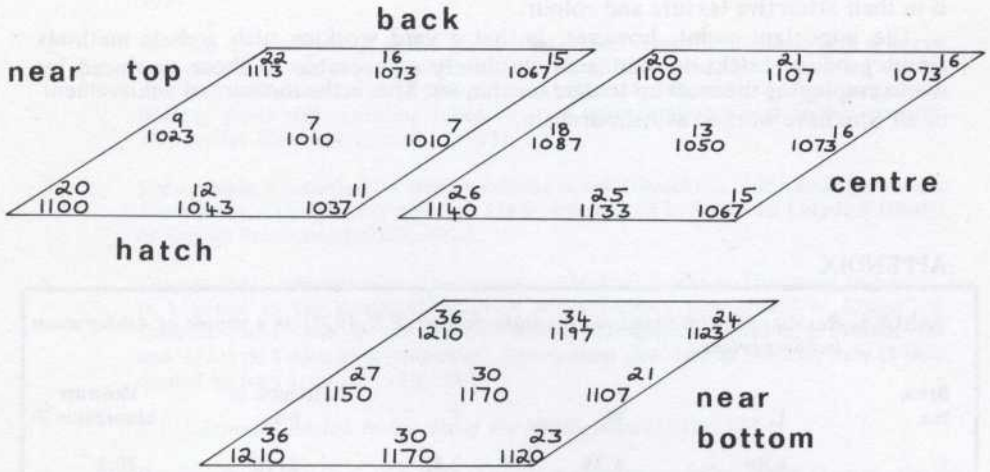

Fig.6 Bullers Firing Trial Rings test at last firing

1. The variation in temperature between the back and front of the kiln (which would be considerably greater were it not for 'damping in').

2. The variation in temperature between the bottom and top sections in the kiln.

3. One or two of the nominal temperatures are high and this could be due to the rings being in direct contact with the flames from the fire in the kiln.

4. Given the method of firing employed, each section is reasonably uniform.

When the firing had finished, care had to be exercised to avoid opening the kiln too soon so as to ensure that cooling was gradual. At the last firing five days elapsed.

Normally 75 per cent of the bricks produced in a firing were first class in grade. As this percentage best in the product of a modern kiln would be good, it is proof of the effective control over the manufacturing process. The bricks produced were sand-faced Ashburnham reds, distinguished by their rich red colour (revealing their iron content), and by the burnt grey ends of those whose heads had been exposed to the direct fire. At the time of writing no research has been conducted into the cause of this burnt grey deposit, although it is possibly potash-glass derived from the burning of the wood in reaction with the silica and alumina. In the nineteenth century and earlier these grey headers were worked into patterns, in which connection Ashburnham Place has already been cited. Another excellent example is Forge Lodge on the estate.

Craftsman-made bricks such as this, like any other craft product, are generally considered to be superior in quality to those mass produced by machine. Certainly Ashburnham bricks have a high reputation–'the best bricks in the world' is the understandable boast on the estate. It was thus the final purpose of recording to try and reach some objective conclusions about the quality, and so a sample of ten building bricks was tested at the Redland Brick Laboratory at Horsham to British Standards Institution tests (B.S. 3921).

Table 1 in the Appendix is the result of these tests, and from these results it may be concluded that these bricks were of good acceptable quality when compared with hand-made bricks produced by Redland. Their particular quality and popularity is in their attractive texture and colour.

The important point, however, is that a yard working such archaic methods could produce bricks to standards absolutely comparable to those produced by works employing the most up-to-date techniques. This is the measure of achievement of all who have worked at Ashburnham.

APPENDIX

TABLE I. *Results of British Standards Institutions tests (B.S. 3921) on a sample of Ashburnham building bricks*

Brick No.	L.	W.	T.	Strength in p.s.i.	Moisture absorption %
1	8.80	4.25	2.55	3110	20.2
2.	8.70	4.25	2.60	4480	17.8
3	8.80	4.25	2.55	4310	21.0
4	8.75	4.30	2.50	4220	18.5
5	8.80	4.20	2.50	3150	20.6
6	8.70	4.10	2.50	4650	18.7
7	8.70	4.20	2.50	4290	17.6
8	8.75	4.25	2.50	4120	19.5
9	8.70	4.10	2.50	4900	18.4
10	8.80	4.20	2.50	2060	22.1
av.	8.75	4.20	2.50	3930	19.4

TABLE II. *Chemical Analysis of Ashburnham brick loam*

SiO_2	76.357
Al_2O_3	9.990
Fe_2O_3	5.320
CaO	1.800
MgO	0.430
Na_2O	0.674
K_2O	1.686
Loss on Ig.	3.450
Not determined	0.293
	100.000

REFERENCES

1. Rev. Arthur Young, *General View of the Agriculture of the County of Sussex* (1808), 205.

2. In 1946 an anonymous writer stated that it was doubtful if there were a dozen brickmakers in the country who still used wood fuel, 'Brick Burning with Faggots', *The British Clayworker*, lv (1946), 37-8. A request by the writer asking about wood-burning yards still operating failed to elicit information relevant to this country, *The British Clayworker*, lxxvii (1968), 54.

3. For example, illustrations in 'Nederlandische Bijbel' (Utrecht, *c.* 1425), and Hartmannus Schopperus, *PANOPLIA* (Frankfurt, 1568), reproduced in Nathaniel Lloyd, *A History of English Brickwork* (1925), 390-1.

4. For example, description in 'The manner of Making Bricks at Ebbisham, in Surrey, in a Letter to the Worshipful Captain James Twiford, now Sheriff of Bristol', *A Collection of Letters for the Improvement of Husbandry and Trade*, ii (1683), 186 and 'L'Art de Tuilier et la Briquetier', *Descriptions des Arts et Metiers*, xxiv (1761), quoted by Lloyd, *op cit.*, 33-5, 30-1.

5. L.F. Salzmann, *English Industries of the Middle Ages* (1913), 123-4.

6. Documentary evidence of brickmaking at Ashburnham before 1840 is given, for example, in the Stewards' Day Books, 1756-1823 in East Sussex Record Office, Lewes, (hereafter referred to as E.S.R.O.), Ashburnham MSS. 1633-9.

7. E.S.R.O., TD/E68, Ashburnham Tithe Map, 1839.

8. E.S.R.O., Ashburnham MS. 1173, Edward Driver, 'A Survey and Valuation of the Estates in Sussex. . . .' (1830), 18.

9. E.S.R.O., Ashburnham MS. 1735, 77-8.

10. Christopher Hussey, 'Ashburnham Place, Sussex, III', *Country Life*, cxxiii (1953), 1334-8.

11. E.S.R.O., Ashburnham MSS. 1735-49.

12. Either Patent no. 10,481 (1845) or no. 11,155 (1846).

13. '. . . .machines, however, are not yet in anything like common use.' *Morton's Cyclopedia of Agriculture* ii, n.d. *c.* 1850), 346. Clearly the estates of landed proprietors were amongst the first to implement the use of new techniques. Compare the Goodwood Estate brickworks at Westhampnett. As early as 1786 consideration was being given for brickmaking machinery, West Sussex Record Office, Chichester, Goodwood MS. E5408, p.355.

14. Compare the small brickyard at Broadmayne, Dorset, typical of a small country works, mainly supplying a ten mile radius, but with the occasional exotic order, as at Cosham and London. Donald Young, 'Brickmaking at Broadmayne', *Proceedings of the Dorset Natural History and Archaeological Society*, lxxxix (1968), 319.

15. E.S.R.O., Ashburnham MS. 1496.

16. These figures, and others quoted in this paper to 1968, are from uncatalogued documents still retained in the Ashburnham Estate Office.

17. See references 3 and 4, and James Malcolm, *A Compendium of Modern Husbandry of Surrey, illustrative also of the best practices in the neighbouring counties, Kent, Sussex, &c.* (1805), 74-92.

18. G.S. Sweeting, 'The Geological Structure of the Ashburnham Battle and Crowhurst Districts (Sussex)', *Proceedings of the Geologists' Association*, xli (1930), 44-52.

19. Donald Young, *op cit.*, 320.

20. F.H. Clews, *Heavy Clay Technology*, 2nd edn. (1969), 237, and anon., 'Scotch Kiln', *The British Clayworker*, liii (1944), 116-7.

21. At Broadmayne the iron roofs of the Scotch kilns were not removed until after the first day's burning. The gable ends were filled with loose bricks to complete the roof seal. Donald Young, *op. cit.*, 321. This extra sealing layer was possibly used at Broadmayne because coal, rather than wood, was used, the fires being much less fierce using the former.

22. The problem was to decide on such a brick. Consultation with Redland Bricks Ltd., resulted in the choice of machine-made Tonbridge kiln stocks, of Wealden Clay. Their rising temperature period, over the range 320°C.–960°C. has been recorded for a duration of 60 hours.

ACKNOWLEDGEMENTS

The author gratefully records the co-operation of the Reverend J.D. Bickersteth for access not only to the brickyard but also to documents retained at Ashburnham, and to the staff of the East Sussex Record Office, Lewes. This paper could not have been written were it not for the interest and enthusiasm of Messrs. Jack Harmer and Will Beale, and for the most generous and unstinting help at all stages from Redland Bricks Ltd. The firing curves, ring tests, B.S.I. tests and chemical analysis of the loam have been produced by Messrs. A. Watts and M. Worcester of the Graylands Laboratory, Horsham. Help and encouragement with ideas and references have come from Messrs. J. Kenneth Major of Reading and John Farrant, the Editor. The kiln plan and section has been based on detailed records prepared by Mr. W.R. Beswick of the Sussex Industrial Archaeology Study Group. The finished art work owes much to the help and advice of Mrs. Marjorie Hallam of Heyshott who considerably improved my original drawings.

A report on the associated tileworks at Ashburnham will appear in a future issue of **Sussex Industrial History**.

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D.F. GIBBS & J.H. FARRANT

The Upper Ouse Navigation 1790-1868

Sussex at the end of the eighteenth century was essentially an agricultural county with no large industry. In that age of agricultural improvement, stimulated in Sussex by the demand for food from London and later by the Napoleonic Wars, any means of increasing agricultural productivity was readily seized upon. Hence, each of the rivers Arun, Adur, Ouse and Eastern Rother, running roughly parallel to each other into the heart of Sussex, was improved for navigation by local landowners.[1] P.A.L. Vine, in his book *London's Lost Route to the Sea,* has written admirably about the Arun Navigation, its crucial Act of 1785 and its role along with the Portsmouth & Arundel Canal, the Wey & Arun Junction Canal and the Wey Navigation in linking London to Portsmouth by waterway. The Adur, with its mouth at Shoreham, was improved for navigation by an Act of 1807[2] and later extended further inland by the Baybridge Canal Act of 1825.[3] The Western Rother, too, was canalised by an Act of 1791[4] and the Eastern Rother flowing out at Rye, and used along with the River Brede by the Wealden ironmasters since Tudor times, was gradually improved. The Ouse was improved under Acts of 1790 and 1791, which created two bodies: the Trustees of the Lower Ouse Navigation and the Company of Proprietors of the River Ouse Navigation, which were responsible for the river below and above Lewes respectively. Although today the small volume of water in the river does not readily suggest it, these bodies made it navigable for barges for thirty miles inland and for sea-going vessels up to Lewes, a distance of nine miles. This article reconstructs the history of the Upper Ouse Navigation Company and describes the physical remains of its works.[5]

I

The river was navigable in part before the improvements. A map of 1724 shows boats at Maresfield Forge, four miles up a tributary which joins the Ouse eight and a half miles above Lewes, with a lock at the junction; remains of the lock are still visible.[6] The river was used for the export of iron from the furnaces and forges of the Weald, and Straker claims that it was second only to the Medway in this respect, but like all sixteenth and seventeenth century navigations it would have suffered from flooding and drought, as it is unlikely that any steps were taken to improve the river, other than at its mouth at Newhaven. In 1790, it was evidently navigable only to Barcombe mill, four miles above Lewes.[7]

With the great revolution in communications in the latter part of the eighteenth century, evidence of the success of river navigations and canals in the industrial Midlands and North spread into the agricultural counties of the South. The river Ouse was an obvious candidate for improvement with, at its mouth, a harbour consistently held by its advocates as the best between the Downs, off Sandwich and Deal, and Portsmouth, and a course which connected the Weald, where lime was in growing demand as a fertilizer, with the chalk pits of the South Downs. Industrial potential, however, was seen by only a few optimists, such as the newspaper correspondent who wrote in 1787 that 'SUSSEX, in the manufacturing of her WOOL and IRON, might *yet,* by attending to the improvements of her inland

navigation, rival the whole WORLD, in these two articles of commerce.'[8]

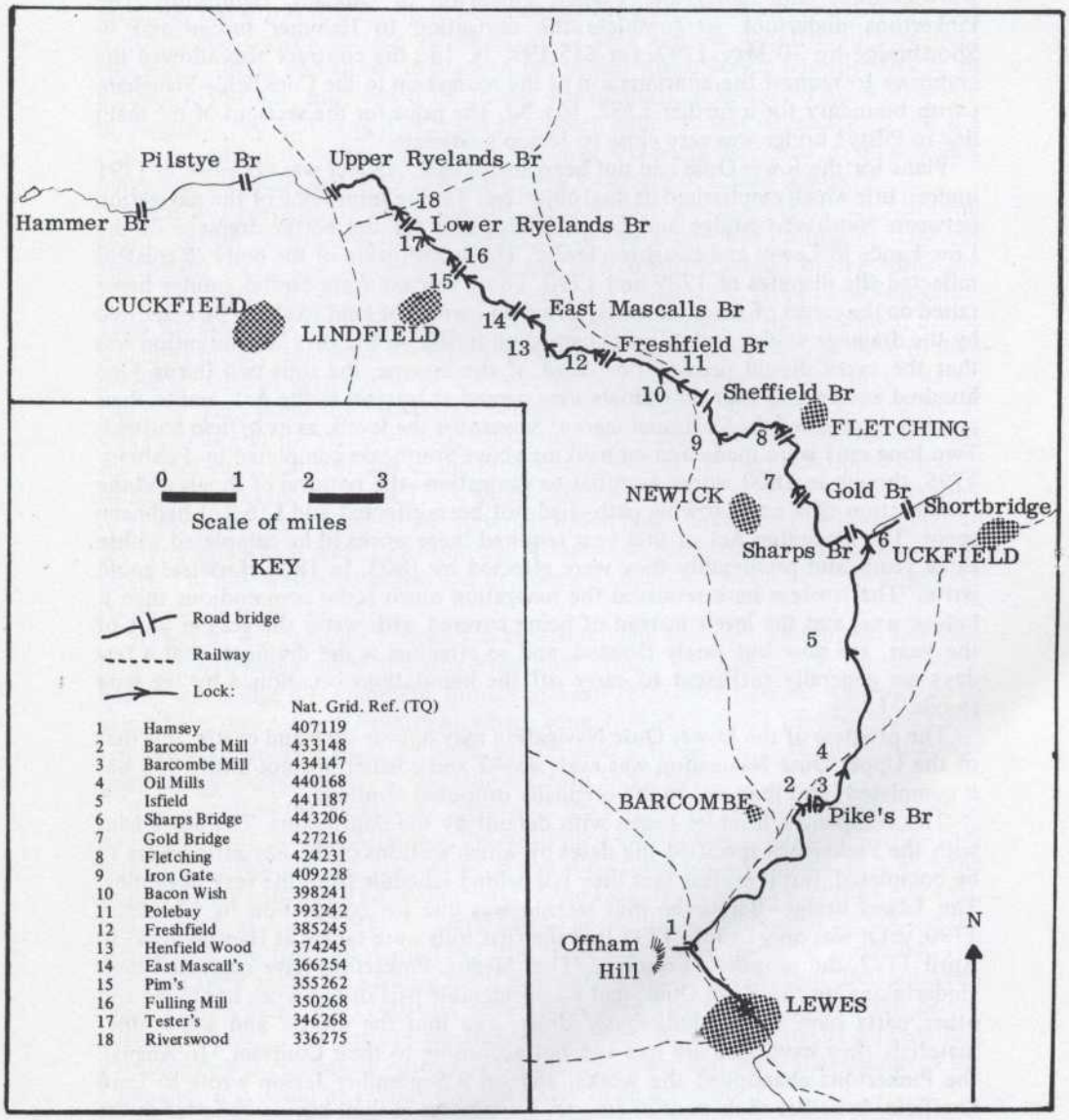
In 1768, John Smeaton reported on the drainage of the Lewes and Laughton Levels and noted that his recommendations would benefit navigation of the river, but only piecemeal improvements were made in the next twenty years. The initiative which led to the improvements of the 1790s seems to have been taken by Thomas Pelham of Stanmer Park, one of the M.P.s for Sussex, in inviting William Jessop to report on the navigation of the Ouse below Lewes and on Newhaven harbour.[9] Jessop was already a leading engineer of canals and river navigations; in Sussex he had previously reported on the river Arun in the late 1770s or early 1780s and on the Western Rother in 1783; in 1786 he was engaged for the construction of canals and dams to form a new harbour at Rye, which was completed in August 1787, but was abandoned three months later, when the old harbour had to be reopened.[10] His preliminary observations were sent to Pelham in August 1787. In October, a meeting at Sheffield Green, chaired by Pelham, resolved that the extension and improvement of navigation above Lewes to Slaugham Place would be beneficial, and a subscription was raised to pay Jessop for a further survey and estimate.[11] Hereafter, the leadership in improvement of the upper Ouse passed to John Baker Holroyd, Lord Sheffield, by far the greatest of the owners of land through which the intended navigation would pass.

Jessop's report on the upper Ouse was dated 26 October 1788 and proposed a navigation from Lewes bridge to Pilstye bridge, just beyond the present Balcombe–Cuckfield road. It was to have a minimum depth of 4 feet and width at the water's surface of 24 feet, and 27 locks to take barges of 30 tons burden. He estimated the constructional costs at £13,595.[12] He emphasised that improvement of the river below Lewes (at an estimated cost of £1,980) was an essential corollary of an upper Ouse navigation, and it was evidently Sheffield's hope to obtain an Act giving powers both above and below Lewes. But because any works on the lower Ouse would be concerned with drainage as much as with navigation, and because it was already navigable free of charge (and hence there was opposition to a company with perpetual powers to levy tolls), Sheffield's compromise formula was not accepted, and petitions for two Bills were presented to the House of Commons early in 1790.[13] Unfortunately the Bills were mutually exclusive as both sought powers for the section of river between Lewes bridge and Barcombe mill. The Lower Ouse Bill did not progress beyond a second reading–perhaps in part because a further survey by Jessop was deemed necessary, which resulted in a much increased estimate of £6,472. In Committee, the Upper Ouse Bill had to contend with several petitions relating to the Lewes bridge–Barcombe mill section, and clauses were introduced to allow toll-free passage up to the mill until £500 had been expended on that part of the river, to give compensation for cuts already made at Hamsey, and to guarantee a minimum head of water for the mill.[14]

The Bill as enacted in April 1790 was for the execution of Jessop's scheme continued to the boundary of the parishes of Cuckfield and Slaugham, for a branch to Shortbridge for Uckfield, and for a cut to Offham chalk hill. The Act incorporated a company of (initially) 45 proprietors authorised to raise £25,000 in shares of £100, of which £10,000 were to be subscribed before any action was taken. The tolls laid down indicated the anticipated traffic of agricultural produce and fertilizers, road materials and coals.

The first meeting of the proprietors was held at the *Sheffield Arms*, Fletching, on 7 June 1790, and a committee of management was elected. Henceforth there were half-yearly general meetings of the proprietors, but also a fair number of extraordinary meetings, and it is of both of these that the minute books survive. On

THE UPPER OUSE NAVIGATION



		Nat. Grid. Ref. (TQ)
1	Hamsey	407119
2	Barcombe Mill	433148
3	Barcombe Mill	434147
4	Oil Mills	440168
5	Isfield	441187
6	Sharps Bridge	443206
7	Gold Bridge	427216
8	Fletching	424231
9	Iron Gate	409228
10	Bacon Wish	398241
11	Polebay	393242
12	Freshfield	385245
13	Henfield Wood	374245
14	East Mascall's	366254
15	Pim's	355262
16	Fulling Mill	350268
17	Tester's	346268
18	Riverswood	336275

the other hand the committee of management with a membership of five could meet at any time and has left no evidence of its activities. At the same meeting the subscribers were called upon for a downpayment of £10 per cent. On 17 November the agreement for construction was signed with Thomas Pinkerton of Coleshill, Warwickshire, and James and Francis Pinkerton of Odiham, Hampshire. The Pinkertons undertook to complete the navigation to Hammer bridge and to Shortbridge by 30 May 1792, for £15,199. 1s. 1d.; the contract also allowed the company to request the continuation of the navigation to the Cuckfield–Slaugham parish boundary for a further £382. 16s. 8d. The price for the sections of the main line to Pilstye bridge was very close to Jessop's estimate.[15]

Plans for the lower Ouse had not been abandoned. An Act was obtained in 1791 under a title which emphasised its dual objective: 'for the Improving of the navigation between Newhaven Bridge and Lewes Bridge and for the better drainage of the Low Lands in Lewes and Laughton levels'. The constitution of the body of trustees reflected the disputes of 1789 and 1790. There was no share capital, money being raised on the credit of taxes, or scots, levied on owners of land likely to be benefited by the drainage works, and of tolls charged on traffic on the river; the intention was that the taxes should provide one third of the income, the tolls two thirds. One hundred and twenty four individuals were named as trustees in the Act, and to their number were added the Commissioners of Sewers for the levels, as *ex officio* trustees. Two long cuts were made and embanking above Southease completed by February 1795, though in 1800 works essential to navigation–the removal of shoals and the construction of a horse-towing path–had not been effected and £16,371 had been spent. The amending Act of that year required these works to be completed within three years, and presumably they were effected by 1803. In 1824 Horsfield could write: 'The trustees have rendered the navigation much more commodious than it before was, and the levels instead of being covered with water the greater part of the year, are now but rarely flooded; and so effectual is the drainage, that a few days are generally sufficient to carry off the inundations occasioned by the land floods.'[16]

The progress of the Lower Ouse Navigation may appear slow and costly, but that of the Upper Ouse Navigation was even slower and costlier, for not until 1812 was it completed–and then not to the originally proposed terminus.

The company's troubles began with default by the contractors. The agreement with the Pinkertons specified the dates by which sections of the navigation were to be completed. But it is clear that they fell behind schedule from the very beginning. The Lewes bridge–Barcombe mill section was due for completion by Christmas 1790, yet it was only in July 1791 that the first tolls were taken, at Hamsey lock. In April 1792, the proprietors resolved 'That Messrs. Pinkertons have neglected their Undertaking on the River Ouse, that a Considerable part of the Work has failed and other parts have been injudiciously done, and that the mortar and some other materials they have used are bad and not according to their Contract.' In August, the Pinkertons abandoned the works, and on 3 September Jessop wrote to Lord Sheffield: 'whether their want of [money] originates in their having undertaken the work for less than it could be performed; or from losses by the badness of the seasons; or from their having misapplied it, whatever may have been the cause, the consequence must now be the neglect of the work, and the flight of the Men from their Creditors.' (They did not flee far: during the winter and following spring, Francis Pinkerton was directing the works on the lower Ouse.)[17] The implication was that the company had starved the Pinkertons of the necessary cash with which to fulfill their contract, yet they had been paid £14,000 by the end of 1791, and one

proprietor reckoned that at least £4,000 was needed to complete the navigation to Hammer bridge, so clearly the contract prices were being exceeded. The Pinkertons, who were often associated with Jessop and were probably given the contract on his recommendation, have been noted for miscalculated estimates, and their tender does look suspiciously low. For not only was it very close to Jessop's original estimate, but it was also for more extensive works than Jessop allowed for, with the width at the water's surface increased to 27 feet and the materials for the locks changed to brick and stone, in place of the timber which Jessop had specified as an economy. Further, supervision by Jessop was minimal, as he visited the works only in August 1790 and May 1792. On the other hand, it was necessary to use the costly expedient of coffer dams when the river was being deepened, as no dredging barge was available, and there may have been shortages of skilled labour.[18]

What was particularly disastrous for the company was that the money had been spent, not on completing the navigation up to one point, but on digging cuts and embanking along the whole length of the river up to Hammer bridge while the craftsmen progressively built the locks, altered the bridges, etc. from Lewes upwards. Thus the company could get no return on a substantial part of its investment unless still more money was spent, while landowners were aggrieved at damage done to their property without getting any of the benefits of a navigation through their estates. Quite to what point the Pinkertons completed the navigation is not known, but it was probably in the vicinity of Fletching mill. Work seems to have continued under the direct supervision of one of the proprietors, so that the river was open to traffic to Sheffield bridge by April 1793, but it probably stopped there.[19] In the summer of 1794, orders were given to sell materials which had been bought for use higher up the river but which were deteriorating. A report to the proprietors in August 1796 referred to this 'Well-nigh useless and declining Navigation', and noted 'the imperfect construction of the locks'.

However, the previous February a superintendent had been appointed, and slow progress was being made towards Freshfield bridge: by July 1799, the last lock before the bridge was complete, though in April 1800 the bargemen who wanted to bring bark down from Freshfield wharf were told they could take up shoals and reimburse themselves from the tolls, and no clear statement that the navigation was open to that point appears in the minutes until July 1805.

The default of the Pinkertons aggravated the company's financial position, which had never been strong. Although the authorised capital was £25,000, only £12,700 was paid up (though the number of shares subscribed for was about 132, as some were not fully paid up). The amount paid to the Pinkertons was in excess of this sum, and as early as June 1791, the clerk had to be authorised to borrow £5,000 on the security of the tolls. In April 1793, the proprietors were told that funds had run out, and were asked to advance loans amounting to £20 per cent on their subscriptions. Furthermore, the 1790s and early 1800s were a period of rapidly rising prices, induced in part by the costs of the Napoleonic Wars. Hence, the cost of constructing a waterway was constantly rising and each delay meant that the initial capital of the company–if it could be raised–was less likely to be sufficient.[20]

The minutes of the next ten years make constant reference to loans, to unfortunate subscribers badgered for more and to creditors demanding payment. Following legal actions against the company for debt the tolls were assigned in June 1797 to Joseph Mighell and in December 1800 to Samual Waller, the clerk; in February 1800 Lord Sheffield gave notice of action for land taken without payment. The tolls were insufficient to meet even the interest payments on loans (or, as Sheffield asserted in 1810, were being misappropriated from 1800 by Waller). In September

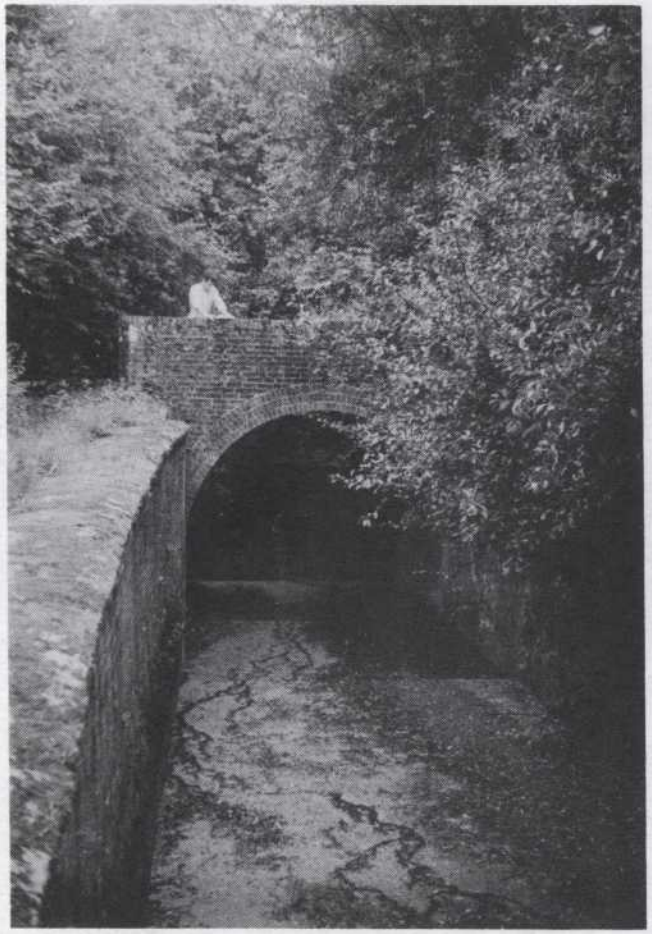


PLATE I Bacon Wish lock and bridge

PLATE II Pike's bridge with Barcombe Mill
1 and 2 locks above and below

1805, the company's debt totalled £13,591, made up of mortgages secured on the tolls (£7,277), unpaid interest (£3,702), land not paid for (£1,726) and other debts of £886.[21]

Nevertheless, there was a renewed effort to complete the navigation. In February 1802, the proprietors resolved that an engineer should estimate for the completion of the Freshfield bridge–Lindfield bridge section, but although it may be assumed that at this time James Creasey was appointed engineer, nothing was achieved until 1805 when the proprietors resolved in favour of the extension and steps taken to procure a new Act.[22] The Act of 1806 clarified the company's power to borrow on security of the tolls and set the limit at £30,000, and authorised the company to abandon the powers to extend the navigation beyond Hammer bridge, a reduction of a little over a mile. Dymoke Wells, a local man of much energy, then tendered to complete the navigation to Lindfield bridge for £3,000, payable in securities on the tolls, and a new engineer was appointed, Creasey having died early in 1807–William Smith, 'the father of English geology', who at this period was principally employed on mineral surveys but had worked on the Somersetshire Coal Canal from 1793 to 1799.[23] Smith estimated the extension of the navigation from Lindfield to the proposed Horley–Whiteman's Green turnpike, which was to cross the river just below Pilstye bridge, at £4,224. Wells contracted to complete this section for £1,500 cash, £1,500 mortgaged on the tolls and 30 of the original £100 shares, valued at £50 each. The first barge reached Lindfield in December 1809, and, Wells's contract now evidently extending only to Upper Ryelands bridge, the navigation was opened to that point on 27 April 1812.[24]

Beyond Upper Ryelands bridge, 22 miles and 18 locks from Lewes, the navigation was never extended, but there were ambitions to do so. Not only did the proprietors require Smith to estimate for completion to Hammer bridge, but Wells had his own plans which do not seem to have been communicated to the proprietors, though he acted in concert with Samuel Waller and his son John. In 1810, John Rennie revived his scheme of 1803, in an amended form, for a canal to connect the river Thames with Portsmouth. At its eastern end, the Grand Southern Canal was to run from the river Medway at Tonbridge, through Edenbridge to Horsham, with a branch to the Ouse, though this was not included in the published plan.[25] Smith took the levels for the branch, which was to leave the Ouse just west of Riverswood lock, rise by ten locks to a tunnel under the Forest Ridge, 1200 yards long and close to the line of the modern railway tunnel, and, running due north, descend by eight locks (and pass through property owned by Wells) to the Grand Southern Canal near Three Bridges. The plan was deposited with the Clerk of the Peace, as notice of intention to apply for an Act, by John Waller.[26]

Smith's connection with the company ended with the completion of Wells's second contract, but Wells now had a commanding position in the company through the shares received in part-payment and through the failure of proprietors of longer standing to attend meetings. Indeed, he asserted to Sheffield in March 1813 that 'since I have become one of the Committee I have had the Sole Management of their Concerns', and despite the failure of Rennie's scheme to get Parliamentary approval, he still held out hopes of effecting an inland waterway to London. In the same month, a Bill was read for the first time in the Commons, to allow the company to increase its share capital by £32,000, of which £19,000 would be used to convert existing mortgage debts and the balance of towards £13,000 to extend and maintain the navigation. But through strenuous opposition by Sheffield, who was principally concerned to safeguard the creditors under the 1790 Act and to stop the alleged misappropriation of the company's income, the Bill failed, and the Act which passed

in 1814 merely allowed an increase in the tolls and laid down that the tolls were to be used first for the upkeep of the navigation and then for the discharge of interest.[27] By this time, the one scheme to avoid the sea journey round Kent which was to be effected—the Wey & Arun Junction Canal—was under construction, and there was no scope for a rival route.[28]

Dymoke Wells's name ceased to appear in the minutes, and no more was heard of continuing the navigation. In 1814, the company's debt (including arrears of interest) was probably about £27,000, in addition to an issued capital of £16,400: and prospects of a profitable trade were slight.

II

There is no direct evidence of the volume of trade which the navigation carried, though for some years the amount of the tolls is known. Under the 1790 Act, the tolls were ½d. per ton mile for chalk, lime, manure, corn and road materials (other goods, 1d.) below Barcombe mill, and 1d. (other goods, 1½d.) above. The report to the proprietors in August 1796 gives the toll income for 1792-6:

	£	s	d	
1792	20	19	3	
1793	101	–	3	
1794	368	14	6	
1795	281	18	9	
1796	191	–	–	(presumably part year only).

The figure for 1794 might represent 7,500 tons of goods carried along the full length of the navigation as then open, to Sheffield bridge.

The next figure available is for 1809, when the tolls were £750; then in 1811 they were leased for one year at £1,625 to Michael Cotterel of South Malling and Thomas Nettlefold of Ringmer. A year later they were leased to Wells for two years at £1,250 per annum.[29] The company often had the greatest difficulty in collecting the tolls from the tollkeepers, especially in the later years, and the arrears are mentioned time and again in the minutes of the 1830s and 1840s.

Even if the Pinkertons had completed the navigation and the company had been able to raise all the necessary share capital, it is unlikely that the company could have ever paid more than a one or two per cent dividend.[30] As it was, neither interest nor dividend was paid. An agricultural navigation could only be profitable if it was intensively utilised and this was never the case on the heavy Wealden clay, though a trade in fertilisers was generated. In fact, much of the land surrounding the river, particularly in the upper reaches, was wooded. There was no industry in the hinterland, apart from Wealden iron which was well in decline by the 1790s, with the shift of iron smelting to the coalfields. In addition there were few towns of note. Lewes, with a population of 4,900 in 1801 and 7,083 in 1821, was by far the most important on the navigation. Otherwise there were only small towns or large villages, such as Uckfield, Lindfield, Fletching and Newick, within a couple of miles of its line. Trade was concerned almost entirely with the needs and products of a sparsely populated agricultural region and of an important, and for those days large, market town.

Jessop foresaw chalk as the main commodity to be carried on the navigation. Most large farms had their own kilns for burning it, to make lime, and if near the Downs their own quarries. But the quarries and kilns around Lewes operated

PLATE III The cottages by Balcombe wharf

PLATE IV The cut, now dry, below Lower Ryelands Bridge. Tester's lock is in the clump of bushes on the right

commercially; the navigation cheapened the transport of the product, while the Lower Ouse Navigation was used to bring from Newhaven the slack coal or culm for firing the kilns.

The navigation company was well aware of the demand for chalk and lime. The initial Act authorised a cut to Offham Hill and the evidence suggests that the company undertook commercial lime burning. In February 1796 the minutes mentioned that the company should endeavour to hire part of Offham Hill, and in June 1800 it was noted that there was an acute shortage of chalk in Sussex, and the committee was directed to get as many leases as possible in the Lewes and Offham area. It was later reported that two pits at Offham had been offered at £8 per annum for three years. An interesting note of accounts of this operation has survived in a letter from the clerk of works to the committee of management:[31]

Profit on a Four Load Kiln of Lime Delivered at the Offham Works

		£	s	d
Chalk at 20 ton at 16p ton		1	6	8
Coal 3 chauldron at 44s chauldron		6	12	-
Limeburner burning of one kiln		1	-	-
Extra men filing/emptyg Hors Cart		-	11	-
Beer for the men		-	2	6
		9	12	2
	Profit		17	10
	Price at kiln	10	10	

Sam[l] Hollingdale
Clerk of Works
June 14 1814

This line was still being pursued in 1830 when a further three-year lease was taken.

Coal was not only used for the production of lime. Annual imports at Newhaven increased from an average of 19,912 tons between 1814 and 1818, to an average of 26,578 tons in the following five years–an advance of 33 per cent.[32] The demand was primarily for household consumption; as the availability of timber for fuel declined and as standards of living rose the market for coal expanded. The Lower Ouse Navigation did not reduce the price of coal in Lewes according to the limited evidence available, since tolls were now imposed on a form of transport which was freely available and used before 1791. It was those places above Lewes which benefited. Coal previously brought overland was expensive and often beyond the means of the inhabitants of places such as Lindfield, Fletching and Uckfield. The navigation greatly reduced its price in these areas, and coal could be collected from the company's wharves or, for the adjoining landowners, from their own wharves.

In opening up the hinterland above Lewes much reliance was placed on roads that were often complementary to the navigation. The heavy Wealden clay had given Sussex roads a notorious reputation, but they were necessary for distributing coal and other commodities from the company's wharves to the outlying villages and farms. Hence we find the company complaining in February 1822 to the surveyors of the parish of Balcombe that the highway from Upper Ryelands bridge to Balcombe was badly in need of repair. The navigation therefore had a vested interest in the roads and not only because they provided a considerable trade in stone and beach gravel for their construction and maintenance.

A good idea of the organisation of trade on the Ouse may be gleaned from the

returns made under the Defence Act in 1801, by which time the navigation had been open to Sheffield bridge for eight years. Under schedule 9 each parish on the Ouse had to make a declaration of all vessels and barges owned within its bounds. Thirty-nine barges with a total tonnage of 743 tons were shown to be trading on the river.

BARGES EMPLOYED IN TRADE ON THE OUSE 1810[33]

Operating base	Number of barges		Tonnage	Number of barges employed between Sheffield Bridge & Lewes	Lewes & Newhaven.
Lewes		27	553		
Hillman	12		230	7	5
Robinson	9		189		9
Gasson	6		134		6
Newhaven		9	148		9
Barcombe		2	32	2	
Hamsey		1	10	1	
Total		39	743	10	29

All these barges were privately owned, as the company did not operate its own carriage services. Three quarters of the barges were owned by three Lewes families. and the Hillman family evidently had a near monopoly on the upper Ouse. The returns also suggest that trade on the lower Ouse was considerably greater than on the upper.

Many of the barges in use on the navigation were built in Lewes in the shipyard at Cliffe Cut. Wealden oak was especially valued by shipbuilders and was brought down the navigation. The first sea-going vessel built at Lewes, the 61 ton brig *Lewes Castle,* was launched in 1839, and in the next thirty years several ships were built by Edward Chatfield. Near the gasworks was a dry dock, of which a photograph, dated *c.*1858, survives, showing a snow undergoing repair. At Newhaven, after a lapse of about thirty years, shipbuilding revived in the 1820s but in both places it declined from the 1850s, as iron ships put a premium on location near iron and coal.[34]

Throughout the years between the completion of the navigation in 1812 and the arrival of the railway in 1841, the minutes record very much the same story, a steady trade at a low level organised by a small and generally part-time staff. When Thomas Smith, the superintendent, was retired in February 1833 on account of old age and infirmity, his account with the company had not been settled since 1826, but neither party seemed greatly concerned. The pace of life was slow in this part of rural England, and the lock keepers and other employees of the company do not seem to have kept particularly busy.

III

The Ouse navigation was already in a poor state when the London–Brighton line was completed in 1841, and it was the development of the railway network in

Sussex that finally brought an end to the undertaking.[35]

Throughout the years 1833-8 Funnel, Smith's successor as superintendent, was reporting to the committee of management (so the proprietors' minutes record), that something or other was in a state of disrepair and needed seeing to. For example, in August 1833 Freshfield lock was 'in a very bad state' and needed two new gates, a new gate was also required at East Mascalls lock and part of the old weir at Hamsey was born away. Frequently the same item cropped up several times, indicating lack of concern and attention. Further troubles in collecting tolls were reported in February 1839, when a list of debtors was given. Many of these names appeared time and again over a period of four or five years. The navigation was in no condition to compete with the railway.

The first indication of the new revolution was at the meeting of proprietors at the *Tiger Inn,* Lindfield, in February 1840. The clerk announced that notice had been served on him of the intended 'Rail Way' from Keymer to Hastings via Lewes which would cross the river in the parishes of South Malling and Hamsey. Nothing came of this, at least for some time, but in the next year the London–Brighton line was opened. The Balcombe viaduct was adjacent to the terminus of the navigtion, and bricks and stone for its construction were brought up the river from Newhaven.[36] It brought additional trade in the short run, particularly as it is believed that goods were brought down from London by the railway and then trans-shipped to the navigation, but in the long run it was merely a nail in the company's coffin.

The navigation was in no way able to compete with the railway, and in August 1844 the tolls on coal and timber were reduced from 1½d. to 1d. per ton mile. In the same year the Isfield paper mill closed, no doubt a victim of the concentration of manufacturing industry which the railways aided, and of the substitution of steam power for water power.

In 1846 Lewes was connected to Brighton and in the following year the Newhaven branch was constructed to run alongside the river. It was from this point that the modern port developed. Soon after, Lewes received a more direct link with the London–Brighton line, thus by-passing the navigation altogether. In February 1849 the coal toll was further reduced to ¼d. per ton and that on beach gravel and other road materials to ½d. per ton. Lindfield wharf was considered such an unlikely proposition that at the same time it was leased for £1 per annum for 21 years. The employees, too, began to suffer. Stapley Ade, employed on the works, had his wage cut from 20 to 12s. per week and Cave, the new superintendent, had his salary reduced to £52 per annum. In the mid-1840s, the income from tolls was down to about £800 a year.[37]

The last years before the company's books cease in 1859 saw very little activity. A dying concern with no prospects gave very little fight, though the coal toll was raised to 1d. in 1854, only to be lowered again to ½d. in 1859 after the Lewes-Uckfield line had been opened in 1858, running almost parallel to the Navigation for several miles above Lewes. The navigation was rapidly falling into disuse, a Mr. Crossitry complaining in August 1857 that the carriage of his coals was seriously hindered by the decay of Isfield lock. Boats were no longer able to pass above Lindfield in 1861 and Hamsey lock in 1868.

This pattern had been repeated on many of the agricultural navigations of the South. They struggled to survive for many years and then were abruptly killed off by the railways.

The Lower Ouse Navigation, however, kept going right into the twentieth century. The river was tidal to Lewes and kept open for navigation without much difficulty, and it still managed to keep a small trade despite the competition of the

ANNO TRICESIMO

Georgii III. Regis.

CAP. LII.

An Act for improving, continuing, and extending the Navigation of the River *Ouſe*, from *Lewes Bridge*, at the Town of *Lewes*, to *Hammer Bridge*, in the Pariſh of *Cuckfield*, and to the Extent of the ſaid Pariſh of *Cuckfield*, and alſo of a Branch of the ſaid River, to *Shortbridge*, in the Pariſh of *Fletching*, in the County of *Suſſex*.

WHEREAS the amending and improving the Navigation of the River Ouſe, in the County of Suſſex, through the ſeveral and reſpective Pariſhes of All Saints in the Town of Lewes, Saint John's under the Caſtle of Lewes, Saint Thomas in the Cliffe, near Lewes, Southmalling, Hamſey, Ringmer, and Barcombe, in the ſaid County, would be found very beneficial, and of great Utility to the Publick: And whereas the continuing and extending the Navigation of the ſaid River Ouſe, Preamble.

The first page of the Upper Ouse Navigation Act, 1790

railway, which ran right along its course. For example, in 1850 a billy boy sloop of 100 tons brought a cargo of building stone from Selby, Yorkshire for the new gaol.[38] The three cement works at Southerham, Rodmell and Asham, all had rail connections, but all made some use of the navigation and indeed the Asham works had an over-head cable-car for the transportation of its produce to lighters and small coasting vessels on the Navigation. The last fleet of 10 ton barges was removed in 1927.

Small vessels could still be moored in Lewes in the early 1950s, but now even they have disappeared. The Sussex River Authority has maintained the river in excellent condition, but only to prevent flooding, and indeed barges are occasionally used in work on the embankments.

IV

The Lower Ouse Navigation has remained largely intact, but the upper Ouse was last used one hundred years ago. Much of it has become derelict and overgrown, but it is still possible to walk from Upper Ryelands bridge, the terminus of the navigation, to Lewes, a distance of 22 miles. It is not always an easy walk as in many places the towpath has become completely overgrown, but for the most part the course of the navigation can be followed through the fields. Considering the upper reaches of the navigation are only 40 miles from London, the valley is remarkably peaceful and beautiful, and, away from the town of Lewes, the landscape around the river is substantially the same as it was when the navigation was opened to Upper Ryelands bridge in 1812. A comparison of the first edition of the one inch Ordnance Survey map published in 1813 reveals little difference from its modern counterpart.

At Upper Ryelands bridge, on the Haywards Heath–Balcombe road, and overshadowed by the Balcombe viaduct on the London–Brighton railway, the site of the terminal basin is still recognizable, though heavily overgrown, to the east of the bridge and north of the river; it is marked on later versions of the 1813 map as 'Balcombe Wharf'. Two cottages (though from appearances, not built at the same time) a hundred yards from the river were no doubt inhabited by men working on the wharf and navigation.

The navigation then follows the course of the river through woodland on the one side, and meadows and the playing fields of Ardingly College on the other, before the first lock, Riverswood, is reached, adjacent to the Horsted Keynes branch railway line, now disused. The lock is on a short cut, eliminating a sharp bend, and although no brick walls remain, the site is clearly visible. The river is crossed by the Ardingly–Haywards Heath road at Lower Ryelands bridge before the first major cut is to be found. This extended for half a mile before the navigation rejoined the river at Tester's lock. The cut is dry and clearly defined, but the stone walls of the lock are heavily overgrown. It was one of the three locks around Lindfield which were built in stone, the rest being in brick, presumably because a suitable stone was immediately at hand. The river continues to pass through lush meadows, though it has been embanked and straightened in places, before a short cut and Fulling Mill lock, again heavily overgrown but beneath it all recognizable.[39]

The navigation is next accessible by car at Lindfield bridge on the Lindfield–Turner's Hill road. Dean's mill, in excellent condition, is located on the right bank and just beyond is Pim's lock, named after the owner of the mill at the time of the lock's construction. The walls remain and in fact it is still used by the river.

Nothing remains of the next two locks, East Mascalls and Henfield Wood, perhaps because both were on the natural course of the river and their brick walls

eroded away over the last hundred years, unlike, say, Pim's lock where the walls have been maintained for the purposes of a weir. It is difficult to follow the navigation through Henfield wood, but at Freshfield bridge the lock walls can be clearly seen adjoining the upstream side of the bridge. On the other side is the *Sloop Inn,* presumably used by the bargees as it was in existence by 1813. The site of the mill here, as at East Mascalls can be seen but little remains in either case. Many of these corn mills were put out of business with the advent of the railway.

One of the most delightful stretches of the navigation, from the walker's point of view, is that between Freshfield bridge and Sheffield bridge, the section which took so long to complete. There are two sizeable cuts to avoid the meandering course of the river. After Polebay lock the river is briefly followed again, and then rejoined at Bacon Wish lock. Both have well preserved walls, and at the latter there is an accommodation bridge.

Sheffield bridge not only carried the A275 Newhaven–London road but is also close by the terminus of the Bluebell Railway. Following for the most part of the natural course of the river, the navigation then curves round the grounds of Sheffield Park, with one lock called Iron Gate, of which little remains. At Fletching the Sussex River Authority has maintained the lock as a weir, though only the site of the mill can be identified.

The Newick–Uckfield road crosses the navigation at Gold bridge but again the site of the lock can barely be identified, although it is on a small cut. Heavy undergrowth prevents the river being followed for all its course to Sharp's bridge, after which it changes its general orientation from east-west to north-south. Soon the entrance to the Shortbridge branch is reached; the branch extended for just under a mile and finishes in a basin, some 200 yards from the Uckfield road. The *Horse & Barge Inn* is nearby, as also the remains of the never used Ouse Valley railway from Balcombe viaduct to Uckfield. Authorized by an Act of 1864, the works were abandoned after a year by the London, Brighton & South Coast Railway. The embankments are marked on the six inch map of 1878 and can still be seen near Haywards Heath between TQ 335270 and TQ 353260, near Fletching at TQ 438226, and joining the Lewes–Uckfield line near Uckfield station at TQ 466208 to the Shortbridge branch at TQ 447209.

A few timber stakes at the point where the branch leaves the main line of the navigation probably mark the site of a pre-navigation flash lock.[40] Just below are the remains of Sharpsbridge lock, after which is another stretch of delightful walking to Barcombe. At Isfield lock, nothing remains of the paper mill but the lock has been converted into a weir. Several short cuts eliminate sharp bends, and the river can be reached from Isfield at Old Mill bridge. Below the bridge carrying the Lewes–Uckfield railway is the *Anchor Inn,* which was built in 1790 and catered for bargees until 1868 when a barge last moored there.

There are two Barcombe mills. The first, up river, survives as a cafe. Here also are the well preserved walls of Oil Mills lock and the junction with Iron river. A mile downstream is a complex of water-ways, much adapted by the Sussex River Authority to maintain its reservoir and prevent flooding lower down. The course of the navigation is made obvious by the two locks by Pike's bridge, Barcombe Mill locks I and II, which, though, were not operated as a staircase. Only the site of the mill is discernible.

The navigation then follows the river meandering slowly through the meadows alongside the railway, before Hamsey cut eliminates a wide bend. The river is rejoined at Hamsey lock, the highest point to which normal tides flow. At low tide brick remains can just be discerned. Below is Chalkpit cut, 440 yards in length, to

connect the navigation to the wharf for chalk from the Offham quarries, from which it was brought down by a gravity-operated incline; it can be seen passing under the main road and into the garden of the *Chalk Pit Inn.*

The river then passes between the chalk downs into the town of Lewes, once the hub of the navigation. The importance of the coal trade from Newhaven is emphasised by the coal wharf, which survives with several warehouses and granaries. But Landham wharf has long since been filled in and built over. It was located 100 yards south of the new road bridge, on the east bank. Canal bridge now forms part of the High Street and is still in excellent condition but that was not the responsibility of the navigation company. It marked the lower limit of the navigation, beyond which was the territory of the Trustees of the Lower Ouse Navigation and their successors. Nine miles distant the river reaches the sea at Newhaven.

Such are the principal remains of this obscure and little used economic enterprise of the industrial revolution in an agricultural county. It was a classic example of considerable sums of capital wasted in a mania. No one made any money out of it and most of the subscribers and mortgagees must have regretted the day they parted with their money.

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13. LM 188, 190. *Journals of the House of Commons*, xlv (1790), 27, 43. East Sussex Record Office, Add. MS. 5440/158, Pelham to Sheffield, 23 January 1790. Copies of the Bills in LM 177, 178.

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15. A copy of the agreement is in British Museum (Dept. of Printed Books), B263.

16. The authorities for this paragraph are PP 4, LM 190, the two Acts (31 Geo.3 *c.* 76 and 40 Geo.3 *c.*liv), and T.W. Horsfield, *The History and Antiquities of Lewes and its Vicinity*, i (Lewes, 1824), 217.

17. LM 182/37. *S.W.A.*, 12 November 1792, 11 February 1793.

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19. A cut beyond Upper Ryelands bridge is evident on Yeakell and Gardner's map of 1795. LM 182/46.

20. The figure of 132 shares is given in a 'List of. . .Proprietors' in LM 181. According to C. Hadfield, *The Canal Age* (Newton Abbot, 1968), 211-12, the average cost of construction per mile for a sample of canals was:

canals completed by 1790	£3,323
canals started and finished in the 1790s	£4,256
canals started in the 1790s but finished after 1816	£9,725

Although a navigation was usually less expensive than a canal, the movement of costs was of the same order.

21. LM 180.

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25. Hadfield, *Canals*, pp.128-30. John Rennie, *Report and Estimate of the Grand Southern Canal. . .*(1810), 7.

26. Phillips, pp.63-4. East Sussex Record Office, QDP/E 29A.

27. A copy of the Bill is in LM 177. Sheffield's opposition to the committee's activities, 1810-14, is copiously documented in LM 187,188,190. The Act is 54 Geo.3. *c.*clxxvi

28. Hadfield, *Canals*, pp.132-3.

29. Minutes, 5 January 1810, 4 March 1811, 13 April 1812.

30. East Sussex Record Office, Shiffner MS. 2813, 'Report of the Committee appointed to inspect the affairs of the Company', 1812, gives the annual running costs as about £600. Some notes in the same bundle by George Shiffner, 1817, suggest that the upper sections of the navigation were particularly unremunerative as chalk was obtained from other directions. The other Sussex navigation with which some comparison is possible is the Arun, which was completed without major mishap in 1790 for £16,000. Dividends were declared in 1792-6 in preference to liquidizing the mortgage debt, but thereafter paid no dividend until 1831, except for 1821, by which time the Wey & Arun Junction Canal was open (Vine, pp.27-30, 41, 242).

31. Shiffner MS. 2813.

32. T.W. Horsfield, *History. . .of Lewes*, i, 336.

33. East Sussex Record Office, LGC/EW1, Proceedings under the Defence Act 1801, schedule 9.

34. This paragraph is based on M.R. Bouquet, *No Gallant Ship* (1959), 107-17 and plate xx.

35. E.A. Course, 'The Evolution of the Railway Network of South East England' (unpublished Ph.D. thesis, University of London, 1958). For a more generally available description of the coming of the railways, see C.F.D. Marshall, *History of the Southern Railway*, ed. R.W. Kinder, 2nd. ed., 2 vols. (1963).

36. J.H. Cooper, *A History of the Parish of Cuckfield* (Haywards Heath, 1912), 201.

37. Cooper, pp.200-1.

38. Bouquet, p.113.

39. According to a field survey carried out when the locks were completer than today, they were all 52 ft. 6 in. by 12 ft. 6 in. between the gates (G.F. Randall, 'Wealden Waterways' [typescript in Sussex Archaeological Society library, *c.*1934], 32). These dimensions accord with the size of barges specified in the 1790 Act (note 18 above).

40. See note 6.

ACKNOWLEDGEMENTS

We wish to thank the staff of East Sussex Record Office, in whose keeping are nearly all the manuscript sources consulted, and Mr. P.J.R. Bright, who took the photographs specially for this article.

Notes and News

Notes and News is in essence the successor of the *S.I.A.S.G. Newsletter* of which five issues appeared between April 1968 and April 1970. The editor is glad to hear not only of the work of members of the Group but also of other local societies' activities which relate to industrial history and archaeology.

TOLLHOUSE AND MILESTONE SURVEY

A year ago the Group decided to give priority to this survey and steady progress has been made since both in recording and in research. Four tollhouses have been surveyed: Blackstone Gate by Mrs. Margaret Holt (see *Newsletter* No.5), Amberstone, Hailsham, by Gavin Flood, Midhurst by John Powicke, and Wiston. A further house at Slinfold, damaged by a lorry and suspected of having been a tollhouse, has been measured by G. Smith and myself. Milestones recorded include the Bow Bell series by Kim Leslie and David Butler (our photographs were printed in *The Guardian* on 14 March, in connection with the B.B.C. 'Chronicle' competition), a stone in the wall of the Fifteenth Century Bookshop, Lewes, and milestones on the Rye to Newenden road by Hugh Gordon, while G. Smith is actively working on the milestones in the Horsham area. He has discovered a cast iron one, uprooted and damaged, on the Horsham to Guildford road, which has been repainted and awaits delivery to the Weald and Downland Museum. The Museum has also been offered a cast iron 'stone' from the Horsham to Worthing road by West County Council.

The research work on tollhouse sites and turnpike roads in Sussex continues, and it is hoped to publish a revised list of tollhouse sites in the near future. Photographs are being assembled, and information have been contributed by many members: typical of this assistance is Philip Burstow's donation of photographs of Firle and Brighton Barracks tollhouses and Hugh Gordon's of Stone Cross tollhouse. A display on the development of the road system of Sussex and adjacent counties is planned for the Upper Beeding tollhouse, now at the Weald and Downland Museum.

There is nevertheless a need for further members to help in surveying and field recording, for every year more houses and stones disappear, particularly as the victims of road improvement schemes. My address is: 1, Mercedes Cottages, St. John's Road, Haywards Heath.

BRIAN AUSTEN

PARK MILL, BATEMANS, BURWASH

The last *Newsletter* reported that the Group had arranged with the National Trust to oversee the restoration of the eighteenth century mill at Batemans and also of the adjacent turbine and generator. The latter have now been removed to the Royal School of Military Engineering at Chatham, and it is quite clear that both machines can and will be restored to an 'as new' condition. One half of the turbine rotor was smashed and a completely new shaft will be provided. The generator needs general overhaul and complete rewinding.

These machines were installed by Kipling in 1903 and ran for 25 years without any trouble, except for eels getting into the turbine casing and bunging it up! It is hoped that in 1971 the Royal Engineers will be in a position to carry out extensive restoration to the masonry and brickwork of the waterworks. At present the masonry dam is slowly collapsing and there are many leaks in the brickwork surrounding the pond and at the iron gate weir. Completion of the work is unlikely before 1972.

BENJAMIN WARE'S TILE WORKS

Early in July, three members of the Group joined with two members of the Uckfield & District Preservation Society to carry out an emergency survey of Benjamin Ware's Tile Works, south of Uckfield. These works had been in existence for exactly two hundred years and run by one family throughout. But the Uckfield Society learnt that they were to be demolished this summer and took immediate action, seeking the expert advise which the Group could provide. Over one hundred photographs were taken, along with notes and sketches, and it is hoped to print a more extended report in a future issue of *Sussex Industrial History*.

TWO WINDMILL RESTORATION APPEALS

Nutley Post Mill, Ashdown Forest (TQ 451291). *Newsletter* Nos.2 and 3 reported that this, the last open-trestle post mill in Sussex (and one of only five in the country), was in a deteriorating condition and that the Uckfield & District Preservation Society hoped to undertake its restoration. An appeal for £3,500 has now been launched. A small team of workers has been putting in long hours over the last year, aided by others who can come less frequently. Gradually the framework of the mill body is being strengthened or rebuilt. The machinery is largely intact: mill stones are in place, as are a meal grading machine, sack hoist and other ancillary equipment. The brake was found to be functioning when the sails had to be turned in order to take them down. Money is still needed, particularly so that building firms can be employed for some of the straightforward but time-consuming jobs–which would speed work up considerably. The Treasurer is J.R. Guy, Lloyds Bank Ltd., 180 High Street, Uckfield. Anyone willing to help on the mill itself should contact Anthony A. Turner, 224 High Street, Uckfield.

Rottingdean Windmill, on Beacon Hill (TQ 366025). This smock mill, probably about two hundred years old though moved to its present site only in 1802, belongs to Brighton Corporation but is leased to trustees appointed by the Rottingdean Preservation Society. Under the terms of the lease it must be kept in a proper state of repair and the Society has spent considerable sums on its upkeep in recent years. But the violent gales of last winter damaged the mill so badly that it is now in serious danger of collapse. Expert advice is that a steel frame should be placed inside the mill immediately and that the cost will be £4,000. A public appeal for that amount has thus been launched; the Treasurer is F.J. Winser, Lloyds Bank Ltd., High Street, Rottingdean.

CUSTOM HOUSE SHIP REGISTERS

The statutory registration of shipping was introduced as long ago as 1695, to assist the implementation of the Navigation Acts, which, by aiming to reserve the colonial and much of the foreign trade for British ships, made it necessary to define 'a British ship' and to list those which qualified. Very little trace of this first register of shipping survives, but by an Act of 1786 there was a wholesale revision and extension of the register which located the work of registration in the individual ports to which the ships belonged. Thus began the series of Ship Registers which are maintained in the Custom Houses of Great Britain to this day under the direction of the Registrar of British Shipping.

A register gives information on the place and date of actual registration, and the preceding and following registrations, or the ultimate fate of the ship; on the dimensions and characteristics of individual vessels; and on her builders, owners and masters. The registers are thus an indispensable source for authoritative work on the shipping of individual ports, on trends in design and the composition of the shipping interest and the sources of its capital. The National Maritime Museum is organising a scheme of transcription by volunteers, so as to make this data more accessible. A special form is used, allowing the data ultimately to be recorded on computer tape.

Unfortunately, no series of registers for a Sussex port is complete, but by drawing on copies sent to the central office, the registers for Newhaven and Rye can be reconstructed from 1815 and for Shoreham and Littlehampton from 1824. I have already transcribed the registers for Newhaven from 1856 to 1914, and some work has been done on the early Shoreham registers. The Museum supplies a copy of each transcript to the local Record Office, and it would soon a good idea to supplement the copies with information from other sources, which might, for instance, indicate the particular trades in which the vessels were employed. Thus a comprehensive record of the shipping belonging to the Sussex ports in the nineteenth and twentieth centuries would be built up.

Anyone who is interested in doing some transcribing–which does not require any specialist knowledge–should write to A.W.H. Pearsall, Custodian of Manuscripts, National Maritime Museum, Greenwich, London, S.E.10. It would be useful for Sussex transcribers to keep in touch with each other, if only to avoid duplication of effort, and I am happy to act as a clearing house (27 Bloomsbury Place, Brighton, BN2 1DB).

JOHN FARRANT

'THE RISE OF THE PORT OF NEWHAVEN 1850-1914'

David Gibbs, a member of the Group and a contributor to this issue of *Sussex Industrial History,* is also author of an article with the above title which appears in *Transport History,* vol.3, No.3, November 1970 (published by David & Charles, price 15s. or 75p. per issue).

While not lacking in devotees of its history (L.F. Field writing in the 1930s referred to his forthcoming *History of Newhaven,* though it never appeared; in more recent years the town's Historical Society has done valuable work), Newhaven has not had the benefit of a substantial published account of its past. Mr. Gibbs's article goes a long way to filling the gap, for it concentrates on that crucial period in the development of town and harbour when it became a 'one industry' town, with the London, Brighton & South Coast Railway as employer of the majority of the labour force. It did not become a 'railway town' within the definition which historians have adopted (a town whose origin and growth was determined by and dependent upon the employment potential created by the establishment of railway company works for the manufacture of capital equipment), but it may usefully be studied as a variant. Only since the 1950s has the town's character changed through the diversification of industry. Within the period from the arrival of the railway (1847) to the outbreak of the Great War, Mr. Gibbs emphasises the central role of the improvements effected under the patronage of the railway company, from the New Cut of 1863 to the completion of the Western Breakwater in 1883; 'if they had not been successfully executed, much of the expanded cross-Channel trade of the late nineteenth century would undoubtedly have been lost to the other cross Channel ports.'

The article is not definitive: it makes little use of the fairly copious archival material now available and perpetuates a couple of the errors which can be traced back to writers at the end of the last century. But it is a valuable starting point and stimulus for further work, by setting out some of the basic facts in a wide context. We can now begin to ask such questions as quite how the L.B. & S.C.R. came to gain control of the harbour (in the early days, the Harbour Trustees seem to have tolerated the packet service only in so far as it did not interfere with the local trade of the port), and how pervasive was the company's influence in the town's economic and social life.

JOHN FARRANT

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