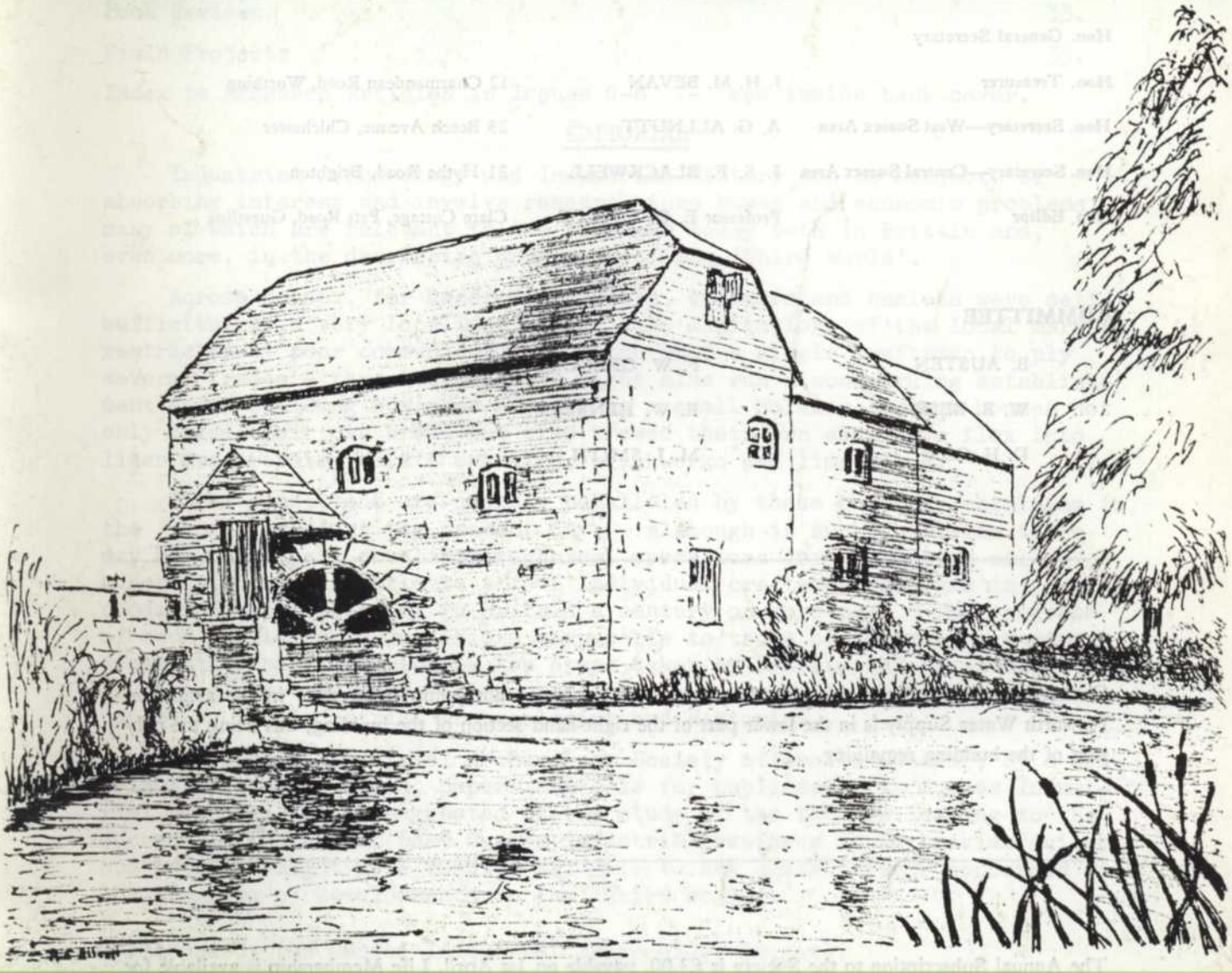
SUSSEX INDUSTRIAL HISTORY

No. 9

1979



IFIELD MILL RESTORATION
IRONMAKING ORIGINS
PETWORTH WATER SUPPLY
OX-CART TO STEAM ENGINE
HURST GREEN FOUNDRY
CHALK PITS MUSEUM, AMBERLEY

PRICE £1.80

SUSSEX INDUSTRIAL ARCHAEOLOGY SOCIETY

Founded, as the Sussex Industrial Archaeology Study Group in 1967

Cover Picture

Coultershaw Mill before being gutted by fire in 1923. The beam pump referred to in the article on Petworth Water Supply is in the lower part of the right-hand section of the building, this being the only part of the building remaining.

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

The Society is registered as a Charity, registration no. 267159.

SUSSEX INDUSTRIAL HISTORY

Journal of the Sussex Industrial Archaeology Society

No. 9 1979

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EDITORIAL

Industrial Archaeology and Industrial History can be subjects of absorbing interest and involve research into human and economic problems, many of which are relevant to the problems today both in Britain and, even more, in the developing countries of the 'Third World'.

Across Sussex, for hundreds of years, villages and hamlets were self-sufficient on a very localised basis; the limitations of the local market, restricted by poor communications, encouraged a single craftsman to ply several trades - thus a blacksmith might also run a woodworking establishment and a building business as well as a small holding. Large houses not only baked their own bread but also brewed their own ale, wove flax into linen and operated estate sawmills, brickworks and lime kilns.

These conditions are closely paralleled by those commonly obtaining in the 'Third World' at the present day. Although in such countries there may be some highly developed technical operations for extracting oil or minerals these do little to affect individual craftsmen who work in conditions that obtained in Britain a century or more ago. The progress of such countries to conditions comparable to those of the modern Western world must inevitably follow the steps taken by Britain and other industrial countries over the past years, steps that are carefully studied and documented by the Industrial Archaeologist and Historian.

The Sussex Industrial Archaeology Society offers to sponsor, by a contribution towards costs, papers suitable for publication in Sussex Industrial History; it is suggested that a study of the factors leading to the success or failure of past Sussex industrial ventures would provide suitable subjects and might give results valuable to any administrator concerned with the planning of developments in the 'Third World'.

Published by the Sussex Industrial Archaeology Society.

THE RECONSTRUCTION OF IFIELD MILL

Part 2. RESTORATION

By J. Gibson Hill and E. W. Henbery.

With Historical Research by P. Bracher.

Part 1, being the historical account of Ifield Mill and its environment, was detailed in Sussex Industrial History Vol. 8 (1978) and covered the period from the earliest known references to the site until the demise of Ifield as a working mill about 1927. The building stood virtually unused during the succeeding years,(1) but retained much of its machinery until the early 1950's.(2)

In 1973, Crawley Borough Council started to acquire land in the Broadfield vale for housing development and Ifield Mill with the related house and cottage were purchased as part of a large scheme. It was at this time that the Crawley and Mid-Sussex Archaeological Group, as part of their campaign to preserve historic buildings and archaeological sites, made a formal approach to the Council for permission to restore the building.(3) A feasability study carried out during 1974, estimated the cost of repairing the roof, exterior walls, and rebuilding the wheel at approximately £6000.

In June 1974, permission was given by the Council for the group to undertake the restoration, using volunteer labour and raising its own finances. No public funds were to be available and the Ifield Mill Project, as it was to be known, was to be self-financed.

The previous owner, Mr. G. Wood, had wanted to restore the mill but commercial costs were prohibitive. However, now it was apparent that a determined group of volunteers were both willing and capable of undertaking this work, he was able to realise his ambitions for the site by providing the necessary financial backing.

A fund to be administered by Crawley Borough Council was established in 1974 with an initial donation of £10,000; subsequently Mr. Wood contributed a further £4000. This generous gift now permitted a more comprehensive plan than originally envisaged and involved renewing all floors, providing suitable stairways, reboarding the internal walls and refitting machinery.

Consideration had been given from the outset to the future use of the building when restored; eventually it was decided that the mill should become the focal point of a linear recreational space encompassing the pond area. Initially it would serve as a temporary home for the town's first Museum, and illustrate a partially working mill.

Description of the Building

The mill stands at the foot of an earthwork dam thrown across the narrow neck of a shallow valley. (TQ245365) Behind the dam the waters form Ifield Mill Pond, bisected by the Crawley to Horsham railway, and covering an area some 17 acres in extent. The building is four storeys high with the ground floor walls of brick, the top courses of which embody a castellated pattern. The sides of the upper floors are of white painted weatherboarding punctuated by Georgian style sash windows. The windows at either end of the top floor are worthy of note, having a central semi-circular fanlight. Plates 1 and 2 show the mill before and towards the end of the reconstruction.

The eaves boards (soffits) are supported by pairs of scrolled brackets and the roof is of grey slate with the sack hoist (lucam) positioned in the North face. The building neasures 9.7 m (32') (East to West) X 7.3 m (24') (North to South) and is approximately 10.6 m (35') to the eaves.

The waterwheel is situated on the Western side and consists of a cast iron axle onto which are fixed three sets of spokes supporting oak rim sections. The cross boards are of elm and carry metal buckets attached to the rims by pairs of curved cast iron angle brackets. The wheel measures 3.5 m (11' 6") in diameter X 3.3 m (11') in breadth and is overshot. Main bearings are of the half shell type and are 254mm (10") diameter (inner) and 152mm (6") diameter (outer).

Condition of the Building.

Ground Floor:- The exterior brick walls were generally in good condition, except in two respects:

(i) In the South-West corner, considerable water seepage from the embankment over an area some 1.8 m (6') X 1.2 m (4') had affected the bonding of the mortar.

(ii) The top courses of the brickwork were loose, having been affected by dampness from the deteriorated timber floors above.

Almost all traces of the machinery had been removed and the original wooden floor, which had been positioned some 457mm (18") above the ground level, had been demolished together with the associated foundation walls.

A concrete floor, laid on a hardcore infill, now replaced the original floor and a concrete bunker was erected over the axle bearing, there being no indication of either the pitwheel or pit. All hursting and other floor supports had been removed and a narrow much modified wooden staircase led up to the first floor.

First Floor: This was the stone working level and there were positions for three pairs of stones. Of these, one was devoid of stones, one (central) had a French burr-stone in place and the remaining position was occupied by a peak bedstone only.

Much of the flooring was badly affected by woodworm and wet rot, particularly in the south-east corner, where rainwater poured down through a large hole in the roof. The southern face was largely open to the elements, the weatherboarding and timber infill being greatly affected by rot and the proximity of nearby tree growth. An attempt had apparently been made some years previously to convert the mill into living accommodation and a modern staircase together with partitioning were evident on this floor.

Second Floor: This had housed the winding gear for the sack hoist and various grading machines, but none of this remained apart from the evidence of fixings to the walls and the open well where the hoist shaft had been. Again, the southern face was mainly open to the weather, and in common with the floor below, the joists and flooring generally were in a poor condition.

A large section some 2.4 m (8') X 1.2 m (4') had been cut out of the floor, apparently to enable a large galvanised tank 2.4 m (8') long X 0.9 m (3') diameter to be hoisted up onto the top floor. It is likely that this was intended as a water supply tank as part of the conversion previously mentioned.

Top Floor: This was the bin floor, the roof being approximately 3.6 m (12') at the ridge and 1.2 m (4') at the eaves, with a pleasing barrel shape at the apex formed by the internal pine boarding. Most of the internal boarding had been removed on all floor levels and that in the top floor is all that remains of the original. The floor area was unsafe and a portion of the roof at the south-east corner was completely open to the sky. The roof around the sack hoist was also leaking badly and the main timbers of the lucam itself were obviously in need of replacement. Numerous holes in the slates contributed to a generally damp atmosphere throughout the building and this combined with the almost non-existant windows completed a picture of gloom. (4)

Waterwheel and Wheelbay: The axle and spokes remained intact, but most of the rim sections and all the metal buckets had disintegrated lying beneath a mass of debris in the millstream. The wall supporting the outer wheel bearing had partially collapsed, causing this end of the axle to drop 102mm (4") out of the level. The original cast iron water-control box that had stood above the wheel had been removed and the brickwork generally in the wheelbay area was in a state of near collapse.

Embankment: The 3.6 m (12') high sandstone wall at the rear of the mill, which reinforced the earthwork dam, had collapsed and filled the drainage ditch up to the level of the ground-floor window sills. Beech trees some 20 - 25 years old had taken root along the remains of this wall and it was these with their sweeping branches that had caused so much damage to the weatherboarding and roof on the southern face.

Restoration of the Building and Waterwheel

In June 1974, work was commenced on the restoration by a small group of about one dozen volunteers later to be known as the IFIELD MILL PROJECT. No funds were immediately available but there were numerous tasks that could be undertaken. Work was put in hand to dig out the collapsed section of embankment at the rear of the building and to identify the source of the water seepage in the ground floor. Accumulations of rubbish were cleared from within the building and a general tidying up operation was mounted. The offending trees on the embankment were felled, temporary shoring was erected to support the landslip and undergrowth and ivy cleared from around the mill. This occupied the workforce throughout the summer.

A three to four year plan was drawn up covering all the main activities envisaged and it was obvious from the initial survey that the roof and southern face were to have priority.

During the winter and spring of 1974/5, the first stages of the roof repairs and the south face restoration were commenced. In parallel with this the ground floor foundations were investigated and some excavation work carried out. The concrete block covering the inner wheel bearing was demolished, uncovering the bearing itself, complete. The pit was uncovered and the remains of the pitwheel found still attached to the axle. All remains above ground level had been broken off. Work also progressed on clearing out the wheelbay, laying sleepers to provide a temporary support for the axle and preparing to demolish the remains of the load bearing wall.

It was learnt that Hammonds Mill was to be demolished in the near future, and in May, a team was despatched to acquire several items of mill machinery. (see below)

The southern face was completed during the summer of 1975 and involved the replacement of most of the infill timbers and in the region of 75 per cent of the main cross members at each floor level. The base (sole) timbers also required replacement in three out of the four bays and an 8' section of main vertical timber adjacent to the rear doorway was renewed. Hydraulic jacks were used to support the centre of the building, whilst this was accomplished.

September 1975 saw the start of work on the west face, over the wheelbay and again as on all faces, the weatherboarding was completely renewed having first positioned a waterproof felt layer onto the structure. The roof had by now been completely re-slated and by the end of 1975, approximately 50 per cent of the flooring was laid.

The west face was completed by April 1976, and work continued during that year on the north face, including the lucam. Structurally, the building had proved more sound on the western and northern faces. but the hoist's frame gave some problems. Small sections of timber had to be removed at a time and renewed in order not to disturb the roof structure and the main oak support brackets required extensive repairs and strengthening with iron ties. By the end of 1976, the north face was completed and internally the three upper floors were relaid leaving suitable stairwells. During the summer, the sandstone wall along the rear of the mill and embankment had been rebuilt and consolidated. Also a considerable length of the mill stream was dug out by hand.

Further excavation on the ground floor had exposed the foundation walls in the area of the hurstings and consideration was now given to the rebuilding of these in order to accommodate any future installation of machinery. It was decided that the ground floor should be rebuilt to the original level (some 18" above the normal ground level) in the area directly beneath the millstone, but the remaining area should be at a lower level to provide a suitable access to the public, particularly the elderly or disabled.

Extensive rebuilding of all the brickwork in the wheelbay section was undertaken with the load bearing wall finished and the outer wheel bearing relevelled. The inner bearing had also been refurbished and the axle was lowered into position and was free to rotate once again.

The penstock removed from Hammonds Mill in 1975 was dismantled and during the very wet winter of 1976, rebuilt in its new position above the wheelbay. The archway leading to the pond was rebuilt and a new sluicegate made and erected on the pond side of the embankment. The design of this gate was based on one that existed on the site of the old Bewbush pond.

1976 saw the start of work on the upper two staircases and balustrades. The internal cladding was also put in hand. Samples of the original style were faithfully copied by the Mid-Sussex Timber Company. Externally the last (East) face was completed and the building 'topped out' on Easter Sunday, 1977.

Internal cladding and staircases were progressing well whilst external work commenced in May on rebuilding the waterwheel. From May till August, complete rewiring of the mill took place, and the Seeboard provided a new 3-phase supply replacing an inadequate single-phase supply.

Work had been put in hand by Crawley Council for the dredging of the pond and this was carried out by mid 1977, when it was allowed to refill.

The porchway and bridge leading to the embankment were completed by Autumn 1977, whilst the remaining rim sections were fitted to the wheel. During 1978, the upper stairs and ground floor foundations were finished and the new flooring laid before the end of the year. Some new window frames are to hand for the upper floors and the successful completion will largely depend upon the availability of the remainder. Work on the water-wheel continued during 1978, and water is now able to flow through the recently constructed trough over the wheel.

Sources of the Mill Machinery

(1) Hammonds Mill (Near Clayton)

This mill was demolished in 1975. For three consecutive week-ends, volunteers worked in conjunction with the contractor in the removal of the following large items of machinery for re-use at Ifield.

Cast Iron Pitwheel
Vertical Iron Drive Shaft
Wooden Wallower and Main Spurgear
Cast Iron Hurstings
Cast Iron Penstock (Manufactured by Coopers of Henfield)

(2) Bewbush Mill (Site of) TQ239356

This grist mill reported as derelict in 1870 was demolished sometime ago. In 1976 demolition of Mill Farm Cottage revealed a millstone used as hardcore in the foundations of an outbuilding. This was rescued and will be on display at Ifield.

(3) Rusper Steam Mill (Site of) TQ205372

In the garden of Averys in Rusper village stands the outer structure of a small building, once a single-stone mill driven by steam power, only the remains of the hurstings are now in evidence.

An adjacent stables erected in 1861 was being removed and the owner, Mr. White, kindly agreed to let us remove 6 large cast iron pillars - to be used as supports for the first floor at Ifield.

(4) Balcombe Mill TQ318305

Many significant timber fittings, such as chutes, store boxes, grading trough and winding gear were found decaying in here. These, together with a set of beamscales were removed for conservation and use at Ifield.

(5) Castle Mill, Dorking

The owner kindly agreed to loan a stone nut and shaft.

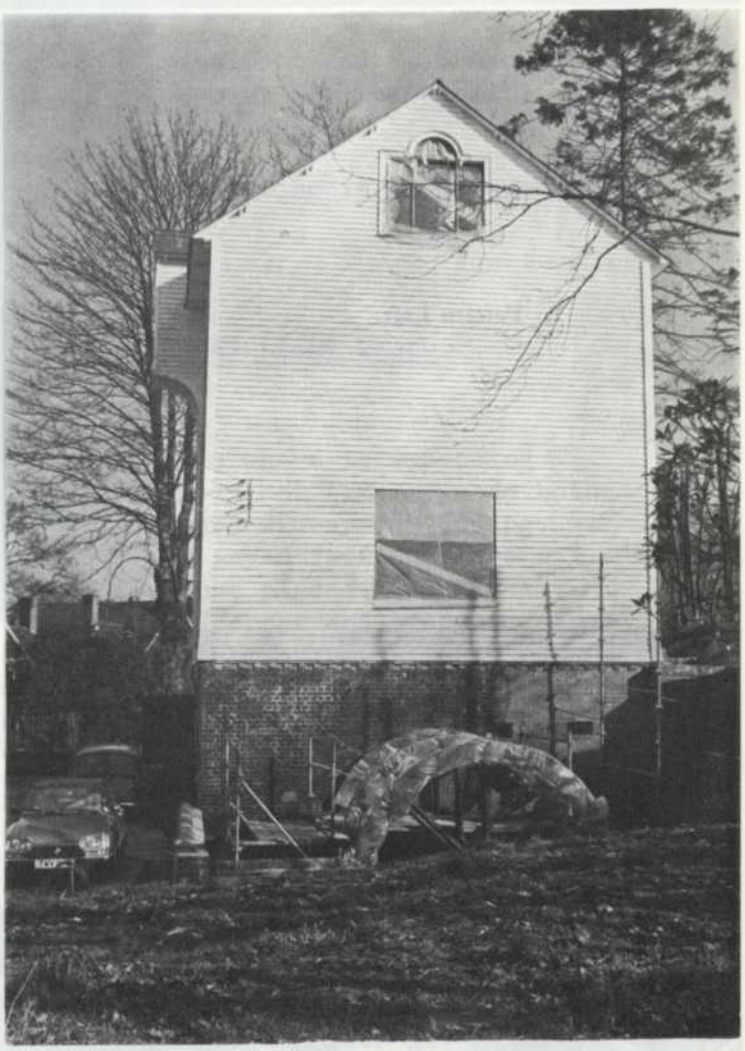
Conclusion

The original aims of the Project seem likely to be realised in 1979. The newly formed Crawley Museum Society have negotiated a 13 year lease on the mill for its use as a temporary local museum. In parallel with this it is hoped to install such machinery as becomes available in a limited area on the ground and first floors. Subsequently, should the museum move to larger premises, the building could be used as a field study centre or possibly become a partially working mill for demonstration purposes.

It is hoped that the surrounding open space will be designated as a conservation area and linked with a new nature reserve to be established at Buchan Park.

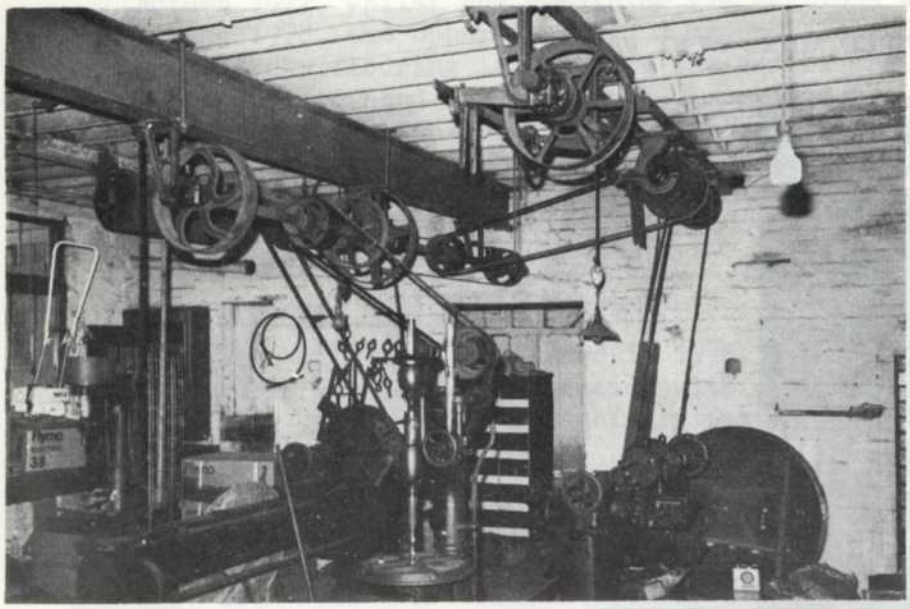
IFIELD MILL, WEST FACE

Soon after start
of project.



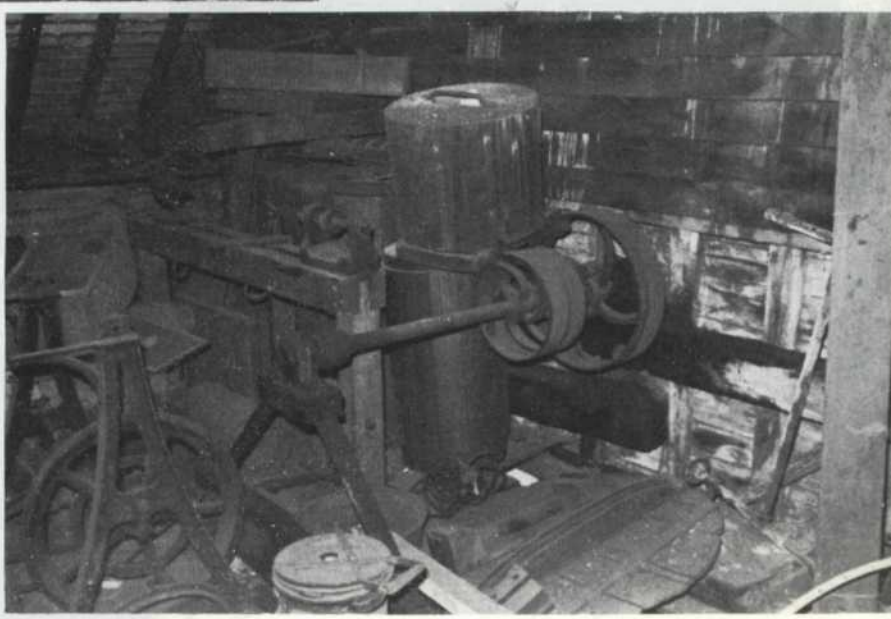
Awaiting restoration of windows
and nearing completion.

HURST GREEN FOUNDRY — I



Workshop.

Pattern Loft.



Blacksmith's Shop.

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1. Sales catalogue, Wm. Wood, Son and Gardner (Auctioneers); dated 15th April, 1934.
2. Provisional Survey of Buildings of Architectural or Historic Interest - Commission for the New Towns Ref. 91650/253/11A.
3. Sussex Industrial History No. 8. (1978)
4. Sussex Industrial History No. 7. (1976)

Acknowledgements

As indicated above, the success of this scheme is due to two main factors; the generosity of Mr. G. Wood and the persistance of our workforce. The latter can be divided into four main groups.

Members and staff of the Archaeological group who provided the initial stimulus and supervision during the early days. Volunteers raised during this period to form the core of the Ifield Mill Project's workforce (incidently, most of these are still engaged on the project). Participants in both Job Creation and Community Service Schemes.

The authors are indebted to Messrs. A. J. Haselfoot and F. Gregory for the interest and advice (based on recent experience at Kipling's Mill, Bateman's, Burwash (4)).

Finally, our thanks to Miss L. Botting for assisting in the preparation of this report.

IRONMAKING ORIGINS AND EARLY IMPACT ON THE ENGLISH WEALD

By Wilfred Beswick

Early records of iron metal come from Anatolia where it was being smelted about 1500 B.C. by the Hittites (1). From that time onwards both the use of iron and its manufacture became ever more widespread during centuries of conflict in which Semitic, and later Aryan factions were engaged. For many purposes the harder, and in most places more readily obtainable metal, found use alongside the earlier copper and bronze. Iron figured for military use, as more and more Aryans spread throughout the Middle East and by 900 B.C. it was common in the Aegean. Some caution is needed however, when viewing iron objects with very early datings in the museums of the Classic and Egyptian Worlds as in most cases they are remarkably free from corrosion and may well have been forged from natural nickel-bearing meteoric iron.

Iron-using people migrated into Europe from such areas as Thrace via the Danube and perhaps into the Alps from the south. Since the name "Hallstadt Culture" has been given to this first phase of the European Iron Age, it is advisable to keep in mind that the area of Hallstadt in Austria had been the home of a wealthy salt mining and trading community for some hundreds of years prior to the earliest dating which has been given to any iron objects found there. These people no doubt bought bronze and iron goods by way of trade and would later encourage smelting of the iron ore which lay not far away in Styria. From about 700 B.C. the culture which had developed alongside this increasing use of iron, continued its path across Europe (2).

Britain had felt the impact of another metal-using world when, from about 500 B.C. or earlier, Phoenician trading posts on the Mediterranean and Atlantic Coasts, established direct links with the West of Britain. Although the leading trade was in both copper and tin, goods of iron could well have been offered to the West Country and even more would be learnt of their manufacture as tin trading routes developed across Brittany or along the Seine to Vix and southwards. Part of this route lay through iron bearing country occupied by a people who still showed traces of the Hallstadt culture (3). It appears to have been the invariable and very natural rule, that trade in imported iron preceded its manufacture in any given area. It is possible that the iron "currency" bars found in the West Country and in Eire may have been a product of this trade from the south.

Whether or not there had been any transmission of iron making know-how direct from the south, it is certain that by 300 B.C. a belt of Celtic peoples stretching from the Black Sea across Middle Europe were conversant with the use and manufacture of iron and that the more westerly of these again emanating from the Alps and usually called the La Tene people, were fostering the art. Several waves of such folk reached Sussex (2). It would seem that the northern route was established across the Channel and that just as the pressures of conflict had carried the making of iron from its Asian cradle into the Mediterranean theatre, so at this later period, similar conditions drove masters of the craft towards our shores. Particularly during the last Century before Christ, the Celtic tribes westwards of the Rhine were under pressure from Northern Germanic elements at about the same time as Imperial Rome was on the move from the south. Hill forts, much like our own at Garden Hill, were enlarged and reinforced and even the iron making operations had been brought inside the walls (4), on reflection a wise precaution since the glow of some isolated forest smelter would have made an easily recognisable target for a night raiding party.

It was quite probably during that last Century B.C. when a wave of Belgic people came into Kent, that organised iron-making began on the Weald. It was not long before these people had need to combine with more of their kind north of the Thames to face the invasions of Caesar and, if ever iron was needed, that was the time. Any source of iron for weapons, chariot parts and the like would be followed up. Such a situation points to our earliest workings being on those ore deposits most easily reached from the Northern side of the Weald, these would include the upper reaches of the Medway and around the headwaters of the Eastern Rother (5). Thereafter iron-making on the Wealden deposits was to form a significant industry for much of the next eighteen hundred years.

If we have taken a brief glance at some of the folk wanderings which helped to bring the first iron makers to the Weald, it may not be out of place to examine the technical routes and their development. The first metal of common use to appear amongst the early civilisations sometime during the third millenium B.C. was copper; later came the alloy with tin called bronze. Copper was smelted from its various ores in much the same Near Asian / Middle East areas from which iron smelting was to emerge a thousand years later. Since some of the copper ores contain significant quantities of iron and as they need treating for the most part with carbonaceous fuels such as charcoal in furnaces at temperatures not very far below those at which iron itself can be made, it seems to be more than probable, that iron as a metal must have been known to the copper smelters, long before it was adopted for general use in its own right. However, it is also reasonable

to assume that once the demand arose, then both the skill of the metal workers as well as suitable furnaces and equipment must have been adapted quite easily, all based on traditions established with the earlier metal. The important difference however would be, that whereas both copper and its slag could be taken to a liquid phase in the small primitive furnaces, with iron only the slag would run, the reduced metallic iron remaining in the furnace in solid or plastic state entrained in the slag or accumulated below it.

Only the architectural features have been preserved at most sites of the Ancient World, but at Enkomi near to Salamis in Cyprus, it is possible to examine a group of copper smelting furnaces and a forging hearth of 1200 B.C. In the 1 m diameter 0.8 m high stone-built vertical shaft furnaces, some grains of ferrous material were present as well as massive dark slag having charcoal inclusions. Both the furnaces and the adjacent rear blown stone-built forging hearth, could have been adapted for iron smelting and refining. In Crete there is a copper smelting site at the Minoan Palace of Phaistos but few details are left. Links between the design of Phaistos Palace and Anatolia have been suggested (6). A. Lupu describes early copper furnaces of vertical design in Israel and comments on their probable operation; here mention is made of iron ore being used as a flux (7). Perhaps all that can safely be said, from such knowledge of primitive copper smelting as exists, is that the two metals are not so different in their treatment at least in some cases, and that the vertical-shaft iron-smelting furnaces which were used by the Romans in Britain and elsewhere may well owe much to the earlier art of copper smelting.

It may now be useful to recall one of the most fundamental aspects of iron smelting. It is that unless the chemical change from iron oxides(s) to the metal has taken place within the furnace before slag melting has begun, then there will be a combination of those oxides and the slag with consequent loss of metal. Unfortunately this cannot be avoided completely in any of the designs of small primitive smelting furnaces. What does appear to happen, is that incomplete reduction of the oxides in the lump of ore takes place and then as the slagging elements begin to soften, the undesirable combination with the oxides starts. At once this increases the fluidity of the slag. If at that stage the furnace heat can be maintained so that the hot reducing gases can surround the now collapsing lump to the exclusion of air, and some of the charcoal or re-formed carbon remains in direct contact with it, then a portion at least of its iron is preserved and will proceed to the fully reduced metal. After that, contact with liquid or semi-liquid slag will not alter it chemically. Iron oxides can of course be reduced, that is the oxygen removed, at very much lower temperatures than those at which iron would become plastic or enter the liquid phase. It may follow, that for the leaner ores of high slag content, a basin or kettle shape of furnace which holds a substantial bath of hot slag whilst efforts are being made to complete the reduction phase above, were found not only the easiest to build but the simplest to operate. To sink them into the ground or build into a bank would assist in heat conservation. Anything in the nature of a shallow bowl would seem to be almost useless; a workable reaction zone can only be achieved with a reasonable depth of hot charge.

Returning to the field, the Roman experience in iron-smelting probably included operations based on the rich ores of Etruria, Elba and Spain, later extending to Austria where the ores would not be so rich but good in quality and into Silesia. Further north, the Celtic and Germanic smelters were for the most part in a very different situation where adaptations to

the shape and size of the furnaces would have to be made to suit the available ores. Such were the lean acid brown haematite of Salzgitter in North Germany, the bog ores of Schleswig-Holstein and the Minette ores of Lorraine and Belgium (8). We begin to find basin or kettle-shaped furnace shells of clay dug into the ground as well as the vertical shaft type. Dr. Hans Hingst has described the numerous kettle-shaped furnaces used on bog ore in Schleswig-Holstein (9) and R. Pleiner has reviewed the furnace types of free and occupied Germany during the Imperial Roman period (10). On the Westerwald in the heartland of the Frankish territory, a sideritic carbonate iron ore similar to that of the Weald would have to be dealt with (11). In that area a distinctive design has been described by P. Weierhousen, it consists of a low shaft vertical furnace but with a rear extension or wind box (12). Although it is believed by some that attempts were made to operate these little furnaces by natural draught, even in one case to the point of providing a removable clay chimney (10), in most cases, the remains of clay tuyeres or blast nozzles show that forced blast from bellows was the more general rule. Most of these furnace designs, or variants of them, have found their way to Britain and to the Weald itself, but only a small number of the known sites have yet been examined in detail. The practice of pre-roasting and grading the ore before smelting was general on the Weald (24).

Examples of the more Northerly type have been reported by J. H. Money at Minepit Wood (5), by C. F. Tebbutt and H. Cleere at Pippingford (5) and at Pippingford Cow Park (5). These three sites are on or near Ashdown Forest. Examples of vertical shaft furnaces are at Holbean Wood described by H. Cleere (13) and at Broadfields near Crawley by J. Gibson Hill (14). Both of these are associated with the Roman occupation period. One example of the low shaft with rear extension has been reported at Turners Green near Heathfield (15). In this and a number of other cases, bloom re-heating and forging facilities were noted.

From about the Roman period, written history begins to give us some pointers as to how the iron industry might ebb and flow as the political and strategic scene changed over the ensuing centuries. The two attacks by Caesar during the last century B.C., as already mentioned, must have had a polarizing effect on the Belgic tribes in the South East, with iron-making developing in areas of tribal influence deeper and deeper into the Weald where outcrops of ore or iron stained streams were found. Such sites are perhaps some of those described by C. S. Cattell on the upper basin of the Eastern Rother (16). This could have well been a prosperous time with supporting agriculture, forestry and ore diggings building up communities alongside the metal working and giving a pattern of trade and distribution not seen on the Weald before. It was to be broken by the Claudian invasion of A.D.43 which was to put much of Britain under Roman Imperial authority for several hundred years.

Of the four legions which landed on the Kent coast, it was the Second Augusta under the (then) General Vespasian which, after the initial battles, drove along the South Coast westwards (17). This legion had come from Strasbourg, which itself is not far from the Minette iron region of Lorraine, and they ultimately settled more or less permanently at Caerleon, where they would monitor the Forest of Dean and its iron production.

Large centralised iron workings were established near the coast as at Hastings (18) and more inland at Chitcombe near Brede and in the Sedlescombe and Crowhurst area. Perhaps later in date are the still more inland workings at Holbean Wood and Broadfields already mentioned. The

first large workings near to the coast could well have been established as part of the early treaty made by the Romans with King Cogidubnus. Professor Richmond points to a guild of iron workers organised in the Roman fashion and speculates on their having been native smiths (19). From present knowledge of the several large operations as well as of their location, it seems difficult to think in terms other than of a large import of skilled metal workers fully competent to establish the operations from first principles and in their own way. No doubt technical aid would form part of the Rome-Fishbourne package as well as the provision of an adequate military presence along coastal Sussex if for no other reason than to secure the new industry which had clearly been planned on an important scale, and to cover perhaps with a naval potential, the only available transport which was then by water around the coast. As to any native iron workers, few if any would be left after the fierce fighting around the Medway during the opening phase of the Claudian invasion; indeed little of a continuing nature could have been left on that northern side of the Weald. The British leader Caractacus retreated far west to join the Silures with his remaining forces. He would have need to ensure that the army smiths and the iron smelters would join that retreat across the Severn, where they would no doubt find scope for their skill in the Forest of Dean, for a while until they were to face the legions yet again. In due time King Cogidubnus settled comfortably into the palace built for him by Roman craftsmen at Fishbourne. Caractacus went to Rome in chains. Thus South-East England approached one and a half centuries of increasing Roman influence, particularly as the initial need to lean heavily on the Regenses was relaxed and Roman settlements tended to supplant local tribal authority. Roads were built across the Weald and it was probably at that point that some diffusion of ironmaking, as well as of other industry, took place under both military and civilian enterprise. Again field research is incomplete but from the several groupings of apparently Roman-British small iron smelting operations, along distinctive ridgeways or in small valley bottoms, it does seem that there had been a development of limited localised production, but well spaced as between one group and another. This might be expected from some system of land tenure.

A time came, about 290 A.D., when internal revolt and external attacks around the South East Coast must have militated against any iron industry on the southern fringe of the Weald and against transport to markets by sea. London and the towns north of the Thames would have to rely on the inland operations from which supplies could reach them by land. Elsewhere across Britain there were by then many iron-making operations serving the needs of their localities. In historic terms none of this was to last much longer than the end of the 4th century. As the over-reaching and now incompetent Rome withdrew its military presence, both Germanic and Nordic elements soon took advantage of the power vacuum left behind.

Meanwhile the shape of Britain's future was being conditioned by happenings away from our shores. In the land between the Elbe and the Weser rivers, groups of peoples had been forced to quit their farms partly by reason of successively rising flood levels and because of raids by the Norsemen. Some of these groups moved far inland to the upper reaches of the Weser where they would mingle with the Franks, others took a southern route to the Low Countries. Two generations later it was the descendants of these people who arrived on our shores. Nor were they in isolation since the people of Jutland and of Schleswig-Holstein were also on the move under Nordic pressures. At the same time a strong and widespread Frankish Kingdom now covered much of Northern Gaul from the coast back to the Rhine.

It was with this Kingdom that the Romano-British, particularly in Kent, became increasingly involved.

Perhaps it was to be expected that left bare of defence, the Romano-British in the South East should seek links with any cohesive authority both for trade and for military co-operation. In fact before the Roman army had finally departed, the connections between the Kent area and the Franks were tangible (20). Westwards along the coast but later, in 477 a significant group came into the other, southern, side of the Weald. It seems to have been more of a sea raiding party under Aella and his sons or he may have been hired to protect a party of immigrants already settled. Either way, as this group spent time attacking the Romano-British or being attacked themselves in turn, and particularly after their "slaughter of all who dwelt at Andredescaster", it is fairly obvious that any Romano-British still living on the Weald would lean towards what was rapidly becoming the Kingdom of Kent and that also at some river or other natural defensive line, a frontier would be established against those to the south who were to become the South-Saxons. It is of interest in this connection, that one very defensible line would be the river now called the Eastern Rother together with the high ground along its northern bank. At that time and well into the dates of the Saxon charters, this river was called the Limen and still today a tributary is called the Limden. This could have been the "Limes" between these peoples and for which the high bluff above Etchingham at Hurst Green called Burgh Wood with its camp site yielding Romano-British shards, could well have been a strong point.

The Kingdom of Kent rapidly developed into the most sophisticated of the various new areas of separate authority and the Franks would find, as the Roman smith must also have done, that the Wealden iron ore, with its manganese content was superior to that of Gaul and as suitable as the same general type of carbonate ore of their own long established Frankish industry on the Westerwald for the production of swords and other weapons. The mercenaries used throwing axes (fransiscas), long knives (scramasaxes), spears and swords. In due course and particularly as political and trade relations with territories north of the Thames grew stronger, iron-making would again flourish as did also the working of precious metals for which Kent was to become famous throughout Europe (21).

Probably the focus on iron production moved strongly across to the west during the 8th century regime of Offa over the whole of the South and Midlands. It would be no part of such a warrior's strategy to permit a potential source of arms material to continue in such an outlying and extremely vulnerable area as the South-East. Soon the constant disruptions caused by the Danish invasion and subsequent events, including fighting on the Weald, must in any case have seen the last of iron-making as a significant trade for long years, certainly in its eastern section.

When the Normans took over in 1066 and onwards, they had no early need of iron since they were well acquainted with all aspects of metal-working and the town of Caen had important ore-fields close at hand. Even the stone for much building was ferried across the Channel. Meanwhile many of the Wealden villages were "laid waste" and only the place names ending in .....field gave some indication that earlier iron-workings and forest clearings for them had existed. It was not until King John was relieved of his French lands in 1214 that there was any need to get the industry going again on the eastern side of England although, around the Severn in the west, it had probably continued quietly throughout (22). In some parts, the Cistercian Monastic Houses played a part in this revival, but the Wealden

House of this Order, founded in 1172 at Robertsbridge, provides no evidence in this direction despite its ore-bearing estates, its woodlands, its very suitable position for seaborne transport and its close contact with affairs of State. Only after the Dissolution was the potential of this site to be realised (23).

By 1253 Henry of Lewes comes into recorded history as the King's Smith and for the same year there is the well known reference to the Sheriff of Sussex being called upon to supply horse-shoes and nails for the army of Henry III. So from the mid 13th century at latest, there is evidence that the Weald was once again a recognised source of iron and its products. All this leads up to the end of the 15th century when Royal introduction into the Weald of Continental blast furnace practice, was to bring England into a totally new industrial era.

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24. For the primitive iron-maker, it would be an obvious step to wash and then dry the pieces of dirty wet ore. Many Wealden sites show evidence of this and of ore grading to walnut size. Roasting the carbonate ore ($FeCO_3$) at quite modest temperatures of say 300 C also produced a conversion to the oxides Fe_2O_3, Fe_3O_4 and FeO. This mixture of oxides is magnetic but dependent on the amount of Fe_3O_4 since neither Fe_2O_3 or FeO are themselves magnetic.

PETWORTH WATER SUPPLY

by J. E. Taylor, P.A. Jerome and A. G. Allnutt

According to Leland (Appendix I) Petworth s first piped water supply was installed during the reign of Henry VII. Rev. John Edmunds, Rector for some 35 years from 1496, installed a 3" diameter lead pipe from springs about 1 mile west of the town. It supplied the Manor House (now Petworth House) and 2 or 3 conduits (1) in the town.

These springs were some 20/30 feet below ground level in Boxgrove Paddock Petworth Park (fig.1) approached through a tunnel in the rock. Water seeped out of the sandstone and ran down a low passage through a deep pit to an underground chamber (10' x 6' x 7' high) of stone and small flat bricks. The depth of water was 3' and a gravel layer 2' thick allowed filtration to a 3" lead pipe running eastwards. The main pipe led to an old stone reservoir in the woodyard on the north side of Petworth Churchyard with branches across the Park to the kennels (then near the cricket lodge) and to points in the lower levels of the town.

This supply was mentioned in the 1526 Will of Anthony Jonson of Petworth in which he set aside from his estate the sum of 6 shillings and 8pence "to the mayntaynance of the channell of the cundyte". According to Lord Leconfield (2), when a survey was commissioned in 1575 by the 8th Earl of Northumberland the pipes were "greatly decayed" as was the old Manor House itself. Doubtless this was due to the Percies being more concerned with their estates in the North, but royal insistence compelled the family to reside at Petworth and Henry (8th Earl of Northumberland) agreed to share the cost of repairs with the town. He endowed the town with a 7 acre freehold known as the Conduit Field (fig. 1) east of Hungers Lane for this purpose. (The field is marked on Tresswells map of 1610). Supervisors of the two fountains outside the Church and in the Market Square were appointed.

Relations between the 9th Earl and his tenants became strained. They sued the Earl in Chancery over breaches of Manorial Custom and his appropriation of common land for his new park. In 1592 they took matters into their own hands, tore down the park railings, and cut off water supply to the Manor House. The Earl complained (3) that they had "in violent manner broken and entred those Conduit Houses and hedds apperteyning and by mere charge belonging to my House stopped and restrayned the water for my necessary euse, supposing the same theire lewde behavious not to come to light....". How long the Earl's supply was cut off is not clear but the case in Chancery dragged on for nearly a decade and the Earl presented a cross-suit in star chamber.

Another complaint at that period (4) was by the portreeve or clerk of the market against the Earl's servants for usurping the time honoured privileges of his office for their gain. Among the prerogatives usurped was the fining of "wasters at the conduits". Lord Leconfield (2 p.39) noted references in the court rolls to a fine of 2d for washing bullocks entrails at the common tap and other amercements at various times for watering horses and washing roots and fish.

By 1625 relations had improved and an agreement (5) was made between the Earl and the Rector (Rev. Richard Montague) and townspeople. It referred to a fountain of springing water and a conduit head standing over it in Hungers Lane and other conduits at the Church stile, the Market Place, and at the north end of South Street (now Pound Street) against a common inn

called "The George". The document recalls that "time beyond the memory of men" there had been the one lead pipe. The revenue from the Conduit Field (para.3 above) was no longer sufficient for maintenance and the document goes on "until now of late that ye said pipes begin to be in soe greate decay that it is thought finnge they should be of new done and made". The Earl would in return for receiving back the Conduit Field, carry out the necessary repairs and be responsible for continuing upkeep. He would be allowed to install an additional tap at Petworth House. Two wardens would be chosen, one by the Earl and one by the townsfolk and they would supervise the maintenance of the supply. They would give the Earl notice of necessary repairs and he would put them in hand within 6 months. The townspeople had to keep the town taps in order at their own cost. By 1640 (2) it was proving difficult to levy money from the town to maintain the taps and the water committee were arraigned before a Chancery Commission of Enquiry to answer charges that they had misappropriated funds intended for charitable purposes, namely water supply upkeep. The Commissioners found that funds had indeed been wrongly used and directed that the townspeople were to be assessed according to their means to raise the funds required. It is not known if this measure was successful.

In 1647 the Court of Quarter Sessions (6) ordered "that a tax shall be forthwith made by the Constable and Churchwardens of the Towne of Petworth upon all the Inhabitants there for raysing and collecting of Seaven pounds eight shillings and foure pence to be payed to Edward Saunders of Petworth aforesayd Carpenter for his labour for new making the Cisternes of the Conduit at the Church stile in Petworth And if any so taxed shall refuse to pay the same to be bound to appeare at the next generall quarter Sessions then and theire to answer his or theire Contempt".

Little is known of the history of the conduit supply for some 200 years until in 1842 Mr. Henry Upton wrote to Mr. Upton the steward (5) describing the system and stating that the fountain head was a large cistern in the old Star Hollow in the Paddocks whence the water was conveyed to the bath-house and stew (A fig.1) beside the Upper Lake in Petworth Park. A branch served the kennels and the main supply fed three conduits in the town, one near Mr. Phillip's library, one in the Market Place and a third outside Mr. Halliday's house near the church. This had been removed because the arched dome of the conduit had been considered a nuisance. He (Mr. H. Upton) had intended to renew the pipes to this conduit at his own expense, but Mr. Tyler the then steward had stopped him. (No date is given for this incident). He continued "I do not think the townspeople have done anything to the two first conduits for some years past except that about 10 years ago they put a new cock on the lower conduit by the Market". He observed that there were now no wardens of the conduits and the new cock had been put on by a few individuals acting on their own initiative.

The ancient conduit supply had been supplemented in 1782 when George 3rd Earl Egremont had installed a pump at Coultershaw Mill (see Appendix II) on the River Rother $1\frac{1}{2}$ miles south of the town. According to Mr. H. Upton in an appendix to his letter of 1842 the river turned an undershot wooden wheel (now breast shot with a cast iron frame and under restoration by the Sussex Industrial Archaeology Society) which worked a large pump with three barrels forcing the water along a main pipe some 3" inside bore. This fed two reservoirs at Petworth - one on Lawn Hill in Petworth Park overlooking the Upper Lake and one to the west of Percy Row near the old Gaol (opposite the present Courthouse and on the site of the British Legion Hut). (see fig.2) Connection to this supply required His Lordship's approval which was less

freely given than formerly because townsfolk had made a number of illicit connections. The system had never been intended to be used for drinking, being untreated river water.

In 1839 Mr. H. Upton had recorded (5) that river water supplied 7 public and 146 private cocks belonging to some 70 people, including the brewery, malt house, a windmill and the Swan Inn (fig.2).

By 1874 serious deficiencies in the system had become apparent and Charles.Kelly M.D. was commissioned to report to the Petworth Rural Sanitary Authority. He stated that the town's sewage was drained to fields to the south and then allowed to flow along an open dyke to the River Rother, ½ mile upstream of Coultershaw where water was extracted and pumped to the town. He noted that the supply through the Park was very good but the daily flow was limited. The River supply was distributed from the reservoir near the Gaol and was unfiltered and unfit to drink and the reservoir was badly constructed and dirty. Very few houses had water laid on, usually a single tap supplied 4 to 6 cottages. Hence despite the state of this supply "many people who will not fetch the conduit water (either due to neglect, illness, or bad weather) drink this dirty water from the river". Nor, he added, was this to be wondered at when some houses were a good ¼ mile from the conduit supply. Dr. Kelly concluded by advocating a new system using 3 other springs in the neighbourhood - Byworth Spout, the Virgin Mary Spring and a plentiful unnamed spring near Rother Bridge Farm (see fig.1). Sewage should be prevented from entering the Rother or a typhoid or cholera epidemic might occur if the drinking of untreated river water continued.

Mr. Robert Downing (apparently a Petworth resident) took exception to Dr. Kelly's conclusions in a letter to Lord Leconfield. He queried Kelly's assumption that water was only fetched from the conduit taps in buckets stating that "many people fetch the water from the conduits in barrels on wheels kept for the purpose so as to keep a good day's supply in their houses". Some houses, notably in Pound Street, were already supplied with spring water and a spring water tap stood in the Swan Yard (fig.2). He challenged Kelly's description of the river supply as "dirty and unwholesome" - many residents had drunk it for years and he himself had done so for 5 years with no ill effects. A filter near the reservoir would do all the cleansing needed. The misguided insistence of the Rural Sanitary Authority Inspectorate on substituting water closets for earth privies was leading to increased pressure on a sewage system which had not been designed for the situation so the change over was making matters a lot worse. (Old plans show that Downing was right).

Despite Mr. Downing's reservations, changes were afoot. Brick barrel drains were installed in the streets although still allowed to discharge at Rotherbridge. The reservoir at the Gaol had a large chalk and gravel filter added to it. Hassard and Tyrrell, Consulting Engineers, were engaged by Lord Leconfield to make an investigation. Their report (June 1881) listed various springs in the vicinity (see Appendix III for a note on the Geology) which might be used and they recommended a series near the brook below and west of Gorehill near Haslingbourne (at B fig.1). (There was a pond and dam at Haslingbourne in 1300). From these springs water would flow south-west by gravity 300 yards to a pumping station and be pumped through 5" pipes to a new reservoir near the Cottage Hospital (fig.1), on high ground a mile east of the town. Supply pipes (also 5" diameter) from the reservoir would enter the town via Shimmings and Angel Street and

connect to the River mains near the Red Lion (A fig.2). The River mains were to be plugged at appropriate points so that only Haslingbourne spring water circulated through the town.

This scheme (7) formed the subject of legal agreement (1882) between Henry Lord Leconfield and the Rural Sanitary Authority which said that Lord Leconfield was "desirous of providing a pure and more copious supply of spring water". The Authority would cease to use the river and Petworth Park supply. Lord Leconfield would pay for installation of the new supply but the Authority would pay for all upkeep and running costs.

In 1878 the Rural Sanitary Authority of Petworth appointed a Parochial Committee to deal with the management of the water supply and drainage systems. From then until 1885 the history is based on the Minutes of this Committee. In 1885 the Minutes suddenly cease but on the next page appears the first Minutes of the Parochial Committee appointed by the Petworth Special Drainage District in 1892 (8).

In 1882 the Consulting Engineer Hassard told the Committee that the Haslingbourne spring would yield 200,000 gallons per day. His scheme included a 6 hp steam pumping engine consuming 52 tons of coal per annum. The reservoir would hold 4 days supply and the head at the hydrants in the town would be 40 ft. The scheme was approved and water would be charged for, the supply having been free since 1625. Tenders were accepted and a Mason and Wayman engine with Cornish boiler was set to work in 1883. The boiler house, pump house and chimney, although small, had typical ornate Victorian polychrome brickwork (still there).

Also in 1882 the Clerk to the Committee was directed to have the price at which house connections to the mains could be made, cried by the Town Crier.

The hospital was put on the mains supply in 1883. Despite much trouble with leaky mains the engine coped well and speed was reduced from 44 rpm to 33 rpm to prevent pumping to overflow.

In 1884 a green algal growth began to appear in the reservoir and there was a reversion to the Park supply while the reservoir was covered in. Lord Egremont was consulted about this and apparently paid for the work.

From 1895 onwards the Committee began to consider duplicating the pump as there had been trouble due to breakdown of the engine and a standby was needed. A water turbine and an oil engine were considered but in 1898 they placed a contract for a steam pump with Pulsometer Engineering Co. The installation of an electric recorder was considered and deferred.

In 1896 the Town Crier was employed to make known all over the Town alterations in the Water Regulations.

1903 saw the first mention of watering the streets and also chemical analysis checks of the quality of the water.

In 1906 the spring was giving 3000 gallons per hour, the town was consuming 40,000 gallons per day and 6 hours pumping was needed. The results of water analyses were posted in shop windows.

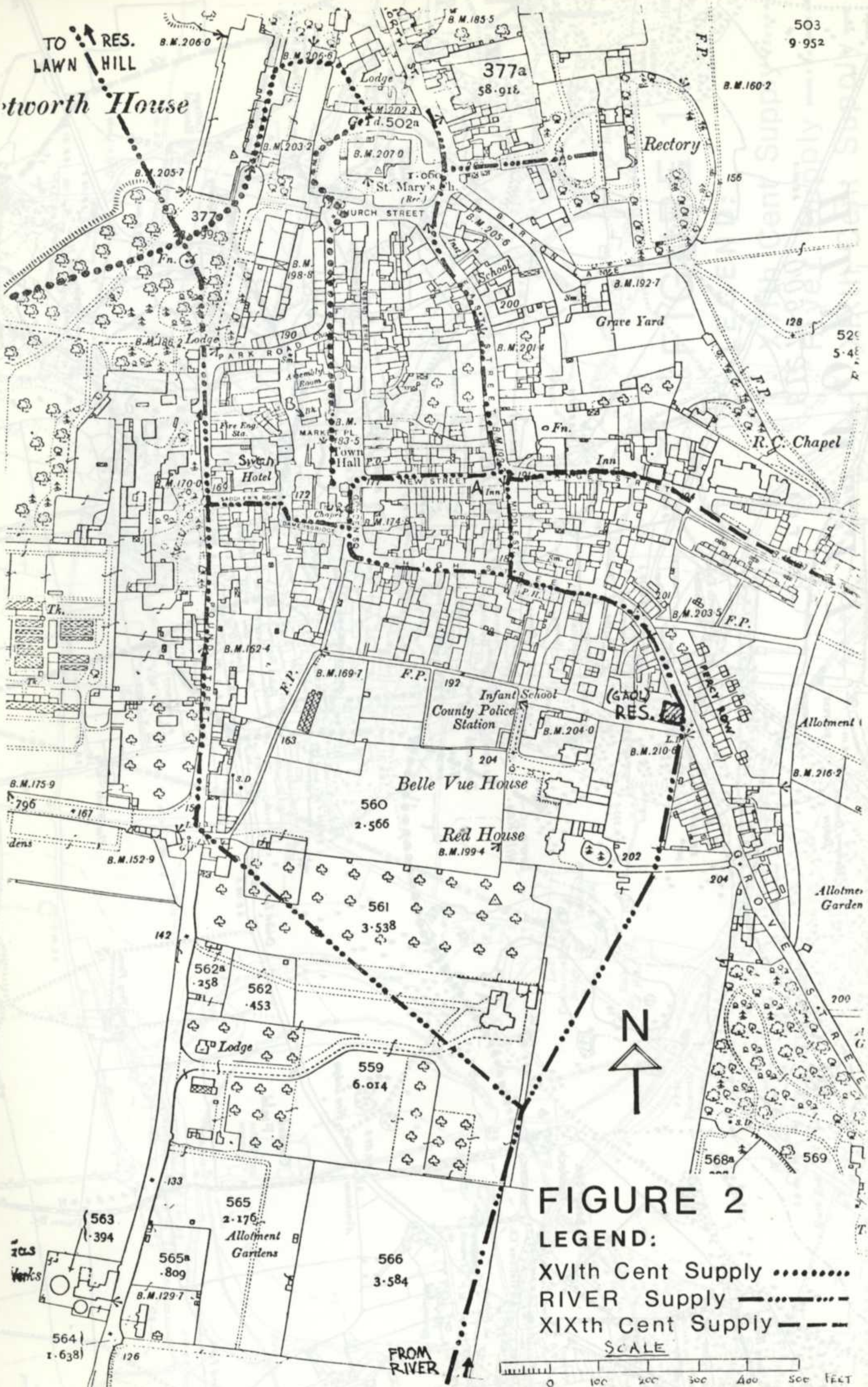
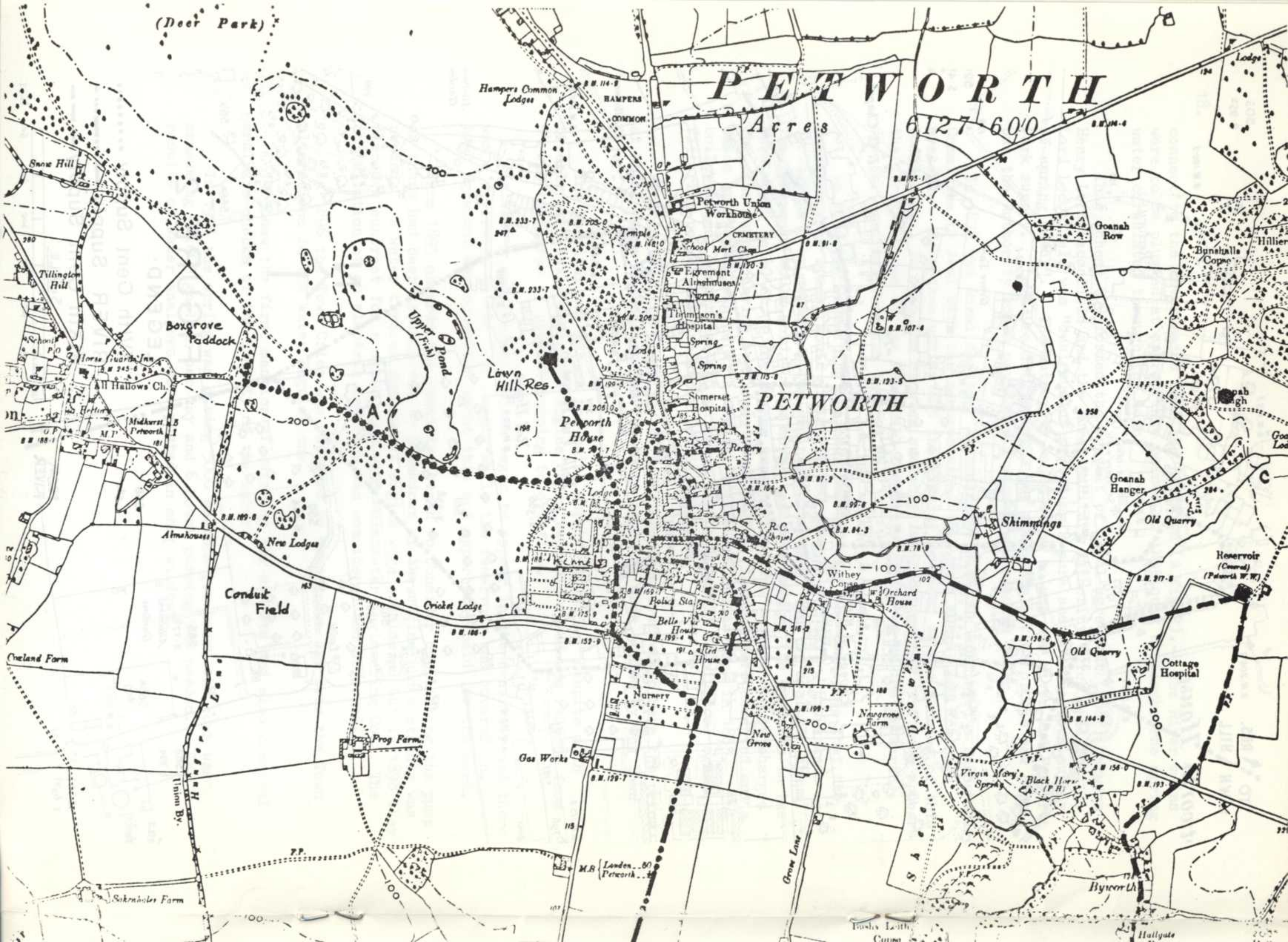

TO LAWN
RES. HILL
Petworth House
Lodge
377a
58.918
503
9.952
St. Mary's Ch.
CHURCH STREET
Rectory
BARTON LANE
School
Grave Yard
PARK ROAD
Assembly Room
Fire Eng. Sta.
Market Pl.
Town Hall
Swan Hotel
NEW STREET
ANGEL STREET
Inn
HIGH STREET
MIDDLE ST.
R.C. Chapel
F.P.
Infant School
County Police Station
(GAOL) RES.
PERCY ROW
Belle Vue House
Red House
560
2.566
561
3.538
562a
.258
562
.453
Lodge
559
6.014
565
2.176
Allotment Gardens
565a
.809
566
3.584
563
.394
564
1.638
568a
569
GROVE STREET
Allotment Garden
FROM RIVER
N
LEGEND:
XVIth Cent Supply
RIVER Supply
XIXth Cent Supply
SCALE
0 100 200 300 400 500 FEET

FIGURE 2


(Deer Park)
PETWORTH
Acres 6127·600
Hampers Common Lodges
HAMPERS COMMON
Snow Hill
Tillington Hill
Boxgrove Paddock
School
Horse Guards Inn
All Hallows' Ch.
Upper Pond (Fish)
Lawn Hill Res.
A
Petworth Union Workhouse
Temple
CEMETERY
School
Egremont Almshouses
Spring
Thompson's Hospital
Somerset Hospital
PETWORTH
Petworth House
Rectory
Lodge
R.C. Chapel
Almshouses
New Lodges
Kennels
Conduit Field
Cricket Lodge
Police Sta.
Withey Copse
Orchard House
Red House
Nursery
Coxland Farm
Frog Farm
Gas Works
New Grove
Nawgrove Farm
Virgin Mary's Spring
Black Horse (P.H.)
Union By.
Grove Lane
Sokenholes Farm
Byworth
Hallgate
Goanah Row
Bunshalls Copse
Hillier
Goanah Hanger
Shimmings
Old Quarry
Reservoir (Covered) (Petworth W.W.)
Old Quarry
Cottage Hospital
C
Midhurst Petworth
Lodge

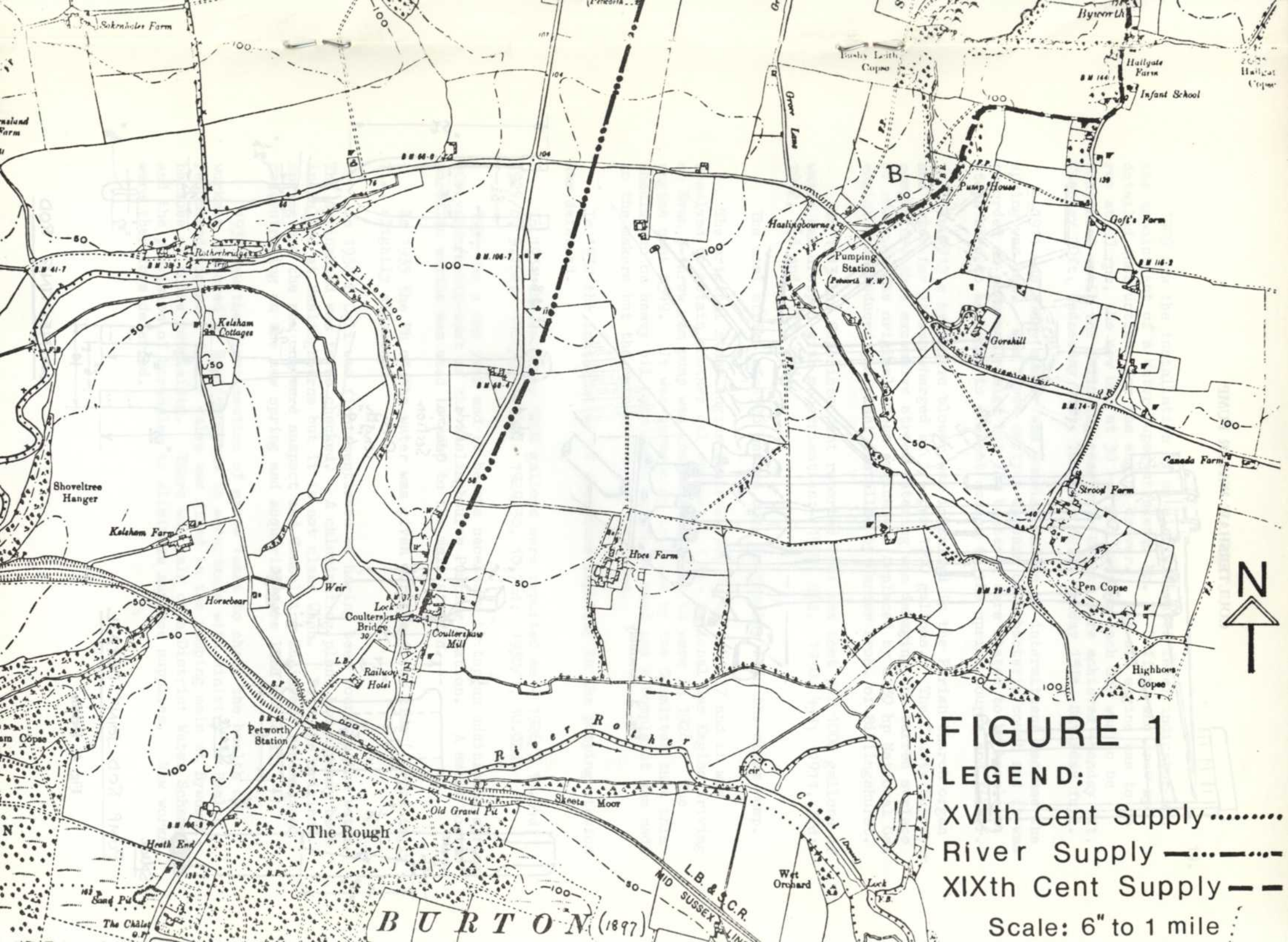


FIGURE 1

LEGEND:

XVIth Cent Supply .....

River Supply —·—·—

XIXth Cent Supply — —

Scale: 6" to 1 mile

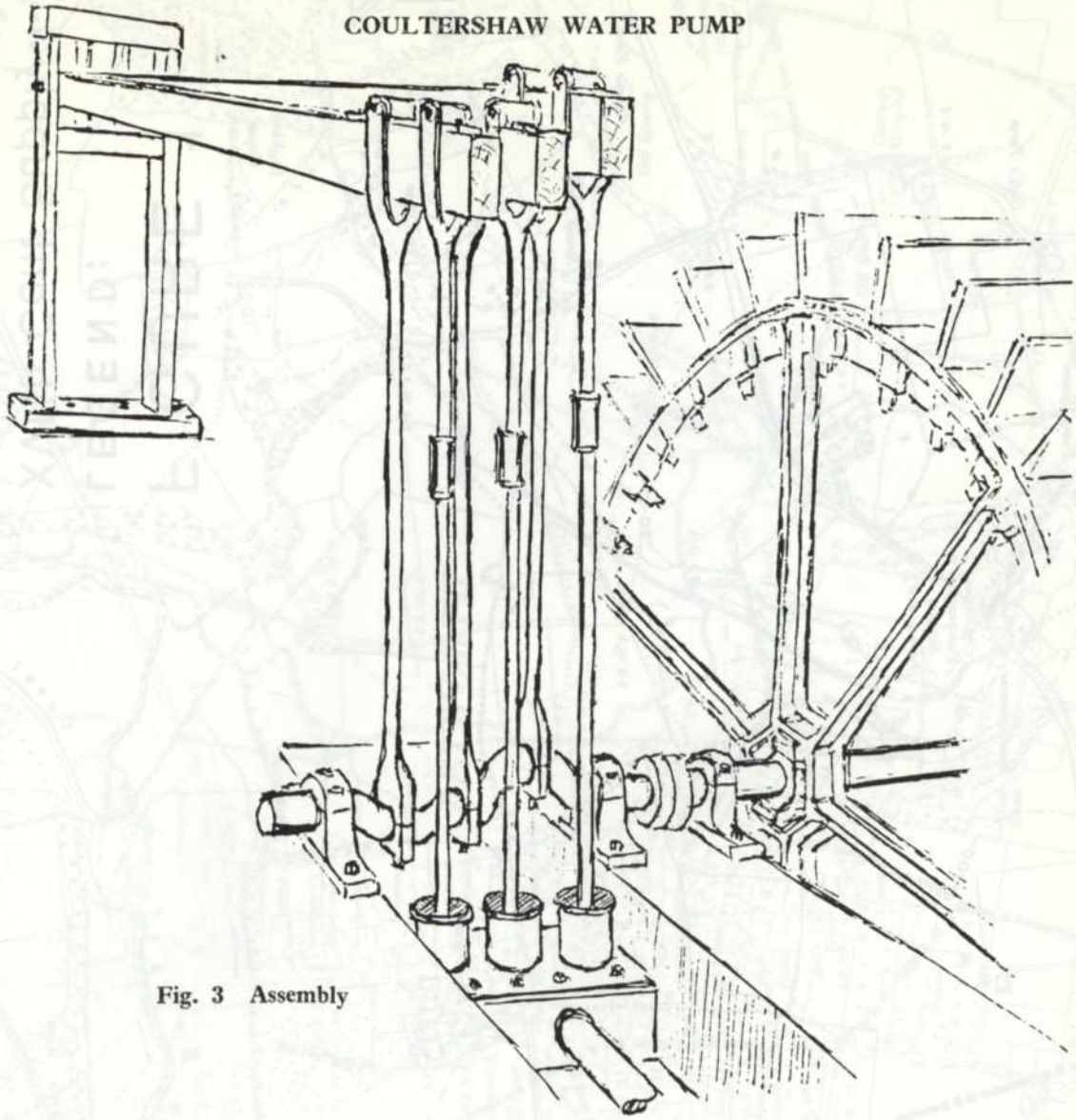
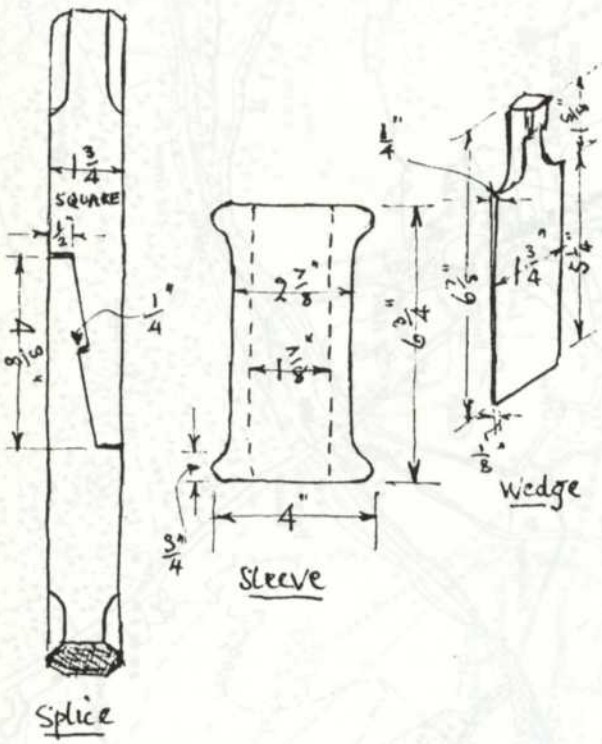


Fig. 3 Assembly



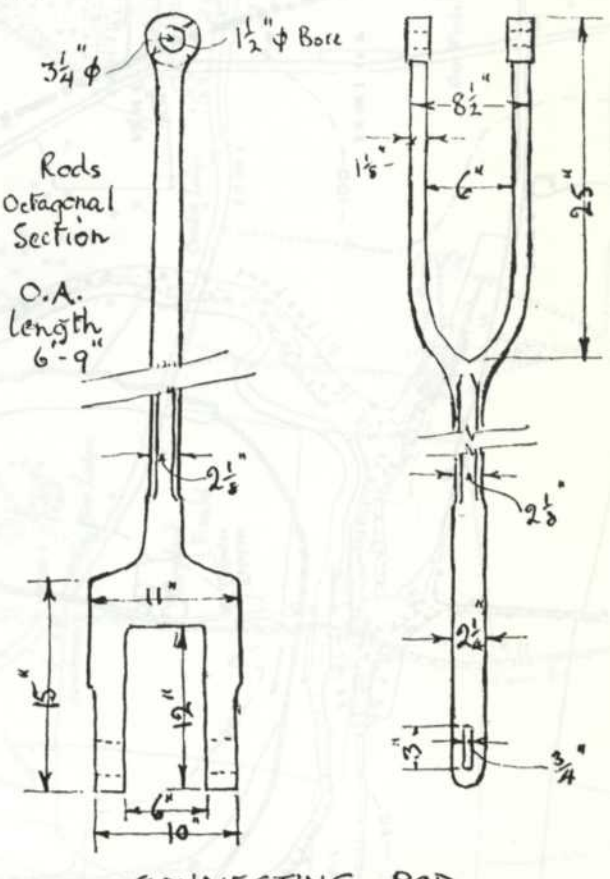


Fig. 4 Details

1909 saw the installation of an electric water level indicator and the appointment of a Water Superintendent, Mr. H. Caffyn, who drew up detailed instructions for the engine driver. The old engine was to be run at 40 rpm, the new one at 30 rpm and pumping each day was to be continued until the following reservoir depths were achieved -Monday 9ft, Tuesday 10ft, Wednesday 11ft, Thursday 12ft, Friday 13ft, Saturday full.

1911 was a dry summer and pumping had to be intermittent because the spring was low. The first mention appears of a bacteria count and it was recorded as abnormally high but the bacteria were stated to be harmless. Steps were to be taken to prevent access to the spring source and filter.

In 1912 a hydraulic blower was installed in the Parish Church organ and water for it was charged at 1/- per 1000 gallons. The County Surveyor complained that excessive street watering was damaging the tarred surface of roads, The original steam engine was replaced by a 30 hp National Gas engine and producer gas plant installed by Carter Bros. of Billingshurst.

In 1913 the Superintendent reported that the cost per 1000 gallons of water had dropped with modernisation:- 1909, 5½d; 1910, 4½d; 1911, 3¾d; 1912, 3¼d and 1913, 2¼d.

The coal strike of 1926 caused some difficulty with the steam pump.

The original steam engine was sold for scrap in 1927 and it was resolved to obtain another oil engine. A New National Gas Engine driving an Evan 3-throw ram pump was installed and set to work in 1928. The engine cost £349. It was apparently intended by the Committee that this should run on heavy oil but diesel had to be used and a complaint was made to the makers but the outcome was not reported.

In 1930 the installation of acetylene lighting in the pumping station was deferred.

In 1931 the cost per 1000 gallons were reported as - 1926/7, 11.34d; 1927/8, 9.76d; 1928/9, 9.11d; 1929/30, 10.76d; 1930/1, 10.02d.

1934 was a dry year and it became necessary to tap an additional spring 400 yards south-east of the Haslingbourne Pumping Station. A small Lister paraffin engine was used to pump to the main station.

In 1935 the Ph of the water was given for the first time (surprisingly 7.2, slightly alkaline).

In 1938 B Coli was first mentioned as having been found in the water. The springhead was to be checked. A chlorinating plant had already been installed at Haslingbourne but it is not clear when. Both the original spring and the new one were suspect and Consulting Engineers recommenced concentrating on the new spring and acquiring more land round it.

1939 saw the first mention of steps taken to check the health of workmen employed at Haslingbourne in accordance with Ministry of Health recommendations. An air valve was fixed in the pumping main at Byworth because of noise complaints. There was talk of a District Water Scheme and the provision of boreholes to eliminate surface supplies. New works were therefore deferred.

In 1940 Mr. G. W. Cargill was interviewed for the post of Engineer and taken on. He retired in 1971 but still lives in Petworth.

The supply was incorporated into a comprehensive Rural District Council scheme on 1st April, 1941. The Committee authorised the removal of disused Parish pumps by the Congregational Church (URC) and Wheatsheaf Inn (North Street).

After the takeover, a new pump house was constructed and two boreholes were put down. Two 80 hp Ruston Hornsby 300 rpm 2 cylinder diesel engines were installed, each geared to a 2 stage centrifugal borehole pump and 6 stage delivery pump by Mirlees Watson, to deliver 20,000 gallons per hour. The pumping main was increased to 8" diameter and a high level reservoir was built (C fig.1) to feed the north part of the town. (This may have been done a year or two earlier).

The installation was taken over by the N. W. Sussex Water Board in 1961/2 and they installed electric submersible pumps in the boreholes. The Ruston Hornsby diesels became standbys and were turned over fortnightly until 1978.

The Southern Water Authority took over in 1974 and since then expansion of supplies has been met by pumping from Hardham.

References

1. The word "conduit" refers in this article to a point where water is brought to a spout or tap from which buckets may be filled.
2. Lord Leconfield Petworth Manor in the 17th Century.
3. E. de Fonblanque Annals of the House of Percy Vol. II.
4. Petworth House Archives, File 5451.
5. Petworth House Archives, File OOD2/Q1/1
6. Quarter Sessions Order Book, Michaelmas 1647. Sussex Record Society, Vol. 54 p.133
7. Petworth House Archives, File 00/417/16.
8. Minutes of Parochial Committee for the Parish of Petworth for considering and dealing with questions of drainage and disposal of sewage and water supply. Record Office, Chichester.

Acknowledgements

Mr. Sven Sternfelt for preparing the maps.
Mr. G. W. Cargill for information.
West Sussex Record Office for access to documents.

Appendix I

Itinerary of John Leland (The Standard Edition)
L. Toulmin Smith (1909), iii, 92.

"Parson Edmundes of late dayes perceyving the great lak of water at Petworth caussid chiefly a great spring, the hedde whereof is about a mile from the toune, to be brought in lede to Petworth, parte of the water cumming to the manor

place, part to the personage, the residue to ii or iii places yn the streate of the toune".

Appendix II

Coultershaw Water Wheel Driven Beam Pump

This pump, installed in 1782, appears to be peculiar to West Sussex, the only other known similar one is in Bignor Park. A pump installed to supply water to Uppark House at about the same time, operated at a higher pressure but was probably not a beam pump. Claverton beam pump (John Rennie) 1813 was waterwheel driven and much more sophisticated but it worked to a low head. It pumped from the River Avon to the Kennet & Avon Canal and has been restored.

As will be seen from fig.3, a breast-shot water wheel was direct coupled to a three-throw crank shaft which swung 3 beams pivoted at one end through connecting rods. The pump plunger rods were connected to the outer free ends of the beams and with a beam length of 12' and a stroke of 1' the tilt of the plunger rods out of the vertical could be ignored being only 6 minutes of arc. The wrought iron connecting rods were provided with cotters for adjusting the big-end brasses, and the pump plunger rods were divided in the middle with a neat sleeved interlocking joint (see fig.4) to facilitate dismantling. Pump plungers were back to back 6" diameter leather cups and non-return valves were leather flaps fixed by brass clamping pieces.

Water was drawn from the main culvert feeding the wheel, through a 4" diameter cast iron pipe and lead strainer, and delivered through a $1\frac{1}{2}$ mile 3" diameter cast iron pipe to two reservoirs at Petworth. A compressed air vessel was installed in the delivery line to reduce pressure fluctuations, (probably at a later date since this use of compressed air was patented by W. Freemantle in 1803). The head was about 150ft, 65 lb/sq.in. There were a number of non-return valves between the pump and Petworth. The pumping rate was 20,000 gallons per day. The supply of water to the wheel was by means of a vertical oak penstock.

Accurate alignment between the forged crankshaft (itself probably not very accurate) and the waterwheel shaft would have been very difficult and was not really achieved. To keep down friction the bearings between the wheel and the pump were left loose and the clatter this caused is said to have got on the nerves of the miller's men working in the other part of the building. The pump only stopped work after the last war.

For restoration we have received grants from the Historic Buildings Section of the Inspectorate of Ancient Monuments DOE and West Sussex County Council and help from Lord Egremont on whose land the installation is situated. To avoid the clatter referred to above, a flexible coupling is being inserted between the two shafts. Water will probably be delivered to a fountain and run into the mill pond. The masonry building housing the pump will be surmounted by a wooden barn for protection and to provide a small display.

Principal Dimensions

Wheel. The original wheel was all wood. The present one has two cast iron spiders cast at Cocking Iron Works owned by Robert Chorley in mid-19th century. The spiders

have hexagonal centres adjusted on the wrought iron wheel shaft by folding oak wedges. Spider diameter 8' 6". Oak paddles 16" deep x 5¼" wide making overall diameter of wheel 11' 2". Wheel shaft 7" diameter.

Beams — 3 No 8" x 3" oak 12' 6" long.

Connecting Rods — Wrought iron 6' 7" long. 2" diameter roughly octagonal. Forked at both ends (fig.4)

Pump Plunger Rods — Upper length 3' 10" 1¾" diameter roughly octagonal. Lower length 4' 6" (fig.4).

Crank Shaft — Three-throw, stroke about 12½" (The present crank shaft was installed during a major overhaul in 1912). 4¾" diameter journals. 5¾" diameter sides.

Acknowledgements

The Society is very grateful of many people for help with the restoration work, including: Lord Egremont, West Sussex County Council, Department of the Environment, Lord March for the barn, many local firms who have contributed materials free or at reduced rates, private contributors, the efforts of many volunteers including groups from HMS Daedalus.

Appendix III

Note on Geology: Petworth is situated on fairly high ground on the Hythe Beds of the Lower Greensand series and these beds are underlain by the Atherfield clay which outcrops on the edge of the town from north round to south-east, forming the floor of Shimmings Valley as far south as just west of Byworth. This impervious valley floor, with sandstone and sands above, accounts for the many springs on the east side of the town including those near Haslingbourne and it is the same sequence that accounts for the springs in the Park, near Tillington.

The boreholes at Haslingbourne penetrated some 80' into the Hythe Beds which are mainly firm sands in this vicinity and this caused a certain amount of trouble with borehole choking and silting up of the waterways of the borehole pumps. Under the town, the Hythe Beds include layers of greenish grey sandstone enabling wells to be dug.

Appendix IV

The public supply was not Petworth's only source of water. The original supply must have been from the springs on the east side of the town. The two which were probably most used were one in Greysleith Meadows 100 yards below the footpath from Shimmings to the R. C. Church, and the Virgin Mary Spring near the little planked footbridge over the brook between Petworth and Byworth (fig.1). The latter bubbled out of the rock and ran down the slope to the stream. An iron pipe was inserted in the spring and a dip hole was constructed so that it would be possible to sit on a stone ledge and let the clear cold water pour over one. The water had traditionally been credited with healing powers. Footpaths round the Sheepdowns were probably formed by people carrying water from the Virgin Mary Spring.

Most houses built during the first half of the 19th century had an additional supplementary system - rain water tanks. At Petworth, Percy Row is a good example; a brick and stone tank holding some 3000 gallons when full. Each of the 12 houses in the Row had a separate lead pump over their sinks. The tank at Petworth House stables held more than 3000 gallons and there is a large tank in Market Square which used to supply the old Half Moon Inn (B fig.2) now demolished. Others were at the Town Hall, Petworth Park Hotel (formerly the Swan) and a 17,000 gallon tank fed from the Church roof.

FROM OX-CART TO STEAM ENGINE

A Sussex wheelwright's business a hundred years ago.

By M. Beswick.

In the summer of 1978 a member of the Society, Mr. H. W. Nightinale of Swanborough, discovered that a number of old tools including a wood-working lathe, were still in existence in the wheelwright's shop above the forge of C. Dean & Son at Rodmell. A visit was arranged, in the course of which we were shown two old ledgers which had been preserved, and Mr. Frank Dean, the present owner, kindly allowed me to borrow these for more detailed study.

They cover a period of five years from 1878 to 1883 and embrace a remarkably wide range of activities, as the wheelwright undertook not only the making of waggons and carts and repairs to these and other agricultural implements, but also the erection of farm buildings, gates and fences, domestic carpentry, house-painting, brick-laying and plumbing. In the winter of 1881 he even sent men to remove snow from the gutters of houses and farm buildings and, on one occasion, arranged for chimneys to be swept. He also repaired the fabric and furniture of the local churches and schools and made coffins and acted as undertaker.

To build up a thriving business which employed between 15 and 20 men (1), the firm of Jeffery and Baker had clearly been established for some time. The Post Office Directory for 1855 lists James Jeffery as wheelwright and blacksmith at Rodmell. By 1867 the partnership of Jeffery and Baker was in existence, and in 1878, the first year covered by the ledgers, they described themselves as builders as well as wheelwrights and blacksmiths and were also in business as blacksmiths at Piddinghoe (2).

From their main base at Rodmell, Jeffery and Baker served an area on the west side of the Lower Ouse Valley, from Kingston in the north to Piddinghoe and Telscombe in the south. A high proportion of their work was done for the big landowners, such as the Marquess of Abergavenny, the Earl of Chichester and W. L. Christie, who owned property in the district. Then there were the landed gentry like Captain J. H. Rosseter of Iford Manor and H. R. Ingersoll of Southease. The clergy, too, were good customers, as, in addition to church and rectory, they had the glebe farm to maintain. The farmers of the district were in constant need of replacement parts for ploughs, harrows, dung-carts and wooden implements like hoes and rakes, and the local tradesmen such as the baker, the miller and the brick-maker and lime-burner, had carts and tools which required the wheelwright's attention from time to time. In all there were 38 customers with individual accounts in the 1878 book and 34 in the 1880 book. In addition, the village people came to the wheelwright's shop for paint, turpentine and linseed oil or to have a saw sharpened and set as well as for such items as a trug-basket or a new handle for an axe. These purchases are entered in the ledger as sundries.

Even the purely agricultural side of the business covered a very wide range. First of all there were new pieces of equipment, presumably all made to order. The most expensive item sold during this period was a 'new 3in. wheel waggon complete: £35'. Two of these are mentioned in the accounts. 'One light cart: £14' is the only other new vehicle, apart from dung-carts, of which there were several at a cost of £12 each. A

'new Sussex wheel plough complete' cost £6.10s. and a new pair of drag-harrows, new coupling and painting same', £3. A wheelbarrow cost £1.1s. or £1.4s. according to size, and ladders were priced according to length, a 35-stave ladder costing £1.15s. and a 40-stave one £2. The role of animal husbandry in the area is indicated by the number of mangers, cribs, troughs and wattles (hurdles) supplied, and clearly fences and gates were of importance too. A 'new sheep-dipping trough inc. boards, nails and painting ditto' cost £2.10s. and, at the other end of the scale, a new milking-stool could be had for a shilling.

A notable fact is that everything was capable of being repaired. Ploughs were given new 'chips' and new axles. Harrows required new couplings. Hay-rakes and corn-rakes were mended, although a small hay-rake would only cost 1s. new. Also among a long list of items repaired were milk-carts, hen-coops, rabbit-hutches, churns and gallon measures, well-buckets and all the various implements which could be given new handles, such as picks, axes, rakes, 'spuds' and flint-hammers. A handle for this last cost 3d.; it was the cheapest item on the list and the frequency with which it appears suggests that flint-knapping was still a common skill in the district.

Some agricultural machinery figures in the accounts. There are repairs to mowers, reapers, winnowing and threshing machines, the latter being operated by a traction engine, which probably served most of the farms in the neighbourhood. In 1879, the engine appears to have come into the ownership of partners, Bannister and Noakes, who had a separate 'Engine A/c.' The expenditure of £8.1s.4d. incurred in that year is made up of £4.4s.10d. from the smith's account and £3.16s.6d. from the wheelwright's account and it seems that the smith made the spare parts like bolts, plates and chains and the wheelwright fitted them, as well as doing general servicing and painting. However, in 1882, when replacement parts, including '14 new spokes for the Engine wheel' were required, these were supplied by Every's foundry in Lewes.

Drainage and flood-control were obviously a matter of concern in an area such as this. No doubt the farmers did their own ditching, but the wheelwright's men were often sent in to erect or repair fences in the 'brooklands' and in 1878 there is a special account headed 'Iford Wall'. This must have referred to a communal effort to strengthen the river bank and improve the land behind it, as there are entries concerning a new sluice, a new bridge, a gate and fencing. There are no subsequent entries under this heading and so one may assume that the work had been satisfactorily completed.

Farm buildings figure prominently in the accounts. These range from chicken-houses and pig-pounds to cow-stalls and barns. Usually what was needed was a new door or repairs to the roof, but there are several instances of complete new buildings being erected, for example, a 'cart-horse stable and granary over ditto' or a 'new fatting stall' which cost a total of £92.17s.11d. In general, it is difficult to discover the exact cost of building operations, because of the wheelwright's methods of listing both labour and materials piecemeal and often intercalating in his accounts other work done for the same customer. However, a separate account shows that in 1880, W. L. Christie had a new sheep yard constructed on Southease Hill at a cost of £200.7s.1½d. Most of the farmers had sheep on the Downs as well as cattle on the 'brooklands', as there are entries for repairs to

a shepherd's hut and to various 'sheep-hovels'. The word 'ox-hovel' also makes its appearance several times, and it would seem that all the heavy work on the farms was still performed by oxen at this period.

Building operations involved work on private houses as well as farm buildings and cottages. Again this could generally be classed as maintenance, but there was a certain amount of new building going on as well. A new house built on the Abergavenny estate in 1881 cost £610.0s.9d. and two new cottages erected at Northease Farm in 1883 cost £323. One or two houses underwent extension or improvement such as a new kitchen, and there was a lot of re-roofing carried out. It looks as though much of this was conversion from thatch to tiles, as 'eave-laths' and 'tiling-laths' appear frequently in the accounts. I was at first misled by the large number of thatching rods which were also supplied, but then realised that these were for thatching ricks, as on one occasion only, in 1878, was the item for thatching rods followed by 'paid Jos. Hutson for thatching cottage:£3'. This particular account subsequently includes further payments to the thatcher as well as '120 trusses of straw, spars, etc.' Slates were used for roofing occasionally, but the majority of the work was done with tiles.

Most of the interior work in houses involved putting in cupboards and painting and paper-hanging. Some of the biggest customers in fact received separate accounts for these services, but all are entered in the wheelwright's book. One unusual job was the installation of a system of bells to ring in all the rooms at Rodmell Place. Window-glazing was also undertaken, and it can be seen that several of the larger houses had conservatories and also greenhouses and cucumber frames.

The wheelwright's men could also handle work concerned with water supply and sewage. Well-curbs are mentioned quite frequently, along with such entries as 'new case to pump and cover over well'. The smith was called in to install iron piping, but in general both water supply and sanitation were handled by the wheelwright. He built both earth closets and water closets and cesspools to accompany the latter.

Work was carried out in the churches at Rodmell, Piddinghoe, Southease and Telscombe. The latter acquired a new screen and additional seating, whereas the items for the other churches are mostly smaller ones, such as a new ladder for the belfry. Running repairs at the schools at Rodmell, Iford and Piddinghoe usually involved broken desks and replacement of broken windows(!). However, Iford School also acquired a new blackboard, which cost 3s.6d. and Rodmell School had some more substantial refurbishing in 1881, including repairs to the roof, new floorboards and repainting.

Other local tradesmen were dependent on the wheelwright to service their vehicles and supply or repair their working equipment. For example, he repaired the roundhouse of Jacob Verrall's windmill and mended his cart. He supplied a new bread trough and a new 'oven peal' for John Glazebrook, the baker and for Edward Baker, the brick-maker and lime-burner at Piddinghoe, he made brick and tile moulds and brick barrows and repaired a whiting-cart.

Nor must we overlook his activities as undertaker. It would appear that coffin-making was work he gave to his joiners during slack periods, as three kinds of coffin figure in the accounts. There are 'Coffins for the District', which I take to be paupers' coffins, at £1.1s.6d. each. Then there are 'Coffins in the House', also a standard product, made for the

workhouse at Newhaven, which cost £1.2s.6d. each. Finally there are special orders, which might cost anything from £2.10s. to £4. ('full trimmed'). Children's coffins, on the other hand, could cost as little as 9s. The ledgers record meticulously the ages of the persons for whom the coffins were required and this makes melancholy reading, when one sees how many young children were among them. However, a good many people also survived to a ripe old age, as there were several in their 80's and one of 91. 'Coffins for the District' also included some for Newhaven, one entry reading: 'man unknown, found in harbour'.

Some inferences can be drawn from the ledgers about the manner in which the wheelwright obtained his supplies of materials. Strangely it is about his timber that we learn least of all. Just occasionally he accepts timber from one of the local landowners in part payment of an account, when the entry reads: 'credit by elm trees: £7.' or 'credit by timber: £13.' When he has to buy building materials, he sometimes notes the name of the supplier; for example, against lead (for guttering) is written: 'Wiston's bill' and later, against glass is written: 'Weston'. This could well refer to the same supplier, as Robert Baker's spelling is not his strong point. The bricks, tiles and drainpipes that he used probably came in the main from his customer Edward Baker, at Piddinghoe, although this is never indicated. What is indicated, however, is when they came from some other source, for example: '300 Chailey bricks - 15s.' or, on another occasion: 'Normans' bill' (i.e. E. & R. Norman of Chailey Potteries). In one isolated instance, in 1897, 8,000 'clinkers' and some ridge tiles were ordered from Johnsons (subsequently Keymer Brick and Tile Co.) of Burgess Hill and the receipted bill is still in the ledger.

This bill throws some light on Baker's method of charging customers for work done. In this case, at any rate, he passed on the cost of the bricks, £21., direct, only adding carriage, and so one assumes that materials were charged at cost price. Labour was charged for per man/day, and this varies from 5s. per day for a skilled craftsman to 4s. for a labourer and 3s.6d. for an apprentice (3). This, of course, only applied to work done on the customer's premises. For work carried out at the wheelwright's shop, the charge for labour is included in the cost of the job. Prices on the whole show little fluctuation during the five years under consideration. One exception, however, is firewood, which the wheelwright supplied from time to time. Charges for this varied from as little as 10s. per cord to £1. which was the most usual price. One wonders at times how much difficulty Baker had in obtaining payment from his clients. Some settled fairly promptly, but others (and these were by no means the ones least able to pay) ran up quite large bills from one year to the next.

From the foregoing account it will be seen that the wheelwright's books shed light on a number of aspects of life in the Lower Ouse Valley 100 years ago. Communities were largely self-sufficient still. Farming was in the main unmechanised and labour-intensive. Rates of pay were low, but there was work to be had and the area seemed to be enjoying reasonable prosperity. Students of Sussex dialect would find numerous examples of local names for implements which are now obsolete, as well as the various parts of an ox-yoke and waggon. It is perhaps unfortunate that the picture is not quite complete, as the smith's day-book for the same period has not survived. The wheelwright's book makes reference to this from time to time and charges are made for items supplied by the smith, such

as nails, bolts and hinges. However, we learn nothing of the rest of the work of the forge. It would have been instructive, for example, to discover from the number of shoes made, the relative importance of horses and oxen as draught animals at this date.

The last quarter of the 19th century saw the continued expansion of the business of Jeffery and Baker (4). By the end of the century, however, there were already signs of change. They now described themselves as ironmongers as well as undertakers, builders, wheelwrights and smiths. This move into the retail trade marks the appearance on the scene of the mass-produced articles, sold in shops, which would ultimately put the wheelwright out of business. In 1910, Christopher Dean, the father of the present owner, bought the forge and took over the builder's business. 'Jeffery and Baker' and later Mrs. Sarah Jeffery continued in Rodmell as shopkeepers only, for another 25 years (5). Christopher Dean described himself as builder, wheelwright and smith until the end of the 1920's, but after that he concentrated on the work of the forge alone. It is pleasant to record that not only his son, but also his grandson are still plying the trade. They travel as far afield as Hickstead shoeing horses and Rodmell Forge seems likely to continue in business for some time to come.

Notes

1. This estimate of the number of men employed is based on a count of the workmen's names which appear in the ledgers. Over the five year period, 18 names appear more than once and five others appear once only. Even if some of these were casual labour, it still represents a remarkable increase over the eight men stated to be employed by Robert Baker in the smith's and wheelwright's shops in the Census returns for Rodmell in 1871 (East Sussex Record Office: ZA 17/15).
2. Kelly's Directories for 1855, 1867 and 1878.
3. Sometimes the ledger merely states 'man'. At other times, names are used and, comparing these with names on the 1871 Census return (see Note 1.), I found for example, that Edmund Brown and George Hansford, for whose services 5s. per day was charged, were already described as 'wheelwright' at the earlier date. The name Rich, the man or boy for whom only 3s.6d. a day was charged, does not appear in the ledger until 1881, hence the assumption that he was an apprentice.
4. Kelly's Directories for 1887, 1891 and 1899.
5. Idem. 1915 - 1930.

THE HURST GREEN FOUNDRY

By A. J. Haselfoot.

The firm of Albert Oakley Ltd., at Hurst Green in East Sussex, was one of the last jobbing foundries and general engineering works in the County and has a long history spanning more than 250 years. According to C. W. (Bill) Oakley, the son of Albert Oakley and last surviving member of the family in Hurst Green, the foundry was started in 1704 by G. Huntley who was probably a wheelwright as well as a smith. It may have been called the Regent Foundry originally as this name was found on the back of one of the

forges. In 1722 it was owned by John Huntley and in 1864 by Thomas Page, although it was rented to and operated by Thomas Pierson and later by George Pierson, who is described in Pike's Directory for 1886 as 'Iron and brass founder and general smith'.

Albert Oakley, who was born about 1857, was one of four brothers, all smiths or ironfounders; Tom had a foundry at Hawkhurst, Ned a forge as Ash in Kent, and Frank, who owned the first motor car in Kent, had a foundry at Horsmonden. Albert first worked at the foundry for George Pierson and later took a 21 year lease of it on 21st March, 1887 from the owner, Henry Walker, who had inherited it under the will of Thomas Page who died on 19th April, 1864. A valuation and inventory made on 12th May, 1887 for George Pierson, when selling the fixtures and fittings to Albert Oakley, is an interesting hand-written document. In addition to the foundry itself with its cupola furnace, foundry crane, bellows, moulding sand etc., there is a smith's shop with three hearths, three anvils, a drilling machine, shears, benches, vices etc., and seven sledges and ten hammers. There was also a fitting shop with two lathes, grind-stone etc., and a 4hp horizontal engine for driving the overhead shafting. The pattern shop with bench and lathe, the pattern store, carpenters bench, tools, scales, barrows etc. and various forgings, castings, scrap and pig iron were also included. The whole was valued at £441.14s.10d.(£441.74) plus 15s.(75p), being half the cost of the stamp and the inventory, giving a total purchase price of £442.9s.10d (£442.49). The inventory and valuation were made by John Every of the Phoenix Iron Works, Lewes, and Edwin Stephen Mills, Auctioneer & Valuer of Sandhurst. Payment was made by £100 in notes, a bond of £150 and a note-of-hand for the remainder, £192.9s.10d. (£192.49).

In a trade letter of 12th May, 1887 Albert Oakley describes himself as 'Engineer, Foundry & Smith's business, lately Thomas Edwin Pierson' so George had continued to trade under the name of Thomas Pierson, presumably his father. There was also another smith's business in Hurst Green, run by James Tester, who is described in the Post Office Directories of 1851 and 1870 as 'blacksmith & ironfounder'; he continues to appear in directories as a smith until 1887, but a trade card of Albert Oakley describes himself as 'late Tester & Sons', so he appears to have taken over Tester's business as a smith as well as leasing the foundry from Henry Walker. A George Tester - painter - appears in Kelly's Directory for 1895 but in their Directory for 1903 a James Tester - blacksmith - appears, besides Albert Oakley - engineer & ironfounder, so the Tester Family had obviously started up a smithy again.

On 20th August, 1890 the foundry, Albert Oakley then being the tenant, was sold at auction by Henry Walker and bought by James Ford of Hurst Green, to whom Albert Oakley was instructed to pay his rent in future. In the Sale Notice the property was described as 'Hurst Green Iron and Brass Foundry, Workshops and Dwelling House'; the stables, front and back gardens were included. The buildings were given as:- 'Foundry 32'6" x 31'6" - Engineer's Fitting and Turning Shop 38' x 14'9" with Pattern Loft over - Blacksmith's Shop with three Fires 25' x 24' - Fitting Shop with Loft over 24' x 14' - Large Drying Store. All in brick with tiled roof'. The double dwelling house was set back from the road, of brick and weatherboard with a tiled roof, extensive garden or lawn in front, and a brick stable and large garden at rear. The dwelling house had been partly destroyed by fire and, not having been

restored, was then unoccupied. As a result of this the rental, which had previously been £44.14s.0d.(£44.70) had been reduced to £30. p.a. The Land Tax payable was given as 14s. (70p) p.a. An indication of machinery prices at this period is shown by an offer from a London firm in 1892 of a 10' lathe with 9" bed-clearance for £45.18s.0d. (£45.90), delivered to Etchingham Station.

In 1908 the lease of the foundry expired and Albert Oakley bought it. He died in 1912 and the foundry passed to the Oakley family who, in 1919, formed the private company - Albert Oakley Ltd. - to carry on the business of iron and brass founders, smiths and general engineers. The foundry side of the business virtually ceased about 1958 when the moulder, Bill Oliver who was the mainstay of it, left, but the engineering side continued until 1972 when the works were sold to Harper & Ede of Lewes. In 1974 Harper & Ede, as part of their development plans for the site, decided to demolish the foundry and workshop buildings. They offered the complete contents of the foundry and pattern shop to the Southern Industrial History Centre who acquired them for subsequent erection at the Chalk Pits Museum, Amberley, together with all the overhead shafting from the workshop and the driving motor and starter. The workshop machines were retained by Harper & Ede.

At this time the foundry itself had been out of use for some years, although the workshop with its lathes and drilling machines was still in use; the original steam engine driving the overhead shafting had however been replaced by an electric motor. Of the three hearths mentioned in the 1887 inventory only one remained and this was no longer in use. The pattern loft also was no longer being used, though there were a number of patterns stored there. The cupola furnace, wooden foundry crane, ladles, crucibles and tongs, and some mould boxes were removed, together with the complete contents of the pattern loft, with its bench and lathe, a large number of patterns and core boxes, and various castings from some of the patterns. The overhead shafting from the workshop, complete with bearing brackets, driving belts, electric motor and starter, was dismantled and removed. A complete set of photographs was taken for record purposes and measured drawings were made of the furnace with its blower, and the overhead shafting, so that it will be possible to construct a fairly accurage representation of the foundry and workshop for ultimate display at the Chalk Pits Museum. A selection of these photographs is reproduced here showing general views of the foundry and its furnace, the foundry crane, the workshop, smithy and pattern loft. Also illustrated are the small crane on the front of the building with the date carved on the wall alongside, some cast iron animal heads that ornamented the doorway of the dwelling house, and the last castings made in the foundry, which were cast by Bill Oakley. A very early hand-operated petrol pump, said to be the first one to be installed between london and Hastings, stood beside the gate and a number of glass globes from early petrol pumps were also acquired.

Subsequent to the removal of the contents and demolition of the buildings Bill Oakley has very kindly presented to the Museum a number of further items, including a set of moulder's tools, and also all the early ledgers and day books of the firm. He himself worked in the firm all his life, both he and his father Albert being particularly skilled at lathe work. He remembers the furnace being hand-blown by casual labourers for beer money. Farm workers also used to come and work the hand blower in their off-time, being paid in beer which they drank out of their boots.

The ledgers and day books give a fascinating picture of the work of the firm over nearly a century. A few entries date from the period 1878 - 1881, two customers being marked as being in account with James Tester & Sons, showing that the Hurst Green Foundry had taken over business from Tester & Sons even before Albert Oakley acquired it. The main ledgers start in 1887 and the Museum has an unbroken run of them up to the end of the First World War. A fair amount of the firm's business has naturally been in the field of agriculture, supplying and repairing farm machinery; drag shoes for wagons are a continually recurring item in the early ledgers and a large number of patterns for these have survived with tyre widths varying from 1½" to 7". However, anything was grist that came to their mill and the outstanding impression from all the ledgers is the tremendously wide range of goods and services that were handled; water-heating boilers and cisterns, pipes and guttering, scythes, spades, shovels, etc., fire bars for furnaces and grates, gear wheels and pulleys, gratings for road drains, wheels and hubs for railway wagons, bearings and baseplates for machines; as well as the supply, repair and maintenance of all kinds of farm machinery, and later on of cars and lorries. Nothing came amiss to them and the firm was obviously prepared to tackle anything that any of their customers needed in the general field of mechanical engineering. Various forms of decorative cast iron work were also made, e.g. rustic style garden benches (a bench end casting is in the Museum), cast iron crosses for graves (a pattern for one still exists) and fronts for domestic grates (several of these are in the Museum). The royal coat of arms on the Royal George Hotel at Hurst Green is also a product of the foundry.

The area covered was mainly East Sussex and the adjacent parts of Kent and Surrey, though in the early years of this century some more distant customers appear, in London, Worcestershire and Nottinghamshire. The number of customers on their books was generally between 200 and 250, though it dropped to 160 in the period from 1901 to 1906 and rose to nearly 400 in the early 1920's. The firm had a very steady trade with local farmers and land-owners, supplying some of the large estates with almost their entire needs in engineering items and general ironmongery, as well as maintaining and repairing their farm and garden machinery. Rudyard Kipling first appears on their books in 1912 and intermittently afterwards. They were also regular suppliers to several big builders and builder's merchants, and supplied items to the Kent & East Sussex Railway, Hastings Corporation and the East Sussex County Council. They also held the agencies for several manufacturers of agricultural machines, ploughs, reapers, binders etc., and also for manufacturers of small portable oil engines for general use on farms and large estates.

In conclusion I would like to express my sincere thanks to Bill Oakley for the help and information he had given me during the preparation of this article, for kindly allowing me to examine various papers relating to the history of the firm, and for generously donating a number of items to the Chalk Pits Museum - in particular the early ledgers and day books which contain so much interesting local history.

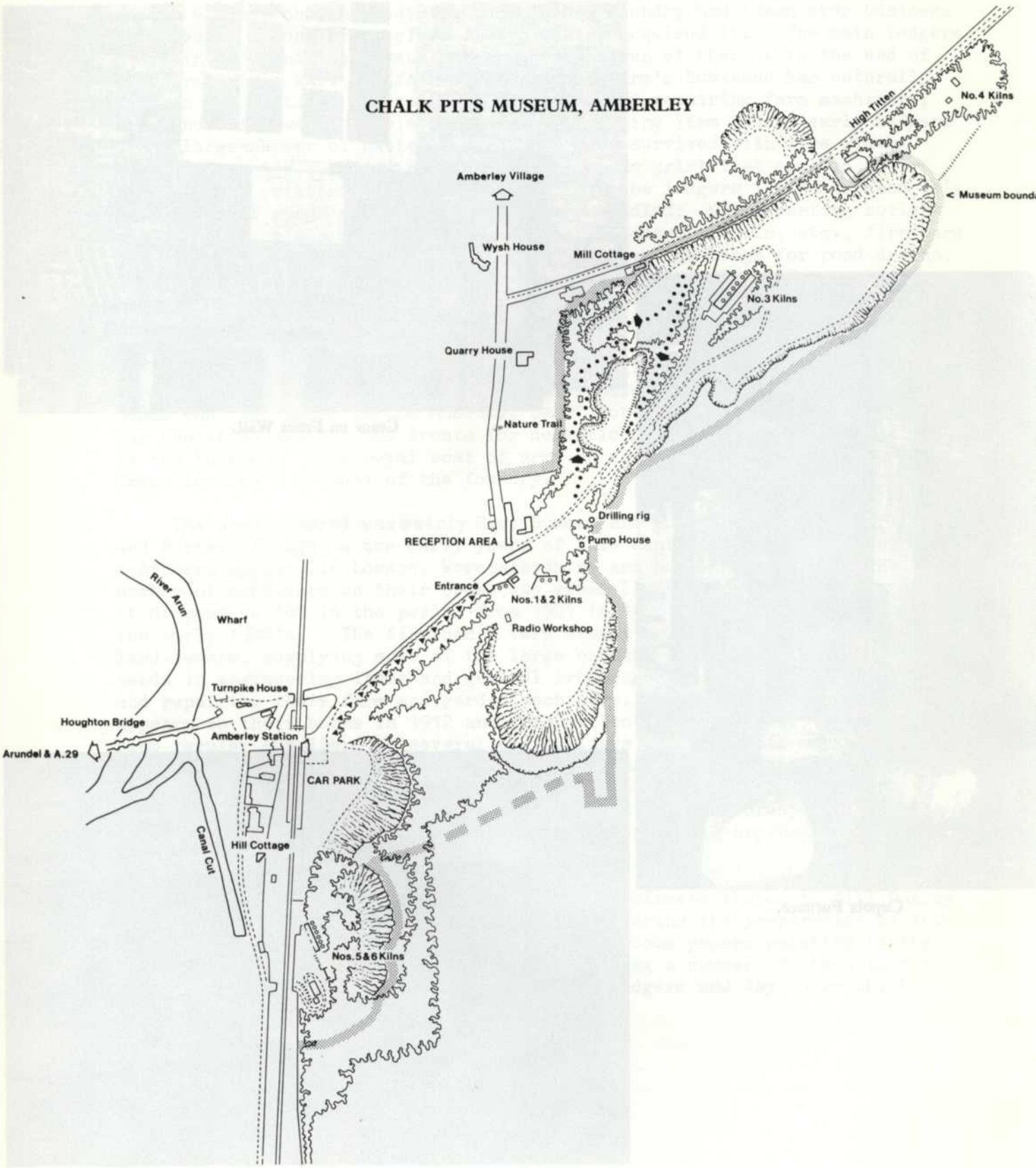
HURST GREEN FOUNDRY — II

Crane on Front Wall.

Cupola Furnace.

One of the last Castings made at the Foundry;
Royal George Hotel, Hurst Green.

CHALK PITS MUSEUM, AMBERLEY



THE CHALK PITS MUSEUM, AMBERLEY

The Chalk Pits Museum, Amberley, the first Open Air Museum of Industrial Archaeology in the South East of England, was opened to the public on Saturday, 26th May, 1979. The Museum, situated in the old chalk pits at Houghton Bridge, has been set up by the Southern Industrial History Centre who have leased the chalk pits from the West Sussex County Council. The purpose of the Museum, as an educational and exhibition centre, is to demonstrate the varied range of industries to be found in South East England which existed to support the predominantly agricultural nature of the area. Industrial Archaeology in its broadest sense is the study of the working life of past generations by the documentary and physical remains they have left behind - how did they live, how did they travel, what kind of machines and power sources did they use, what were their working conditions - all these aspects will in due course be covered by exhibitions and demonstrations at the Museum.

Chalk has been quarried for lime-burning at Houghton Bridge from 1841 or earlier, as several lime-burners are listed in the census returns for that year. By 1847 a block of three kilns had been built in a pit to the south of the present museum car park, but these were subsequently destroyed when the railway was built. They were worked by William Warren and the lime was shipped by barge from a wharf on a short canal cut from the R. Arun, which still survives though much overgrown. The 1851 census shows three lime-burners, James Cooper, William Smart and Richard Lee, as well as labourers and bargemen.

The railway, opened in 1863, greatly increased the facilities for transport of the lime and by 1866 a fourth lime-burner, Walter Saunders, is listed. About 1874 John Pepper & Son acquired James Cooper's interest, apparently in settlement of a debt, and by 1899 only two lime-burners are listed, William Lee and Pepper & Son. It is of interest that a miller and lime-burner, Joseph Brown, is mentioned in 1878, and a windmill is shown on the 1879 O.S. map at High Titten on the high ground to the north of the pits - this may have been used to grind chalk.

Pepper & Son continued to work the pits, which were extended on both sides of the road over High Titten and also to the north-east and south of the railway station. There were kilns in all the pits and various railway sidings were laid down to serve a number of them. By about 1880 there were said to be about 24 kilns. Hard chalk was also sold as a building material and was used in the crypt of Lancing College Chapel and in the Roman Catholic Cathedral at Arundel. About 1904 further kilns, of a Belgian design, were built and these still survive, though in a modified form. In the 1950's there was a considerable output of lime for building purposes, 3-shift working being often used to give continuous production. In the 1960's production gradually ceased though the buildings were used for agricultural purposes for a while.

The lime-burning exhibits, which, when fully restored, will form one of the most important parts of the Museum, comprise Nos.1-6 Kilns. No.1 Kilns, alongside the entrance, were built in 1879 and much work has still to be carried out on the kilns, bagging sheds and grinding machinery in this area. The original rail siding from Amberley Station ran along what is now the entrance track and the locomotive was stabled in the engine shed where there was provision for it to be coupled to the grinding

machinery by a belt drive. No. 4 Kilns, now buried under dense undergrowth at the far north-east end of the pits, also date from 1879. The No.2 Kilns, one of which has been restored and can be viewed both from above and below, were built shortly before 1910. The earliest kilns, Nos. 5 and 6, which were probably built soon after 1863, are in the south pit and work on them has not yet started nor is the area open to the public at present, though it may soon be opened up. The No.3 Kilns, the De Wit Kilns, are the largest, having been built to a Belgian design in 1904 with 18 chambers operating on the downdraught principle. They were not successful and were very soon modified to the normal shape and enlarged. They are in fair condition, though not yet restored, and a special trail has been arranged so that they can be viewed from below and also, at a distance, from above. The grinding and processing machinery at the south-west end of the kilns has still to be worked on. In connection with the operation of the pits the office building of Pepper & Son still survives with the weigh bridge at one end of it. It is being restored to form a small flat and an audio-visual room where a slide show and commentary gives a good introduction to the Museum. The old account books of the firm, dating back to the 1890's, have also been preserved.

For some years past the Southern Industrial History Centre has been collecting and storing items illustrating the industrial history of the area and some of these are now on show together with details of the various restoration projects designed to exhibit fully the different industries concerned. One of these is the small jobbing foundry and engineering workshop, where the complete furnace, foundry contents and pattern shop of Albert Oakley Ltd., Hurst Green, have been acquired and are now in store (see p.29). A number of items from this collection are displayed and it is intended that a reconstruction of the foundry and workshop shall be established in due course when a suitable building is available.

The blacksmith's shop, which was a necessary adjunct for repair work as well as for shoeing horses, has also been rebuilt and tools donated by Duke & Ockenden and by the Stanmer Preservation Society from the old Stanmer Forge are on exhibition.

The history of brick-making is another project in hand, as a number of items relating to this industry have been collected and are in store. The Sussex Industrial Archaeology Society has a Brick Survey Group whose research into the history and remains of past brick works will be of value to this project.

The Museum has a collection of small stationary oil engines dating from the early part of this century. A number of these are exhibited and can be seen running. Among other large engines a 2-cyclinder 350hp oil engine at Fishbourne Pumping Station has also been promised to the Museum.

Water supplies will be another project for exhibition. There is a bore-hole on site and when the original pump has been restored to working order this will be used to supply water again. There is also a drilling head for a bore-hole on site and the Sussex Industrial Archaeology Society has in store a water-wheel driven pump, complete with its driving wheel, from Sutton Hall, Newick.

A transport project will be arranged beside the concrete road which runs along the chalk pits.

A most comprehensive display of early radio equipment, including military installations from the 1914-18 and 1939-45 Wars, can be seen in a building above the No.2 Kilns. This has been arranged by Mr. Ronald Ham and is probably unique in its range and coverage.

A most worth-while project, but one requiring much financial support, is the preservation of part of the No.3 Ship Shop at Portsmouth Dockyard, due for demolition in October. This building dates from 1843 and is the first building in the World to use large cast-iron arched trusses. Five bays of this building re-erected on the Museum site would afford valuable covered exhibition space as well as being a fine exhibit in itself.

The geology of the chalk pits is of particular interest and an exhibition and geological trail have been arranged; there is also a good nature trail. The Museum is open from Wednesday to Sunday, and on Bank Holiday Mondays, from 11.00 a.m. to 5.00 p.m. until 28th October. There is ample car parking space at Amberley Station where the entrance kiosk and Information Centre are located.

A. J. Haselfoot.

BOOK REVIEWS

The Batsford Guide to the Industrial Archaeology of South-East England

by A. J. Haselfoot. B. T. Batsford, London 1978.
152pp. 65 Photographs, £3.95p

A. J. Haselfoot in his 'Guide to the Industrial Archaeology of South-East England' has succeeded in producing a book which will appeal to practically everyone no matter what their level of interest in the subject. The past few years have seen a steady growth in public support for industrial archaeology and a book of this nature had been long overdue. This is a book to dip into, for no one can fail to find something of fascination amongst the 573 sites described or in the 65 photographs it contains. John Haselfoot has visited the majority of these sites personally during the course of his researches, and this intimate contact with his subject shows strongly in the text. Let us hope that this book will go someway towards alerting public opinion to the importance of industrial monuments as part of our heritage and stimulate further research and interest in the subject. If there is to be a criticism, then it must be of the book's somewhat high price, which might have the unfortunate effect of deterring the more general reader.

A. G. Woodcock.

Sussex Railway Architecture

by John Hoare. Harvester Press. £6.50p

An excellent and much-needed historical survey of the railways of Sussex, which, at their greatest extent in 1928, afforded a closely-knit network of communications over the whole of the County. After defining the main aspects of railway architecture the author deals with the development of railways in Sussex from the original London-Brighton line, authorised in 1837, through their peak in the first quarter of this century, to their subsequent present day decline. The architecture of the two principal early railway companies, the London & Brighton and the South

Eastern, is then dealt with followed by a detailed consideration of the several architectural phases which can be identified from the 1850's up to the present day, and the architects and engineers who have influenced their styles. A great deal of research has plainly been undertaken in the writing of this book and the author is to be congratulated on the logical arrangement of his material and the very readable text; a useful and comprehensive classification of stations is a valuable addition. One of the delights of the book is the large number of photographs, both old and new, which illustrate various aspects of the subject, but here I must enter a protest - there are 101 illustrations but none of them are referred to in the text and there is no list of illustrations. This last appears to be a recent gimmick of some publishers and it can be exasperating to the reader - I found myself continuously searching the book to find a picture of the station being described, and which I felt sure I had noticed earlier on. In spite of this criticism the book is well worth possessing, being a first-class record of the architectural history of Sussex railways, much of which has already passed away and which is still disappearing at an alarming rate.

A. J. Haselfoot.

English Provincial Posts

by Brian Austen. Phillimore. £4.95p

A fascinating study of a hitherto unknown facet of the English Postal Service. The author has concentrated on the operations of the Post Office in Kent and East Sussex, comprising the services on the London-Dover and London-Rye and Hastings routes and their extensions. Separate chapters deal with the organisation of the service in the periods 1633-1660, 1660-1784 and 1784-1840, with additional chapters on the Postmasters in the last two periods and the Post Office Surveyors in the final period. Three maps are included showing the gradual expansion of the service from 1700 to 1839 and a number of useful appendices covering postal costs and revenue and details of both major and minor postal routes. Until 1770 all mail was carried by postboys on horse-back but mail carts began to be used after that date and in 1784 the mail coach was introduced; local branch posts were however often served by foot posts up to a distance of 12 miles. As well as internal mail the foreign mail to France and other European countries was carried on the Dover Road. The Post Office monopoly suffered from competition from stage coaches, steam ships and private carriers, particularly after the periodic increases of postal charges. Throughout the book the author has the happy knack of carrying the reader with him into the period being described so that he feels he is getting a birds-eye view of events as they happened. Altogether an excellent piece of social history and a very readable and human document. A very minor complaint; I found the large number of tables interspersed in the text slightly distracting, perhaps they might have been better grouped together at the end. The dust jacket bears a charming illustration of delivery and collection of the mails without stopping the mail coach - the guard drops one mail bag on the ground and picks up another one off a pitchfork held up by a woman as the coach thunders by - a forerunner of the similar automatic device used on the Travelling Post Office on the railways!

A. J. Haselfoot.

Route Map. L. S. W. R. Main Lines

by J. C. V. Mitchell. Middleton Press, Easebourne Lane, Midhurst, Sussex, GU29 9AZ. Price 90p plus 10p postage. 35pp.

This small book contains full-scale reproductions of those portions of the 1 inch to the mile Ordnance Maps (4th Edition, 1919-1925) that cover the main L.S.W.R. lines from Waterloo to Exeter, Weymouth and Portsmouth; it thus shows the railway arrangements existing at the time of the grouping in 1923.

Each map section is accompanied by a gradient diagram and extremely interesting and informative historical notes relating to the various stations, junctions and track lay-outs on the route; these explain why particular lay-outs were originally adopted, why they were often subsequently changed or abandoned and other information of value to railway historians.

Anyone interested in railways and also in old maps can spend a most fascinating evening studying the book or, alternatively, it would make an extremely interesting companion for a journey over the routes described as many of the abandoned features are still recognisable.

The cartographic techniques employed fifty years ago were not entirely suitable for subsequent reproduction so that some clarity in the maps is lost but certainly not enough to impair the reader's enjoyment.

This 'Route Map' is the first of a series which, it is hoped will eventually cover all the main and many of the minor lines of Britain.

E. O. Taylor.

FIELD PROJECTS

The Brickmaking Survey

In 1978 Members of the Society interested in brickmaking got together to form a study group with the object of recording as far as possible the extent of brickmaking activities in Sussex in the past and also the methods of manufacture that were employed. It was felt necessary to do this, as ten years had elapsed since the recording of the last firing of the wood-burning kiln at Ashburnham (see Sussex Industrial History No.1) and the number of people still alive who remembered the old brickworks and their methods of operation was dwindling fast.

Although it is intended that the survey shall cover the whole of Sussex, it has been necessary to organise field work on a local basis, and small groups or individual Members are already active in various parts of the County. Recording and documentation of sites has been done in the Midhurst, Brighton and Heathfield districts, historical evidence of brickmaking in the southern half of the Rape of Bramber has been collected and work is getting under way in a number of other localities.

It is hoped eventually to publish a general survey of brickmaking in Sussex, together with a gazetteer of sites. However, much work remains to be done and offers of help would be appreciated with documentary research, tape-recording of reminiscences and recording of sites.

Study Group Chairman: E. W. O'Shea, 14, Pelham Terrace, Lewes.
Secretary: Mrs. M. Beswick, Turners House, Turners Green, Heathfield.

Burton Mill (SU980180)

The West Sussex County Council has made a further contribution towards the cost of restoration of the mill and has also signed a lease for its two lower floors with Mrs. Anette Mills, a Member of Sussex Industrial Archaeology Society.

Replacement of the faulty timberwork is proceeding with the help of fortnightly naval working parties. A cast-iron free-standing hursting and two French Burr stones have been located near Cardiff and transported to the site for eventual installation.

Coultershaw Bridge Water Pump (SU972194)

The significance of this water-driven pump is referred to in the article on the Petworth Water Supply elsewhere in this issue. Work has continued on the restoration (Sussex Industrial History Nos. 7 and 8) and during the past year the wheel has been completely re-timbered and is now free to rotate; attention is now concentrated on restoring the pump, a problem having arisen due to lack of alignment between the crank shaft and the wheel. The Water Authority has dredged the river to relieve flooding and has thus provided a channel leading to the old lock of the Midhurst Navigation.

Petworth Station (SU970191)

As a result of action by the Sussex Archaeology Society in 1976 the Station has been officially 'listed' as worthy of preservation. Efforts to find a suitable tenant to provide an alternative use for the building have so far proved unsuccessful while proposals to transport and rebuild it on the Bluebell or Dart Valley Railways have also not materialised. The Society would be very pleased to hear from any reader having a serious proposal for its future use.

Index of Research Articles in Issues 1-8

A few copies of the above issues are available from the Hon. General Secretary, price £1.00, including postage. Copies are also available in the Reference Sections of the chief Sussex Public Libraries.

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