

**BROSELEY
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SOCIETY**



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EDITORIAL

Broseley Local History Society

The Society was originally formed as the Wilkinson Society in 1972 and was renamed in 1997 to reflect its main purpose:

‘the research, preservation and promotion of Broseley’s unique heritage’.

Meetings are held on the first Wednesday of each month beginning at 7.30 pm, at Broseley Social Club; and annual events include a summer outing, an autumn walk and a winter dinner. Members receive a quarterly newsletter and an annual journal. The Society’s collection of artefacts is at present stored at the IGMT Tile Museum at Jackfield.

The Society has a web site which contains information about Broseley, copies of the newsletter and articles from previous journals. This can be found at *www.broseley.org.uk*

The Journal

In this issue we celebrate the 300th anniversary of Abraham Darby’s use of coke to smelt iron with an account of the ironmaster’s association with Broseley. The context of John Wilkinson’s vital contribution to the development of the steam engine was outlined in this year’s Annual Wilkinson Lecture, and we are publishing an edited version of this. A short article looks at the Gottheimer brothers, travelling photographers with local connections. We are grateful to Mrs Regina Pfeiffer for permission to reproduce her grandfather’s remarkable account of his early years in this area.

The articles represent ongoing research and reminiscences of Society members and others, and we are grateful to individual contributors. Our thanks also to Steve Dewhirst for design and typesetting.

Contributions for the next issue would be welcome and should be sent by 31 August 2010 to the editor, Neil Clarke, Cranleigh, Wellington Road, Little Wenlock, TF6 5BH.

Abraham Darby and Broseley

by Neil Clarke

300 years ago at Coalbrookdale, Abraham Darby I successfully used coal in the form of coke to smelt iron. Some years later his daughter-in-law described how she thought this came about:

About the year 1709 he came into Shropshire to Coalbrookdale, and with other partners took a lease of the works, which only consisted of an old blast furnace and some forges. He here cast iron goods in sand out of the blast furnace that blowed with wood charcoal; for it was not yet thought of to blow with pit coal. Sometime after he suggested the thought that it might be practicable to smelt the iron from the ore in the blast furnace with pit coal. Upon this he first try'd with raw coal as it came out of the mines, but it did not answer. He, not discouraged, had the coal coak'd into cynder, as is done for drying malt, and it then succeeded to his satisfaction. But he found that only one sort of pit coal would suit best for the purpose of making good iron.

In looking at Darby's origins, the reasons he came to Coalbrookdale and the significance of his use of coke, we should not overlook Broseley's contribution to his story.

Darby was born near the Wren's Nest, Dudley, in April 1678, the son of a peasant farmer who also made locks for a living. He was apprenticed to a malt-mill maker in Birmingham, and in 1698 moved to Bristol. There, after first setting up as a maker of malt mills, he formed a partnership with a group of fellow Quakers who in 1702 established a brass works at Baptist Mills. The following year he set up a foundry in Cheese Lane, Bristol, and took out a patent for casting bellied pots in sand rather than loam in 1707. Darby's use of an air furnace to melt pig iron from the Forest of Dean, and also his use of wooden patterns to shape sand in a mould box, enabled him to produce iron pots that were of thinner section and less weight than others made at the time. But he needed his own blast furnace to provide a plentiful supply of pig iron for casting, and the opportunity to acquire one appears to have presented itself on a visit to the Severn Gorge in 1706.

In that year Darby visited Quaker friends in Broseley, where there had been a meeting house since 1692, and at about the same time he and his Bristol partners set up a brass works at Coalbrookdale. He

would also have been aware of the advantages the area had for making pig iron. Supplies of raw materials were available locally. With there having been a pre-Reformation bloomery, forges, Sir Basil Brooke's steel works and an existing mid-17th century blast furnace at Coalbrookdale, there was a small population of skilled ironworkers in the area. Streams at the head of the Coalbrookdale valley had already been dammed to form reservoirs for water power; and the River Severn could provide transport links, particularly with his Bristol business colleagues. Added to these factors, Darby would have noted that the blast furnace at Coalbrookdale was in a semi-derelict condition, caused by an explosion in 1704 which had led to its former lessee, Shadrack Fox, abandoning the site, and that it might therefore be available on favourable terms.

In 1708 Darby leased the blast furnace at Coalbrookdale from Comberford Brooke, lord of the manor of Madeley. Its rebuilding began at the end of October and it was in blast by January 1709. Examination of Coalbrookdale Company records in Shropshire Archives and the Ironbridge Gorge Museum Trust's library reveals that from the first the furnace was fired with coke. But what led



A view of the Upper Works at Coalbrookdale (Vivares 1758), showing features of Abraham Darby I's time: Old Furnace, Upper Furnace Pool, coke hearths and Dale House

Darby to try using coal in this way? Coal had been applied to a widening range of industrial processes in the late 17th century and its use in ironmaking had long been foreseen. In East Shropshire it had been anticipated by John Weld of Willey in his Memorandum of 1631, and in the Black Country Dud Dudley, who managed several ironworks on his father's estate, claimed in his book *Metallum Martis*, published in 1665, that he had smelted iron with coal in a blast furnace. No doubt Darby himself had gained some knowledge of the use of coal in the melting of metals in his Bristol enterprises, and from his early career knew that coal in the form of coke had been used in the making of malt because of its low sulphur content. One of the factors in his decision to lease the Coalbrookdale furnace was the availability of locally mined coal, several varieties of which were known to be low in sulphur. He was obviously prepared to experiment with coal, to turn it into coke by burning off the impurities, because supplies of charcoal, which was the traditional fuel in the blast furnace, were becoming more difficult to secure.

Although it is clear that in 1709 Abraham Darby used coke as his fuel for smelting iron ore, it is evident from several sources (including the letter of Abiah Darby, quoted above) that he encountered some difficulties with the process and experimented in the following years with other fuels. These included a mixture of coke, charcoal and peat and also other varieties of coal, significantly from the metal working areas of Bristol and Neath. It appears that it was not until 1715 that Darby finally settled on the one local coal that produced coke which successfully smelted iron ore - clod coal. Once he had done this, and with increased orders for castings, he secured capital from the Bristol merchant Thomas Goldney and built another furnace at Coalbrookdale.

The iron that Darby produced by coke smelting was suitable for making castings, but not for forging into wrought iron. Forges still used charcoal-smelted iron because it contained fewer impurities than iron smelted with coke. But in 1710 Darby's involvement in the setting up of a joint works on the River Tern just upstream from its confluence with the Severn, handling iron and brass side by side, suggests perhaps that he was hopeful of producing iron at Coalbrookdale that could be used in the forge at Tern. However, the joint enterprise encountered difficulties, brass production ceased (as did that at Coalbrookdale), and Tern was reduced to a conventional forge with some wire drawing. No doubt, this forge, like the forges



Madeley Court, leased by Abraham Darby I

at Coalbrookdale, had to rely on supplies of pig iron from the charcoal-fuelled blast furnaces at Leighton, Kemberton and the Clee Hills.

The two Coalbrookdale blast furnaces, fuelled by a plentiful supply of coke, provided the pig iron for Darby's foundries to manufacture cast-iron goods including pots of all sizes, pans, kettles, smoothing irons and firebacks, which found their way to local and distant markets. But coke smelting did not at first catch on elsewhere. The major demand in this country was still for wrought iron and more experimenting was necessary before coke-smelted pig iron became acceptable to the wrought iron makers. It was to be Darby's son, the second Abraham, who succeeded in making this breakthrough in the early 1750s with improvements in furnace technology. To Darby himself, however, must go the credit for being the first to use successfully the fuel which was to replace the diminishing supply of charcoal in the making of iron.

When Abraham Darby I first came to Coalbrookdale he lived at White End, a timber-framed house halfway down the valley (now demolished); by 1712 he was renting Madeley Court and soon after 1715 began constructing a new house (now called Dale House) overlooking the ironworks, which was unfinished at the time of his death in 1717. He had made contact with the Quakers of Broseley on an early visit to the Severn Gorge in July 1706, when he had signed as a witness a deed of purchase for the graveyard beside their meeting



Adam's Ferry, Jackfield (c.1900) - Darby crossed to Broseley at this point

house. While he lived in Coalbrookdale and at Madeley Court, since there were no Quaker meetings on the north bank of the Severn, he would have used Adam's ferry at Jackfield to cross the river and make his way up to Broseley, where he was clerk for monthly and quarterly Friends meetings. When he died at the early age of 39, he was buried in the Quaker graveyard at Broseley.

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This article is adapted from the author's 'Abraham Darby, Coke and Iron', published in the Salopian Recorder, Autumn 2009.

John Wilkinson and the Improved Steam Engine

by Dr Jim Andrew

This is an edited version of the Annual Wilkinson Lecture given on 6 May 2009

On 20th April 1778 Aris's Birmingham Gazette published a letter, to the Birmingham Canal Company, which it was stated 'affords irrefragable Proof of the great Utility of the new-invented Steam Engine, lately erected on the said canal, under the immediate Direction of Mess. Boulton and Watt, the Patentees'.¹ This beam engine, which like all early steam engines was for pumping water, was ordered after the canal company committee requested its chairman 'to have some conversation with Mr. Boulton about the erecting of a fire engine...to raise the water...into the summit'.² The newspaper passage refers to a test carried out, on a small canal pumping engine, by John Smeaton, the famous eighteenth century engineer, who had himself spent much time improving the earlier type of engine, invented by Thomas Newcomen, but without achieving the performance of even the earliest of the Boulton and Watt engines.

Few history books covering the eighteenth century, and none concerning the industrial history of that century, fail to mention James Watt's improvement to the steam engine. It is usually stated that the engine gave three times the efficiency, meaning it used a third of the fuel, of the earlier engine and the inefficiency of the Newcomen engine is usually explained as the losses in heating and cooling the steam cylinder every working stroke. Any further explanation often mentions condensing steam to produce a vacuum in these engines, but the popular perception is that dropping the temperature of steam below 100°C creates something like a perfect vacuum, zero pressure. In fact only a partial vacuum was created in these early engines and a very partial one in the case of Newcomen engines. There is seldom any mention of Watt's engine giving considerably more power than the earlier design but due credit is given to Matthew Boulton for the commercial success of the engine and to John Wilkinson for producing accurately bored steam cylinders for the engines.

This paper hopes to explain in a simple way just why Boulton and Watt's engines were such an improvement over the earlier design and why they offered so much more scope for development when other aspects of steam technology, such as boiler materials and design, were improved. In this way it will be seen that the Boulton and Watt engine paved the way for the exploitation of steam power through the nineteenth century and on well into the twentieth century. The reader should not be put off by the thought of some technical explanation because the ideas are quite simple and the result will be a better understanding of the brilliance of the engineers who achieved such significant improvements, despite their limited understanding of how power was produced.

The fundamental difference between the Newcomen and Watt engines was where the steam was condensed to form the 'vacuum' which created their power. In the Newcomen engine a water spray condensed the steam in the steam cylinder, while in the Watt engine the steam was condensed, by a similar water spray, in a separate vessel connected to the steam cylinder, which could then remain hot all the time. The popular explanation for the improved efficiency, that the Newcomen engine wasted heat in heating and cooling its steam cylinder every stroke, creates something of a difficulty. The steam cylinders of these engines were large and weighed between two and six tons each, while a typical engine worked at eight to twelve strokes per minute – it does seem unlikely that this weight of metal could be heated and cooled that many times a minute, although it would clearly have fluctuated in temperature to some extent, so there must be another explanation.³

The first point to ponder is the relationship between the temperature and pressure of the steam within these engines and here we are talking of what is termed "wet steam", because both the Newcomen engine cylinder and Watt's separate condenser always contained some condensed water lying about and this was at much the same temperature as the steam within the cylinder/condenser. Figure 1 is a graph of the boiling point of water at various pressures with some of those pressures identified; for example, the boiling point of water at atmospheric pressure is 100°C and a pressure cooker with a 15 pound load (meaning it blows off at a pressure of 15 pounds per square inch above atmospheric pressure) cooks at about 122°C. With wet steam, the pressure and temperature are always on this curved line because just cooling the steam will condense some of it

and lower the pressure to match the new temperature, while just lowering the pressure will let some of the hot water boil absorbing latent heat and so lowering the temperature.⁴ Similarly raising the temperature will boil some water and raise the pressure while raising the pressure causes some steam to condense which releases latent heat and raises the temperature

The pressures found in early steam engines are also marked on figure 1 and these were controlled by the temperatures in the engine, but understanding these means looking more closely at how these engines worked. Both types of engine we are examining were ‘single

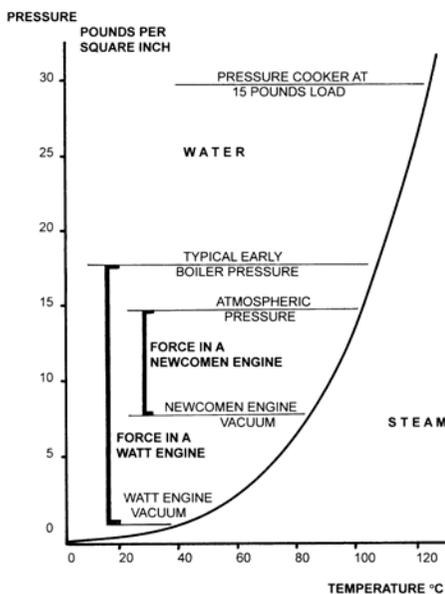


Figure 1 The effect of pressure on the boiling point of water

pressure from the boiler through the steam valve into a Newcomen engine’s cylinder (see figure 2) would fill the cylinder as the piston was drawn up while blowing most of the condensed water out down the eduction or exhaust pipe. Closing the steam valve and spraying water into the cylinder condensed some of the steam to produce a partial vacuum and atmospheric pressure acting above the piston

acting’ mine pumping engines where the steam piston was driven down by pressure, above the piston, and then lifted up because the pump piston and rods were weighted to return the steam piston to the top of its stroke. The steam piston rod and the pump’s rods were connected to the engine’s beam by chains.

Early steam engines used crude boilers which were only safe at a little above atmospheric pressure; in other words, they were little more than large kettles. Letting steam at just above atmospheric

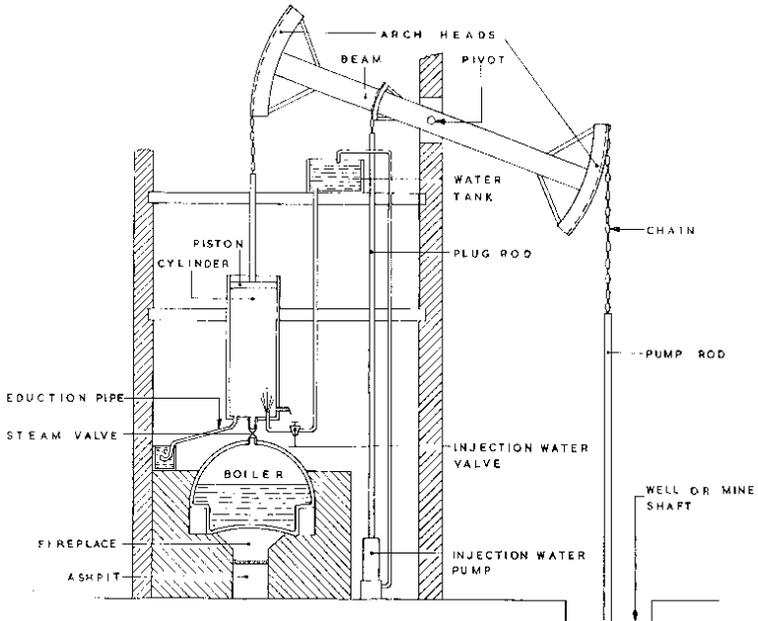


Figure 2 A Typical Newcomen Steam Engine (note - the valve gear is not shown)

drove it down, raising the pump rods and doing work. When the piston reached the bottom of its stroke, the valve gear opened the steam valve again, steam from the boiler rushed into the partial vacuum and the weight of the pump rods raised the piston back up again to the top of its stroke as steam filled the cylinder and again blew water out through the eduction pipe, which ended in a non-return valve immersed in a tank of water.

Engineers soon found that cooling the steam in the cylinder below about 80°C took too long and the engine then needed far more steam to refill the cylinder. This slower running of the engine produced less work, so the engine's characteristics were set to suit the partial pressure obtained at 80°C. Just cooling the steam to 80°C meant that the pressure in the cylinder only fell to about 7½ pounds per square inch and, as atmospheric pressure is about 14½ pounds per square inch, there was only some 7 pounds per square inch difference in pressure between above and below the piston. The partial vacuum

would be seriously affected by any air in the cylinder, either from leakage or released from water in the boiler. This air was blown out through a non-return valve in the side of the bottom of the steam cylinder using the slight pulse of pressure as the steam valve was opened, before the piston began to be drawn up. This valve made a snorting noise and was known as the sniffling valve.⁵

About fifty years after the first recorded Newcomen engine, a young instrument maker at Glasgow University was asked to repair a model Newcomen engine used in demonstrations. The model performed rather badly and the instrument maker, James Watt, was puzzled that it used so much steam when it did not even do any real work. We now know that reducing the size of a Newcomen engine would exaggerate its inefficiency to the point where it could hardly run. If Watt had been studying a full size engine he might never have queried its inefficiency, although engineers had been worried about this for many years. After many months of puzzling over this problem, Watt had the inspirational thought that the steam cylinder needed to be kept hot all the time while the steam needed to be condensed in something cold, and this could be a separate vessel. The two could be connected by a valve which opened at the right time to let the steam rush into the cold vessel where it would then be condensed, thus maintaining the vacuum. This was his famous separate condenser.

It took ten years and a move to join Matthew Boulton in Birmingham to progress Watt's design from a simple little test rig to a fully working and full size engine. Along the way Watt found that better machining would be needed to make a seal between the piston and cylinder, something which was to be achieved by John Wilkinson in the Midlands. At this time most steam engines used a packing of loose twisted hemp rope wrapped round the piston, soaked in some form of grease, to seal to the sides of the cylinder. The Newcomen engine relied on water lying on top of the piston packing to help seal it against the poorly machined surface of the cylinder, but that would not work with Watt's hot cylinder. Indeed, to keep the cylinder as hot as possible, Watt enclosed its top and used steam from the boiler to force the piston down. In many cases he proposed surrounding the cylinder with a steam filled jacket to ensure it remained as hot as possible. The vacuum maintained in the condenser meant that condensed water and air now had to be pumped out rather than run off as in the Newcomen engine.

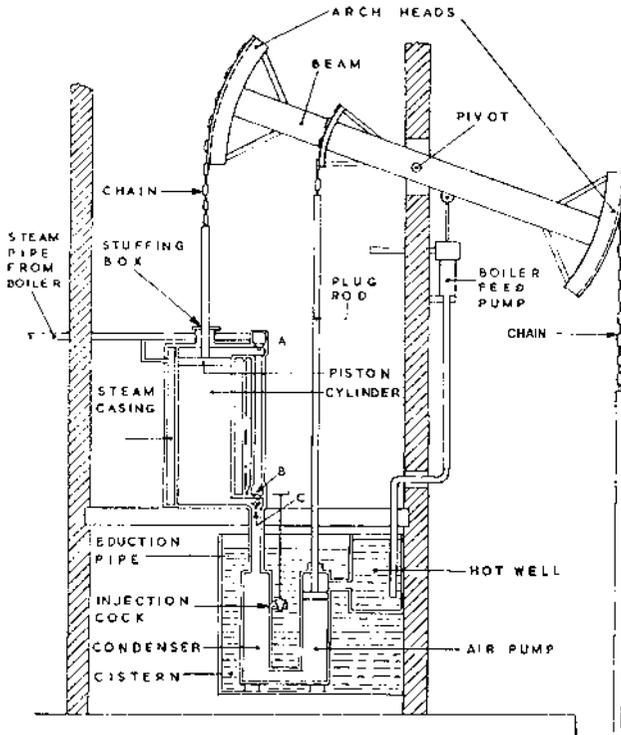


Figure 3 A Typical Watt Steam Engine (note - the valve gear is not shown)

In its developed form (figure 3) the Watt engine let steam from the boiler into the space above the piston, in the steam cylinder, and the steam pressure forced the piston down against the vacuum already existing below the piston. As the piston approached the bottom of its stroke, the steam admission valve and the exhaust valve (A and C in figure 3) were closed and the 'equilibrium valve' (B in figure 3) opened, which allowed the steam to be transferred from above to below the piston as it rose under the weight of the pump piston and pump rods. As the piston approached the top of its stroke, the equilibrium valve B closed, the steam admission valve A opened and the exhaust valve C opened to allow the steam below the piston out into the cold condenser where it was condensed by a water spray, and thus a vacuum was created below the piston. The air pump removed

air and condensate from the condenser and some of this condensate was fed as hot water to the boiler.⁶

Watt's engines still used steam at only just above atmospheric pressure because boiler technology had not progressed very far, but applying this pressure to the top of the piston, in place of the air at atmospheric pressure in the Newcomen design, gave a small increase in the pressure on the piston. The vacuum, however, was now far better because the separate condenser, sitting in a tank of cold water and with a water spray, could usually operate at something below 40°C, which gave a pressure of about a pound per square inch, so that the pressure difference between above and below the piston was now some 15 pounds per square inch, over twice the pressure difference in the Newcomen engine. Since both types of engine worked at about the same speed, this meant that the Watt engine immediately gave more than twice the power of a Newcomen engine with the same size cylinder. A better explanation is that a Watt engine only needed a cylinder of two-thirds the diameter of a Newcomen engine's cylinder to produce the same power, quite a saving in the cost of construction.

Watt was soon able to carry out tests using a model engine which showed that his design used much less steam than the earlier one and therefore was more efficient, but he began having difficulties in scaling his design up from a model to a full size engine. The major problem was that, at that time, the machining of the pistons, cylinders and valve gear of steam engines was very crude compared with the accuracy of the much smaller items produced by instrument makers. This poor quality machining was not too serious in the Newcomen design with its water seal helping the piston's rope packing and with the lower pressure difference across the piston, but in the Watt design this simply introduced too many problems for satisfactory running.

Initially Watt's development work was funded by John Roebuck, whose business empire in Scotland included the Carron Ironfoundry and collieries where drainage was a problem, so he was interested in pumping engines. The Carron Ironfoundry was casting and machining cylinders for Newcomen engines using a boring machine designed by John Smeaton, where a long boring bar was rotated by a waterwheel and the cylinder was mounted on a trolley running on rails so that it was drawn over the rotating cutter on the end of the boring bar. The cutter tended to follow imperfections in the casting and, because of its length, often drooped giving a bore which might

be round but was certainly not cylindrical. When the Carron Ironfoundry produced an eighteen inch diameter cylinder for Watt's first experimental engine, they were unable to machine it accurately enough to allow proper sealing between the piston and the cylinder. Watt tried many different flexible compounds to try to seal the piston in the cylinder but none were satisfactory. Watt even considered mimicking the liquid seal of the Newcomen engine but, as water would simply have boiled away, he tried various oils without success.⁷ He then considered using mercury or one of the low melting point alloys such as Newton's metal, which melts at 95°C, with a small pump to recirculate it from the bottom of the cylinder back to above the piston.⁸ There is no sign that he tried this approach; he did, however, fabricate a cylinder from sheet tin which gave a smooth surface, but it could not be made sufficiently cylindrical to work for any length of time.⁹ Eventually, his other activities slowed development of the engine until Roebuck's financial failure allowed Matthew Boulton to take over funding the engine development in 1774.

It was Watt's move to Birmingham, where Matthew Boulton had contacts with industrialists such as John Wilkinson and had the determination to bring the design to satisfactory operation, which ended almost ten years of unsatisfactory progress. Watt had brought the parts of his experimental engine with the unsatisfactory eighteen inch cylinder to Birmingham with him. Wilkinson had a Newcomen cylinder boring machine, similar to the Carron Ironfoundry's one, but he was also producing cannon using his patented cannon boring machine, which allowed much more accurate machining of the cannon's bore. In this machine the cannon was rotated in bearings while a substantial non-rotating boring bar, set in suitably robust mounts, was fed into the cannon to produce a truly cylindrical bore. An eighteen inch diameter cylinder would have similar overall dimensions to a large cannon barrel and so, with suitably large bearings, it was likely it could be rotated in Wilkinson's cannon boring machine to give a much more accurate cylinder. Watt settled in Birmingham in June 1774 and it seems that a new eighteen inch cylinder was ordered from Wilkinson well before the end of the year.¹⁰ Early in 1775 Boulton wrote to Watt that he had no news of the new cylinder but would chase Wilkinson for news of it.¹¹

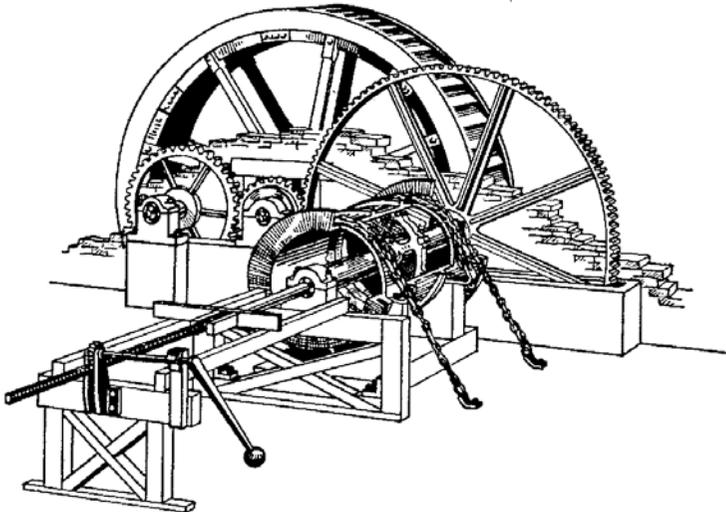
One of the first moves, on establishing their partnership in 1775, was for Boulton and Watt to seek an extension to the patent which Watt had obtained in 1769. This meant seeking an Act of Parliament and, before there was any real progress on perfecting the engine design, Watt had to spend months in London dealing with Parliamentary matters. Thus it was left to Matthew Boulton to make progress with the engine in Birmingham. Boulton's factory had some skilled craftsmen who were able to make any new smaller components needed for the experimental engine and in April 1775 he wrote to Watt about the fine new cylinder provided by John Wilkinson.¹² The testing of the engine showed great promise, an Act of Parliament was granted, extending the patent to 1800, and the partners could move to supplying designs of full size engines for their customers.

In March 1776, the first full size engine was set to work at Bloomfield Colliery, near Tipton.¹³ It had a fifty inch diameter cylinder which Watt ordered from Wilkinson in June 1775.¹⁴ This first commercial engine was soon followed by one with a thirty eight inch cylinder for John Wilkinson. Clearly Wilkinson had moved on from using his cannon boring machine and it seems he had perfected a much more accurate way of machining full size cylinders. Details of his boring machine were slow to emerge, although many different designs of accurate boring machines were known over the next century, and then in 1919 a drawing was found among the Boulton and Watt drawings in Birmingham.¹⁵ This *Drawing of the Bersham Boring Mill* by one John Gilpin shows how Wilkinson probably redesigned his Newcomen engine cylinder boring machine, similar to the Smeaton machine at the Carron Ironfoundry. The machine shown is really four separate machine tools driven by the same waterwheel. One boring machine is still of the old Smeaton design, but there are two different sizes of the new more accurate boring machines together with a large lathe which could well have been needed to machine the components of the boring bar.

The large Watt engine cylinders would be too large to rotate, as in the cannon boring machine, so they were strapped down on the machine bed. As the cylinders were open both ends, the boring cutter could be moved along a substantial boring bar which rotated in bearings beyond each end of the cylinder. A slot in the side of the boring bar allowed the cutter to be moved along by a mechanism linked to a rack

beyond one of the boring bar supports. The speed of Wilkinson's move from the cannon boring machine to this accurate cylinder boring machine shows his grasp of the commercial advantage of working with Boulton and Watt.

As Boulton and Watt's more powerful engines started to be produced, it is worth returning to understanding why the engine had so much better efficiency before considering how it led to even better engine performance in the following years. It is relatively easy to see why



*Figure 4 One of Wilkinson's Cylinder Boring Machines
(after L. T. C Rolt)*

the new engine design was so much more powerful than the earlier design, as this was basically just the greater pressure difference from condensing the steam to a lower temperature and hence lower pressure. The degree of efficiency gain is less obvious and much less easy to quantify, but it is possible to consider this in two different ways - one is a plausible popular explanation and the other relies on thermodynamics. Many engineers had wondered if they could reduce the amount of steam used in the Newcomen engine. It is quite possible that some of them realised that, in addition to filling the steam cylinder with steam of a high enough pressure to allow the piston to be pulled up to the top of its stroke, a great deal of steam was condensed in the cylinder. The cool walls of the cylinder, which had

been exposed to the cold air above the piston, the cool underside of the piston, the condensate lying in the cylinder bottom and the water running down the cylinder walls from the water seal above the piston, all had to be heated by condensing steam, which also provided a bit of heat to the fluctuating temperature experienced by the cylinder. Knowing that lots of steam was being used in this way and causing the inefficiency, however, did not really solve the problem. That was to take James Watt's innovative design.

John Smeaton managed to improve the machining of the cylinder bore, which would reduce the amount of water running down the cylinder walls, suggested applying some insulation to areas such as the underside of the piston and worked to ensure that pipes and valves were of such a size that they did not restrict steam flow in the engine. It must be remembered that, at this time, there were no suitably fast-acting pressure gauges to record the fluctuating pressures within the engine, so it was difficult to even monitor what was happening inside the engine. Smeaton's attention to detail allowed him to double the efficiency of the Newcomen engine, but this seems to have been as far as the design could be improved and few of his customers understood the need to maintain this optimum level of care if they wanted efficient operation

The many different possible causes of wasting steam, mentioned above, might well add up to the amount saved by Watt's design and these factors are certainly closer to the truth than the old idea of just the heating and cooling of the cylinder and piston, but it would be very difficult to measure all the factors involved. Fortunately, there is another way to compare the efficiency of these two engine designs, although it was to take over a century of the understanding of thermodynamic theory before heat engines could be analysed in this way. It became established, among those versed in the ways of thermodynamics, that the efficiency of a heat engine was related to the difference in temperature between the hot and cold aspects of the engine, although the complete theory is a great deal more complicated than this.

Fortunately, the Newcomen and early Watt engines were built to similar engineering standards, using similar types of boilers, and thus from a thermodynamic viewpoint the only significant difference between them was the temperature range over which they operated. Both Smeaton and Watt recorded the temperatures of the condensate

from both types of engine and the boiler temperature can be deduced as just above 100°C for both engines. The condensate temperatures were measured at about 80°C and 40°C respectively so the two temperature ranges are slightly over 20°C and 60°C, which places their efficiencies in the ratio of one to three; suggesting the Watt engine used about a third of the coal required by a Newcomen engine doing the same work, the accepted figure for the improvement of the early Watt engines. This is all very approximate and anything but an exact interpretation of the thermodynamic theory, but it does lend some support to the conclusions made about the relative efficiencies of these two designs of engine.¹⁶

An appreciation of the effect of the temperature range through an engine also helps us to understand the improvements in efficiency to be gained by the steady development of the Watt engine during the life of the patent and then through the nineteenth century. There was another significant gain from the increased efficiency of the Watt engine compared with the Newcomen design. As the engine only used a third of the amount of steam for the same power, it could be operated from a smaller boiler, or even fewer boilers in the case of more powerful engines. In many cases the saving in the cost of the steam engine cylinder, piston and boiler, compared to an equivalent Newcomen engine, would cover the additional cost of the separate condenser, air pump and more complicated valve gear. Thus a Watt engine might not cost any more than a similar power Newcomen engine, built to the same engineering standard, and the fee demanded by Boulton and Watt for using the patent was paid out of the saving in coal consumed by the engine.¹⁷

Despite the initial success of his production engines, Watt continued to seek improvements both in the mechanical components such as the valve gear and in the extraction of more energy from the steam. The early working cycle of Watt's engines had the boiler steam pressure applied to the piston almost to the bottom of its stroke, but he realised that the steam pressure and the inertia of the moving parts would allow the engine to complete its stroke if the steam valve closed partway down the stroke, so letting less steam into the cylinder. This was termed expansive working and tests on a second Birmingham Canal Company engine in 1779 showed a 14% improvement in efficiency if the steam valve was closed at that point which just allowed the engine to complete its stroke.¹⁸ Such progress could not

be achieved with the Newcomen design and so this was a further benefit from Watt's separate condenser.

Although James Watt became very concerned about the safety of steam at much above atmospheric pressure, other engineers were more adventurous and sought to exploit the benefits of working engines at higher pressures. Sadly, this move did introduce the potential for boiler explosions; indeed many lives were to be lost through them but, with improved boiler technology, insurance inspection and legislation, more powerful and efficient engines were built. Increasing the working pressure increased the engines' power, just as the Watt engine was more powerful than the Newcomen design, but the higher pressure also meant higher boiler temperatures which, under the thermodynamic principles, outlined above, meant greater potential efficiency. Many high powered engines continued to use separate condensers to maximise the extracted power from the fuel burnt and the best of the beam engines in the nineteenth century reached efficiencies five times that of Watt's own designs.

The long term contribution made by Matthew Boulton and James Watt to steam power, their legacy, is much more widespread than the basic detail given above, with improvements in design, manufacture, machining and metallurgy as well as the technologies of lubrication, instrumentation and boiler operation. For almost twenty years John Wilkinson was their preferred supplier of steam cylinders and many other components. It is difficult to know how much longer Boulton and Watt would have relied on Wilkinson for accurate steam cylinders, but the dispute between John and William Wilkinson in the early 1790s meant that Boulton and Watt had to recommend other suppliers until they could establish their own steam engine works, the Soho Foundry.

An insight into why the Watt engine was such an improvement on the earlier design, and one with massive potential for further improvement, gives us all a better understanding of the brilliance of these two engineers in inventing and developing their improved steam engine. The rapid development by John Wilkinson of a boring machine which would provide the accuracy needed for Watt's design to succeed has long been accepted, but often without realising that his rapid change from the cannon boring system to the new cylinder boring arrangements was fundamental to the rapid establishment of the improved steam engine.

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2. The National Archives, Public Record Office, Kew, Rail 810/4 Birmingham Canal Navigations Company, Minute Book 1775 to 1784, 23 August 1776.
3. The author recalls the popular explanation being disputed by Donald Payne at a meeting of the Newcomen Society in Birmingham. Donald helped assemble and then operated the Black Country Living Museum's replica Newcomen engine and had taken measurements of temperatures and quantities of injection water as well as closely observing the engine while it was running.
4. *Chambers Technical Dictionary* defines 'latent heat' as the heat which is required to change the state of a substance from...liquid to gas without change in temperature.
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9. Ibid.
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14. Ibid p113 and footnote 3.
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17. Andrew, J.H., 'The Costs of Eighteenth Century Steam Engines' *Transactions of the Newcomen Society*, (1994-95) p83.
18. Boulton & Watt Collection, Archives of Soho (Birmingham Central Library), MS 3147/4/1 Box 53 Watt's Blotting and Calculation book, Vol. For 1779-1781, p.9. MS3147/3/81 Letter Book No.3, p.219, Watt to Henderson, 28th June 1779.

The ironmaking techniques behind Wilkinson's manufacture of cylinders for the Boulton & Watt steam engine - i.e. (1) the improved and reproducible ironmaking techniques to produce consistent quality iron for the castings, and (2) modified moulding and casting techniques to produce sound castings relatively free of blowholes and other significant defects - we hope to explore further in the next issue of the Journal - Ed.

The Brothers Gottheimer

by Jim Cooper

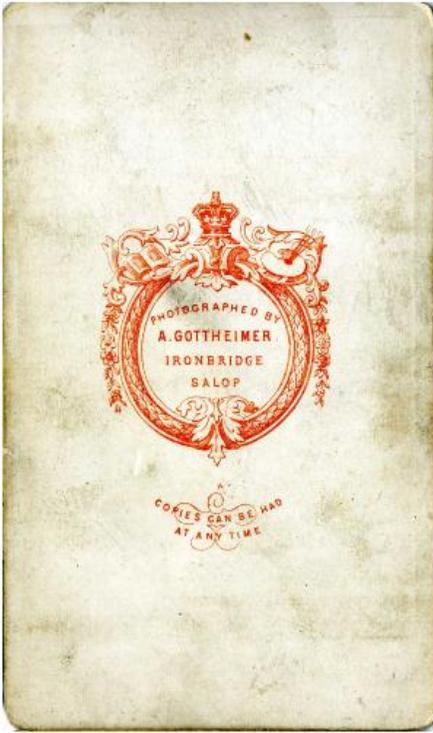
*“Our friend Gotthiemer, in spite of the ‘vet veather’,
did not do amiss at his photographic studio”*

So wrote the Wellington Journal correspondent in his 1871 report of the St. George’s Races. Two brothers, Christian Jews Aaron and Jacob Gottheimer, were travelling photographers with local connections. Aaron, aged 51 at the time, had been in business in Ironbridge since at least 1850, initially as a clothier and, since April 1861, also as a licensed lodging house keeper in Waterloo Street; whilst his much younger brother Jacob was a brickyard labourer. Both brothers had been born in eastern Europe; at various times their birth place was described as Poland, Prussia or Germany. In the later years of the 18th century, Poland had been partitioned between Russia, Prussia and Austria and, following the French Revolution, there was a failed Polish insurrection. The following years saw terrible persecution of the Poles, with many thousands being exiled to Siberia and thousands more fleeing to the west. No doubt the relatively quiet Shropshire town of Ironbridge was a welcome refuge from their troubled homeland.

Before the end of 1861 Aaron had plans for a travelling photographer’s studio. A dispute in September of that year, over the cost of making a dark box and a tent for photographic purposes, was settled in Gottheimer’s favour by the County Court at Madeley. The tent frame was to be ten feet by twenty feet with two ends; presumably the ends were solid and only the sides and roof were to be canvas. The cost agreed was £2.10.0 but the dispute arose over whether the dark box was to be included in that cost.



The Crown Inn, Waterloo Street, Ironbridge where Aaron Gottheimer was proprietor in the late 1860s



The logo on the reverse of a photograph taken by Aaron Gottheimer

Another disagreement, in 1872, reveals that Jacob was returning to Ironbridge with three caravans, each pulled by a horse. The toll for crossing the bridge was one shilling and sixpence, but because the road had been newly repaired the first of the vans became stuck and, when Jacob tried to use a second horse to assist, the gate keeper demanded a further toll. Jacob refused to pay and was summoned for obstruction.

Aaron was proprietor of the Crown Inn, Waterloo Street in 1868 when one of his lodgers, Bernard Zusman, a travelling jewellery salesman, was the victim in the notorious Stirchley murder mystery. Two men, George Harris and Richard Hart, were apprehended but only Harris was prosecuted. After a trial lasting three days, Harris was acquitted leaving the mystery unsolved. Within three years, Aaron had given up the Crown Inn and both brothers and their wives were 'on the road'; in April 1871 their mobile studio was set up in the market place at Llanfair Caereinion,

Montgomeryshire. It might be that Aaron was only an occasional traveller. Certainly by 1877, he was again trading in Ironbridge as a clothier and two years later as a tobacconist and general dealer in the High Street. Jacob continued to travel; his caravan and photographic studio were to be found at the Lion Inn yard, Welshpool in April 1881. Aaron was still a tobacconist in 1888 but died a year later at the age of 70. He was buried in a polished oak coffin at St. Luke's churchyard, Ironbridge, attended by a 'large number of sorrowing friends'. The ceremony and service of the Ancient Order of Foresters, a friendly society, was performed by the Rev. G. Wintour.

The 1891 census found Jacob in Oakengates as a showman. The photographic tent had gone - bring on the steam hobby horses. His roundabout was at the Llangollen Smithfield in April 1901 and at Church Stretton and Much Wenlock in May 1911. In June that year he was charged at Madeley with having no light on his vehicle. These were the longest days



Jacob Gottheimer's roundabout (note the variation in the spelling of the name)

of the year! Was he moving his van in the dead of night? No wonder he told police officer Plant 'it was a pity he had nothing better to do'. Just a month later his steam engine was wrecked in an accident at Castle Foregate during a move from Shrewsbury to Oakengates. He re-equipped with Electric Jumping Horses, which appeared at Shifnal in July 1912 but, within two years, 57 year old Jacob was selling his 'roundabout and travelling van'.

Jacob died and was buried at Holy Trinity Church, Dawley in 1928 and, by request, there were no flowers. Neither Jacob nor his brother Aaron had children to carry on their family name. Their only memorials are their gravestones and the Primitive Methodist Chapel foundation stone which is now preserved in the stonemason's yard at Blists Hill Victorian Town. Aaron had represented local tradesmen when laying the stone of the chapel on Madeley Road, Ironbridge. This may have been a result of the respect afforded to him by the tradesmen, but Fred Lloyd told oral historian, Ken Jones, that 'there was a little bit of controversy about who should do it. Nobody really wanted to do it'. Fred supposed that 'the trades people were belonging to other denominations'. There is no date on the stone but the Chapel was originally built in 1860 and rebuilt in 1883. The newspapers reported the ceremonial laying of three stones in 1883 but not by Gottheimer, so perhaps his was laid in 1860. The chapel itself was demolished in the 1960s.

'And it's all uphill from there' - my early memoirs

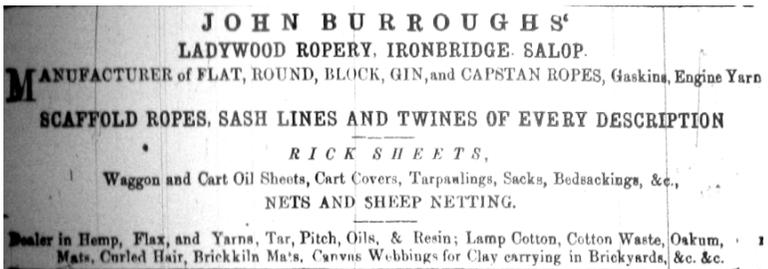
by H. S. Burroughs

The following is an account written in later life by Herbert Stanley Burroughs of Vancouver, British Columbia, and submitted to the Society by his granddaughter Regina Pfeiffer. It is reproduced as written (apart from minimal editing). Mr Burroughs died in 1972.

I was born at Broseley in the county of Shropshire, England, September 12, 1890, the third of four children and the second son of Thomas Richard and Mary Ann Burroughs. My father was a tenant farmer on the estate of Lord Forester, and the name of our home was 'The Woodlands'. Broseley is situated about one mile on the west side of the river Severn at Ironbridge (and its all uphill from there), and about a dozen miles south of the shire's capital, Shrewsbury.

Family

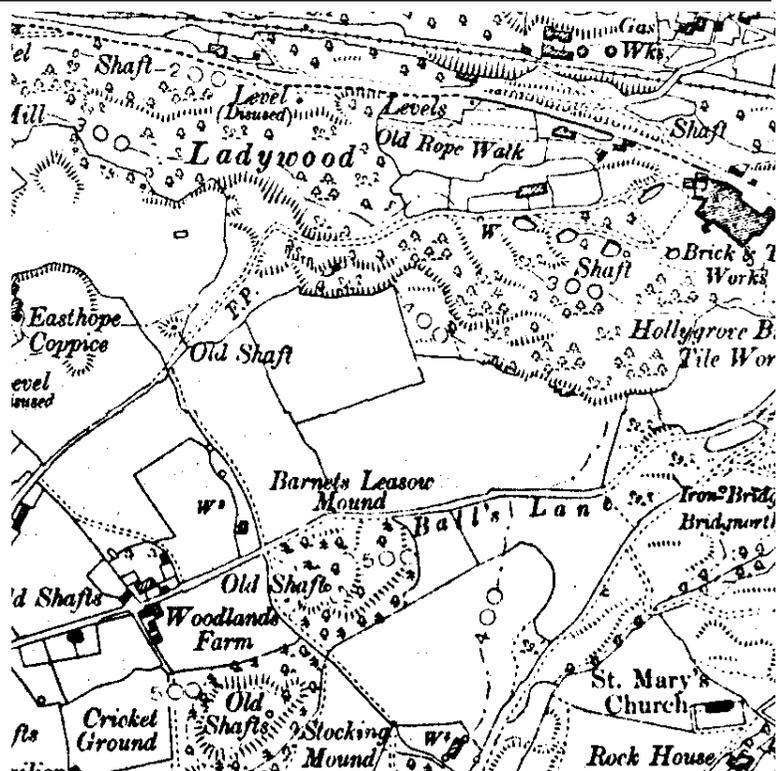
My paternal grandfather owned and operated a ropewalk on the banks of the Severn, a little distance below Ironbridge; he also, at a time before my memory, had operated a fleet of barges on the Severn. Though very young at the time, I can, in my mind's eye, see those big hempen ropes being twisted together on the long walk, the big wooden wheel which twisted them being operated by man muscle.



Advertisement from The Wenlock and Ludlow Express 1880.

The Burroughs family originated from Whitchurch and came to Broseley in 1829, living at the Folly and operating a rope walk at Handley's Hitch. In 1848 John Burroughs took over the rope walk at Ladywood on the death of James Harrington.

Thomas Richard was born in 1840 and as well as running Woodlands Farm was a clerk in his father's rope works and owned property in Broseley. He married Emma Hughes in 1866 but she died 20 years later. In 1887 he married Mary Ann Doughty, who was 20 years his junior, and they had three children, John, Herbert and Cecil.



The Burroughs rope works is shown as disused in this map from 1902. The family house was at the eastern end of the walk and is now called Ladywood house. Woodlands Farm, on Balls Lane, was leased from Lord Forester. The house is on the northern side of the lane and the farm was on the south. The farm no longer operates; the barn was converted into a house in the 1980s.

This business died on my grand father's death when I was about five years old.

My mother's family operated a brick and tile works at Jackfield. This place is also near the Severn, barely a couple of miles below Ironbridge. I never saw my grandfather, whose name was Doughty, though I do remember my grandmother. My mother was one of fourteen children, twelve of whom lived to adulthood, six boys and six girls; the male offspring, at least five or them, scattered over the globe - Australia, South Africa and Canada. The one who stayed at home (not the eldest) fell heir to the brick and tile works. There were

quite a number of such works at Jackfield; the clay used in the manufacture of the brick and tile was mined from underground pits. Jackfield was so honeycombed with clay mines that a newspaper sent to me from England in the 1940s told of a subsidence there which destroyed a great deal of property. However, long before this happened the Doughty firm was out of business.

The local scene

Broseley had two little factories, both of which manufactured clay pipes (the smoking kind); one of them was owned by a Mr. Southern, whose son Onslow was a chum of my older brother. A fringe benefit for me from this was that I got to see the pipes being made, short stubby ones and up to the long churchwardens. Dad and Mr. Southern were very friendly with each other. Dad, when necessary, supplied equipment, i.e. a horse and cart with a driver, to haul coal from Ironbridge & Broseley railway station to the pipe factory; this coal was used to fire the kilns. Once, when I was about ten years old, I went to the pipe factory to collect a bill for Dad; I was quite puffed up with the importance of my mission, especially so when I signed my name across the postage stamp (provided by Dad) which was affixed to the receipt for the cheque given me.

It was in Broseley itself that I first saw a motor-car (as automobiles were known); it was being refuelled in the street. The petrol was being poured from a can through a tundish (funnel) into the tank which was under the car seat; a chamois skin was used to strain the petrol. It was in the infant years of the new century that I first saw an automobile; the century was in its twenty second year before I rode in one - this in British Columbia.

Childhood pleasures

I, as all others in my childhood days, had to make my own pleasures - no radio, T.V. or even electricity then. Paraffin lamps and both tallow and wax candles were our illuminating medium, and we made our own tallow dips; coal fires served for cooking and heating. Many of the long winter evenings were spent in looking through Gamages (of London) catalogue, which pictured just about everything a kid would like to be the owner of, but very rarely became such. There was nothing like a weekly allowance, no bribery to do chores in those days. One was told to do, or not to do, certain things and that was it, period. An occasional gift of a penny was really something and would be spent on sweets(candy) in two goes, a half-penny at a time.

Twice during those days I was the recipient of a silver three-penny piece - wealth unlimited!

In the summer we wore straw boaters, at sixpence each. When I was about twelve years old I accompanied my dad to Bridgnorth (some seven miles from our home) where he had some interest in the livestock market on that particular day. We travelled by pony and cart. Needing a new boater, Dad had been instructed by Mother to purchase one for me. Dad, having made merry with some old cronies, went all out on the deal and bought me a really expensive one. I remember that it cost two shillings and sixpence, the price of five boaters of the kind Mother would have bought. This straw hat had a black string (like a shoe lace) some 24-30 inches long fastened through the hat brim at the rear which could be attached to one's coat lapel, an insurance against a vagrant wind. Was I ever proud of that boater? I'll say I was, and still am.

Trips

The only method of transportation in those days was train or horse, the former for long distances and the horse for shorter. Train trips were few and far between; two I made with my family to Rhyl for seaside holidays, one for a week and the other for a fortnight. Broseley church choir (of which I was a member) day outings accounted for two more train trips, Llandudno and Aberystwyth.

Another trip was to Birmingham, made with my brother Reg, two years senior to me; we stayed with Mother's youngest sister there, our Auntie Kate. I must have been about six or seven years old at the time. From Birmingham, after our visit there, we went by train to Broome station, the nearest one to Bidford-upon-Avon, where we visited relatives on Dad's side. Mother had equipped both her travelling sons with silly wide brimmed straw hats (Little Lord Fauntleroy type) of which we were both really ashamed. The hats had elastic chin straps, and the brother, who had lots of what it takes, very deliberately stuck his hatted head, elastic other than under his chin, out of the train window just before we reached Broome; and of course, his head quickly was stripped of the hated hat. But the ending was not a happy one for brother. Someone from Bidford saw the happening, picked up the hat and later managed to return it - shades of Jimmy Durante. Was my brother mortified!

Bidford-upen-Avon is Shakespeare's country, where he supposedly lost a day and a night after hitting it up with the gang. It was here that I first heard 'Love's Old Sweet Song'; a young couple, in and out of the home where the brother and I stayed, were everlastingly singing it, the girl playing the piano accompaniment. Every time I hear that lovely old song, my mind goes back to Bidford and the brother's lost hat.

Food

At home, a pig was killed every year in the late autumn. What an exciting time that was! I can see it all now, the grand eats such provided and the proverbial squeal, almost all of the poor pig which gave us no benefit. Dad salted down the hams and bacons. Mother rendered down the fat for lard; the dried-out fat was called scratchings, and what a treat to eat, salted, on bread. The pig's head ended up as brawn (headcheese). The chitterlings, after many a scrupulous scouring with salted water, both inside and out, were boiled in a vinegar and spiced solution. This, to me, was as good a part of the pig as any. Mother made at least a dozen pork pies; members of the family and special friends had to be given a taste of our pig. A few of these pork pies had to be sent through the post (mail) to distant aunts.

On this subject of food, one which is very dear to me, I may as well continue here. We had four sessions a day at the dining table (in the kitchen). The standby for breakfast was porridge (this was before the many cereals now available were even thought of), with milk and sugar, a boiled egg when our hens produced enough, bread and butter, and hot milk. The noon dinner was the main meal of the day, always a satisfying one; never once was there not a dessert of some kind. Mother made use of all the fruits which our orchard and garden provided, and of even those of which our orchard and garden did not. Here, I think particularly of blackberries; we used to gather such from the wastelands of our little farm and these were made into jam, and the same were used with apples for pies.

Tea (unless what was called High Tea for some special occasion) wasn't such-a-much: tea, bread and butter, jam and occasionally cake; a fish paste to make the bread and butter tasty. A high, tea called for all the aforementioned but with other food, such as cold meats, pickles, relishes, etc (the two latter items for the grown-ups). The last eating time was supper, just prior to going upstairs, with a lighted



Woodlands farm house, the home of the Burroughs family. When they left the farm was run by Thomas Instone

candle, to bed. Supper was usually bread and cheese and a glass of milk; sometimes chives were added to the bread and cheese.

Pickled walnuts and shallots, mushroom ketchup, etc., all put up in season by Mother, were taboo for us children. Dad figured such were unnecessary adjuncts for young appetites; in fact, he used to ask 'If condiments and such are required to make your food palatable now, what are you going to need when

you reach my age?' Dad was 49 years old when I came into this world.

Something in the foregoing, desserts maybe, reminds me of one Saturday dinner which to me then was a poor do. Mother and Dad attended someone's wedding, a mid-day affair, and our servant girl had to take care of our dinner which in the main consisted of a can of Libby's corned beef, the dessert being boiled rice with milk and treacle. How I hated both! Incidentally this can of corned beef was the only one I ever saw in our home. There have been several times since that day when I would have given almost anything for such a meal; the trouble was then, that I wasn't hungry, not really hungry, the kind of hunger one has when he hasn't eaten for some time and doesn't know when next he might do so. That, to me, is hunger.

Every year Mother bought a setting of four goose eggs, which she set under a hen. The fertility of them was practically 100%, for there always seemed to be four goslings, later four geese, around the place between spring and Christmas time. One of the geese provided our

Christmas dinner and the others were sold at that time. Once, the flock of four, fully grown, were grazing in a meadow next to the orchard which was flat for a short distance, then took a very sharp dip. When on the very brink, one of the flock got the idea of trying out its wings; it took off from there across the Severn Valley and landed at Madeley, whose elevation on the other side of the Severn was comparable to that of Broseley, but its location was a considerable distance downstream. The flight must have been at least a three-mile one; how, I don't know, but it was located the next day, brought back home and received a wing clipping for its derring-do.

School days

I started school at the age of five, attending Leggs Hill School, a kindergarten not very far away from my home. Three recollections of my one year spent there remain with me. First, I fell very much in love with my teacher Miss Elsie, a student teacher, though designated there as a pupil teacher, she was at least three times my own age. The other two recollections are not such pleasant ones; one was a dog bite from a large dog which I was petting on my way home from school - a little scar on my left eyebrow is a mute reminder of the incident; the other was getting my left thumb badly smashed in the heavy wooden school gates - an inch long scar on the inside of the thumb and a deformed nail are the result.

At the age of six I entered the big school, which was located about a mile from my home; a first grader (but the grades were called standards there), eight grades to go and my formal education would be ended. Boys and girls had separate buildings and never came into contact with each other on the school premises. The principal of the boys' school was a Mr. Clark and, like all other Clarks, he was known- behind his back- as Nobby Clark; he was a stern disciplinarian. School hours were 9 a.m. to noon and 1. 30p.m. to 4p. m. I went home to the mid-day dinner, as did all the other school children, so some four miles were footed daily in obtaining an elementary education. A few times in the eight years spent in school, something happened to make it impossible to get back to school after dinner to make the 1. 30 p.m. entry into the classroom on time. Then I found the door locked while a prayer was said, after which the door was opened and late comers marched to the principal's desk where Mr. Clark himself would serve the punishment which, usually for such a breach of conduct, was one on each uplifted palm by a really

flexible cane. Mr. Clark's desk was in the main classroom which contained three separate classes with no dividing walls, so that probably as many as a hundred boys had a free show of the punishment being administered.

Entry in the big school was made about the same time as I learned that there were other things in life beside eat, sleep, play and school. My parents sold surplus milk from our little farm to the residents of our immediate vicinity, all of whom were working folks; few of them bought more than a pint a day. The milk was delivered to them in individual covered cans which had a bail, and so four cans per hand were easily managed. Some of these deliveries were made before school time in the morning, others in the evening; ergo, I was a milk deliverer. This never ending chore irked at times, it interrupted games, but it had to be done; so do it and get it over with, a principle which has, in later years, undoubtedly saved me much mental anguish when some particularly unpleasant situation had to be confronted. I think the most irksome of these twice daily milk deliveries was the evening one, on the occasion of Queen Victoria's Diamond Jubilee. On that day of days, a holiday for everyone except seemingly milk deliverers, there were celebrations nation-wide. Ours, at Broseley, comprised an afternoon of sports, refreshments for free, in some pasture land beyond the big school, where a tremendously high beacon had been built and was ready for the torch, just waiting for the day to turn into night. All this I had to leave for that evening milk delivery, but it was made and I was back at the scene of festivities long ere the torch was put to the beacon. Soon afterwards the light of other beacons in the distance could be seen, the one on the Wrekin (a little mountain near Wellington, some eight to ten miles away) was very much in evidence.

I remember having but one fight in my school days; when I was about 9 years old a boy about my own age and size - he was in the same class as myself - threw me a challenge from a distance when I was on my way home from school one afternoon. It was on a Friday, no school next day; overnight, I mulled the situation over and came to the decision that I had to prove to myself whether or not I was afraid of him. So I sought him out that Saturday morning on his own home ground where we had a very unscientific bash at each other. He gave in, ergo, I had found out that I was unafraid of him.



Tuckies House, formerly the home of Lord Dundonald and William Reynolds. The Doughty family moved here from Calcutts House between 1851 and 1861.

Special occasions and presents

Other long memories of my childhood include the twice a year pancakes that Mother made on Shrove Tuesday and Good Friday. These were made of a very thin batter in an iron skillet suspended from a kind of swinging iron arm over an open coal fire in the kitchen. They were thin, like crepes suzettes, we just put sugar on them and really went for broke. And on Good Friday our piece de resistance for our mid-day dinner was invariably a big chunk of cod tied in a piece of cloth mesh, to hold it together, and boiled in court bouillon. We kids were never asked what foods we wanted; we were given what had been prepared and if one hadn't room for something on the dinner plate, one most certainly didn't have room for dessert.

At home, our childish eyes, glued on some delectable dish, might be bigger than our stomachs. We were admonished by Dad to 'Take all you want but eat all you take'. On one occasion, Mother, Dad and I were the only ones at the dinner table (where the rest of the family was fails my memory now). Mother had made a dish of blanc mange for that day's dessert. When it was brought to the table, I greedily and foolishly declaimed, 'Oh, I could eat all of that'; it was immediately mine in its entirety. Fortunately for me the day was a Saturday, no school; I was at the table a very long time and towards the end of the

blanc mange each spoonful was more slowly consumed. Eventually, it was wholly absorbed, and with it a lesson too.

On New Year's Day we often went to Mother's old home at Jackfield; one of her brothers was now the head of it and of the brickyard. The dining room was quite a long one, as was the dining table, such was very necessary for the former generation of the Doughtys. Always the main item of the New Year Day dinner was a huge chunk of boiled pickled beef, home-cured; its variegated colours while being sliced used to intrigue me. On one such occasion the Christmas tree in the drawing room still had a few presents on it, and one of them had my name on it. It was a pocket knife, probably cost about sixpence, but to me it was the finest present anyone could imagine.

The best about birthdays was that one was a year older and growing up. Such birthday presents as the present generation expect, and often get, were not even thought of. A penny or even tuppence, an extra goody at teatime, and the birthday was made.

I remember one severe winter, when I was around 8 or 9 years old, a pond at the bottom of our orchard froze hard enough to bear traffic. Mother resurrected an old pair of ice skates from somewhere, the rear end of which had screws which screwed into the heel of one's shoe and straps that came over the toe of the shoe. These she affixed to my shoes (only in those days we called them boots), took me down to the pond and patiently taught me how to stay upright. I did actually learn to skate, but, admittedly, nothing fancy.

Illness

This is as good a time as any to say that from all accounts I was the most robust of all the four babies born to Mr. & Mrs. Thos. R. Burroughs. But, alas, when about a year old, something happened inside of me; a scar still visible on my back attests to the fact that I was opened up there for some season, I don't know what. My parents told me later that for some six weeks I was so fragile that I had to be carried on a pillow, and that nice old Doctor Collins visited twice daily, expecting each visit to sign the death certificate; but I fooled him, and plenty too. Some four years later Doc did a little personal job on me and sometime (a couple of years maybe) cauterized two wounds in my right hand from a dog bite, the latter quite accidental - the dog, our own, got my hand instead of the cat, which he was aiming for and my hand got in between. Ergo, two more scars, of which the

old body has a plenty of. The physical trouble, when a year old, left me very delicate, very susceptible to colds. This necessitated the use of woollen vests (under-shirts) the year round. I had a heart condition, too, all of which excluded me from the usual boyish rompings and kept me pretty much on the sidelines. An advert, depicting a man carrying a huge codfish on his back, always reminds me of the quantities of Scott's Emulsion I was dosed with in my youth. I have heard of some youngsters who really liked this emulsion; I wasn't one of them.

Ablutions

All our plumbing at the 'Woodlands' was outside, the whole of which consisted of a drainage pipe connecting the iron gutters of the house and adjoining buildings' eaves to a cistern a few steps away from the kitchen door, from which all the water we used (except in the hot summer) was drawn by hand pump. In summer we carried water from a spring-fed well in a field some 500 feet away; this well had a locked door and was sometimes used to store perishable food. While water from the well was being used, the cistern was annually cleaned out.

With all this plumbing, one can readily imagine what the baths were; yes, a portable tin tub in front of the kitchen fire on Saturday nights (only). Daily washings, hands and face (perhaps neck), were had upstairs in the bedrooms (my elder brother and I shared a double bed in one or them). Clean water had to be carried up there; later, after being used, carried down again - pity the poor servant girl in those pre-plumbing days.

Local historic sites

Broseley, as far as I know, has no particular historical associations but is in the midst of many. The remains of Buildwas Abbey are but some two or three miles away, up Severn. Much Wenlock, with some of its old castle (*sic*) still discernable, is but some 5 or 6 miles westwards. Roman ruins below Shrewsbury (the name of which escapes me) were only about a dozen miles away; many relics from this site are on view in a museum at Shrewsbury. Then, of course, and much nearer home, was the iron bridge at Ironbridge, reputedly the first bridge of iron ever built. Coalport, the home of the well-known china of that name, is located down Severn, not more than three miles away.

And so to work

Our long summer holiday, a month in August, was an almost year-long anticipation. The one of 1904, which started when I was within six weeks of my fourteenth birthday, ended my schooldays; as far as a formal education was concerned, I had had it. So, what to do? Physical condition precluded any strenuous occupation; no trade, nor any particular bent for any; really too young to know my own mind. But within a month or so, after attaining the ripe old age of fourteen, I was on a payroll. That of the Great Western and London & North Western Joint Railway lines, whose headquarters were at Shrewsbury. This joint company's main operations were from Shrewsbury to Hereford and from Chester to Birkenhead which were operated to the two separate companies' mutual advantage: the passenger revenue of the Shrewsbury/Hereford section going to the Great Western Co. and that of the Chester/Birkenhead to the London & North Western Co. ; and the goods (freight) revenue of both sections alternating daily. I had to take an examination at the Shrewsbury office for the job (such would be referred to as position); in fact, I had to take two. I failed the first, principally on the spelling of 'vehicle', a word I honestly didn't know. Anyhow, outside of that 'vehicle', it couldn't have been too bad for I was called up to take another exam which I must have passed, for in a very few days I was a wage earner of the princely sum of twenty pounds per annum.

Pontesbury

My first job was at a little railway station named Pontesbury, on a short branch line, some 7 or 8 miles beyond Shrewsbury. I was a small third of the total staff of the station, the others being the station-master, a Mr. Huxley, and a porter. It was at Pontesbury that I received my initial training on how to sell passenger tickets and make correct change, bill parcels and goods, etc. Mr. Huxley was a stickler for legible figures, and some of mine were not, but he kept on coaching until I satisfied him in this respect. Here I am already working, without any mention of my lodgings at Pontesbury.

My mother, on a free railway pass, took me to Pontesbury and, with Mr. Huxley's help, found me lodgings, room and board, with a widowed woman who had one son a couple of years older than myself. The cost of my room and board was a trifle more than the Railway Co. would be paying me, the result of this being that my folks had to dig up five shillings every month for the next year to keep me solvent.

Naturally, the fourteen year old, away from home, living with and among strangers for the first time, was homesick. Though being but some twenty miles from home, it was a long six weeks before I saw it again. The trip was made by train: Pontesbury to Shrewsbury, a change there to another train, and Shrewsbury to Ironbridge; the climb uphill from there to home was made in record time. This was on a Saturday evening and I had all day Sunday at home. Far too soon for me, Monday morning came and I had to reverse the route I had made some 35 hours earlier.

Soon after this I acquired an old second hand bicycle, really almost a gift from a friend of the family; then I was independent of an awkward train service and of having to ask for time off in which to make it. On weekends when I was not on duty on the Sunday, I could leave Pontesbury after work on Saturday evening and be on my way. However, I had to make a pretty early start from home on a Monday morning to get back to Pontesbury on time. One such morning when it was raining quite heavily, weather and probably a little homesickness mixed in gave me butterflies in the mid section. Mother fixed them (the butterflies) with a small dose of port wine and brandy, my very first known taste of alcohol.

Only one unpleasant incident can I recall of my stay in Pontesbury; this was at my lodgings. My landlady's son and I were eating together, having soup. There was cheese on the table; the landlady's son picked up the cheese and with his table knife slivered some of it into his soup, something I had never seen done before. It seemed like a good idea to me, so I thought I would emulate him, picking up the cheese to do so. I was informed by the landlady, who was nearby, that the cheese was not for me. I couldn't say anything, but I know that I thought a lot about it and have done so many times since.

Craven Arms

Five months at Pontesbury ended my novitiate, and I was transferred to Craven Arms, still in Shropshire and on the Welsh border. This station, on the Shrewsbury to Hereford line and some twenty miles below the former, was a rather important one; besides being on a main line, the Great Western ran a branch line from it to Wellington, and the London and North Western branched off at Craven Arms for Swansea. This company ran direct services from London to Swansea and vice versa. The company had a round house at Craven Arms which stabled several locomotives (spoken of there as engines); these

were used on this direct service as well as for local runs on the Craven Arms-Swansea section.

In addition to the foregoing, Craven Arms was the terminus of a private railroad, the Bishops Castle Railway; this was a little more than a dozen miles in length and ran two trains daily (except Sunday), one in the morning, the other in the evening, to connect with major services at Craven Arms.

I was one of two junior clerks; then there was a chief clerk, whose name was Mr. Gaylord; the station master was a Mr. J. Owen; others were a telegrapher, signalmen, numerous porters, a ticket collector and a parcel boy. The goods department had a separate staff with its own head.

The first train of the day for which tickets had to be issued (booked) was at 7. 15 a. m, the last at 10.20 p.m. One junior, with either the station-master or the chief clerk, went on duty in time to book the first train in the morning; this junior clerk went off duty as soon as he had balanced his ticket sales after booking out several trains in the evening, up to the 7. 00 p.m. departure. Sometimes an unfortunate error would prolong the time of the balancing, making an already long day into an even longer one. Three sets of tickets were handled, which made it somewhat complicated. The late shift, as we called it, came on duty at 10. 00 a.m. and got off after the 10. 20 p.m. left. Two meal times of an hour each still made the work day at least a ten hour one. The hours of the station-master and those of the senior clerk were somewhat more flexible than those of the juniors. At the end of each month a summary of all ticket sales and parcel bills had to be made; such resulted in quite a lot of overtime, but for free!

All correspondence, which was considerable, was hand written by the junior on the late shift. Mr. Owen dictated this, then, after his signature, the letters were put through a letter press. For the uninitiated, the letter press was a heavy metal contraption, operated by a wheel screw which could exert considerable pressure. Letters were written in a copying ink. The correspondence ledger was made up of tissue paper leaves, enough of which were moistened to take care of the day's letters. The letters were placed under the moistened tissues and the book put into the press, which was then tightly screwed down. Copies of letters were thus permanently retained in the correspondence ledger.

The transfer from Pontesbury to Craven Arms meant goodbye to the temporary home where cheese in the soup had been denied me; such goodbye was in no way sad. I got lodgings with a childless couple; the husband worked in the L&NWR round house at Craven Arms. I stayed with them only a few months, for by then I had made a pal of a boy of my own age, Jack Pugh, and went and boarded with his family, sharing Jack's bed. The family consisted of the parents, two boys and two girls, Jack being the oldest. I stayed at the Pugh home for the rest of my sojourn in Craven Arms; to me it was a home away from home.

Seven months at Craven Arms completed one year's service, whereupon a raise of five pounds per annum was given me, precluding the necessity of my parents having to dig up the monthly five shillings for my subsistence. This was a godsend for them, as Dad, who had for years been a victim of rheumatism, was by now totally incapacitated by it. Just about everything now depended on Mother; poor Mother, who all her married life up to about this time had had the help of a servant girl in the home, was now without such.

During my third or fourth year at Craven Arms, my folks had to give up the farm. They moved into Shakespeare's country, becoming tenant publicans at a little wayside country public house, the name of which was 'The Golden Cross', at Temple Grafton, Warwickshire, a couple of miles from Bidford-upon-Avon. Mother now had a servant girl's help again, which she simply had to have because the running of the pub took most of her time. Dad, due to his rheumatic condition, wasn't much help other than as an entertainer. I remember that Dad, about this time, switched his smoking habit from pipe to cigarette, smoking 'Woodbines' which then cost one penny for five cigarettes; poor and few teeth were the reason for the change.

Craven Arms station was about in the middle of a long, straight stretch of track which had a slight decline north to south. A daily non-stop express, Shrewsbury to Hereford, would a little before noon whiz through our station at quite a clip. Once in a while Mr. Owen would check its speed, sending a flagman one mile downtrack. Mr. Owen would then stand on the station platform, from where he could see the flagman, and with a stop watch and a signal from the flagman time the express's speed. If the authorized speed was found to have been exceeded, a written report, dictated to and written by the

junior clerk, letter pressed (of course), was immediately submitted to the superintendant of the Joint Railway system.

While Craven Arms was an important station, it did not warrant its station master wearing a top hat and morning coat, as some of the most important stations' masters did; but even without top hat and morning coat, Mr. Owen was important and looked it. He was a fine old gentleman and a wonderful boss.

The completion of my second year with the railway company saw another five pounds per annum raise. Now I was getting, and I'm quite sure earning, thirty pounds per year. The two succeeding years were much better for me financially, as the yearly raise was ten pounds per annum. I well remember my first good suit of clothes since leaving the parental roof. I started its purchase the day I received the first month's pay (salary as it was called) at the fifty pounds a year rate. I visited a tailor, a Welshman who had his shop only a couple of doors away from where I was domiciled. First the selection of the cloth - I chose a heather mixture of tweed; my measurements were taken; a couple of fittings later, and presto, I was the proud possessor of a grand suit. The same called for new shoes and hat, the latter a bowler. Then I was class with a capital 'C', or so thought myself.

During the latter part of my being stationed at Craven Arms, I became friendly with a fellow, a little older than myself, who for some two or three years running had gone to Canada in the spring; he worked there, going as far west as the prairie provinces for the harvesting and returning to England when the latter work was over. What he earned in Canada took care of his travelling expenses and he was, as he said, seeing something of the world. He fired my imagination, so that I too wanted to see something of the world. From then on, Canada was my goal.

Ellesmere Port

My sojourn at Craven Arms abruptly ended, when, on extremely short notice, I was transferred to Ellesmere Port, Cheshire, on the Chester-Birkenhead section of the Joint Railways, operated by the London & North Western Railway. Ellesmere Port is a manufacturing town on the river Mersey, which connects up with the Manchester ship canal; seeing ocean going vessels passing up and down, to and from Manchester, did nothing to diminish my desire to do a spot of travelling myself.

My stay at Ellesmere Port was less than a year. An unpleasant incident occurred there. During a week I was away visiting my folks at Temple Grafton, the big Saturday evening ticket sales made by my junior clerk (I was in charge of this department) couldn't be balanced and I subsequently could not balance the monthly summary. The auditors were brought in to do it; their findings were that both the station master and my junior clerk, whose names I cannot recall, were involved in a cash shortage. The former was demoted to a small unimportant way station and the junior clerk was fired. I forthwith resigned - next stop CANADA!



Herbert in Punalu'u, Hawaii. It is possible that this was the house he built for himself and his family.

Herbert travelled to Canada, eventually ending up in Vancouver. There he joined the Merchant Navy, travelling around the Pacific. He settled in Hawaii where he married and brought up a family. He was the chief of police on Kahuku Sugar Plantation on the north shore of O'ahu. On his retirement, he and his wife returned to Vancouver. His family remained in Hawaii and he is survived by four of his seven grandchildren.