BLUNDELL'S COLLIERIES: TECHNICAL DEVELOPMENTS, 1776–1966

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THE rise and progress of Blundell's Colliery enterprise has been described in a previous article,[1] but it may be of interest to note briefly the various collieries worked:

1. The Orrell group of collieries was worked by Blundell from 1776 to 1830.
2. Ince Cannel Works on the Holt-Leigh estate at Ince from 1791 to 1815.
3. Blackrod and Worthington Collieries from 1800 to 1849.
4. Pemberton Collieries from 1815 to 1966.
5. Chorley Colliery from 1836 to 1853.
6. Wigan Cannel Works on the Mesnes at Wigan was opened in 1839 and closed in 1855.
7. Ince or Amberswood was opened in 1840 and exhausted by 1873.

The whole series of the middle coal measures was worked at these collieries. Pemberton was by far the most important, sixteen seams being worked with an aggregate thickness of 60 feet of coal. At its peak, 60 years ago, this colliery employed 3,500 men, women and boys and raised well over three quarters of a million tons of coal per annum—a very large output even by modern standards.

I THE SEARCH FOR COAL

Between 1750 and 1850 very many boreholes were put down in the townships surrounding Wigan, especially in districts where small estates were numerous.[2] Jonathan Blundell & Son were pioneers in mining development at this time, and considerable sums of money were spent on prospecting, especially during the first hundred years of the firm's existence.[3]

In boring these vertical holes, both from the surface or from a point below ground, there was very little difference between the equipment used in 1776, when the firm began operations, and in 1942 when their last surface bore holes were put down in

[1] See *Transactions of the Historic Society of Lancashire and Cheshire*, Vol. 116, pp. 69–116.

[2] For example, a map of 1763 of the Orrell Hall Estate, adjoining Saltersford or Orrell House Estate, which Blundell later bought, shows twenty-four boreholes in one five and a half acre field.

[3] An old notebook kept by one of Blundell's Colliery officials contains these entries regarding boring: 'Started bore No. 14 hole August 1 1820. Started boring Upholland July 7th, 1823. Started boring Robey Mill Febery 14 1826'. In Wigan Reference Library there is a section of 'the sixth hole' bored in the Great Long Hey at Pemberton by Henry Blundell Hollinshead in 1814.

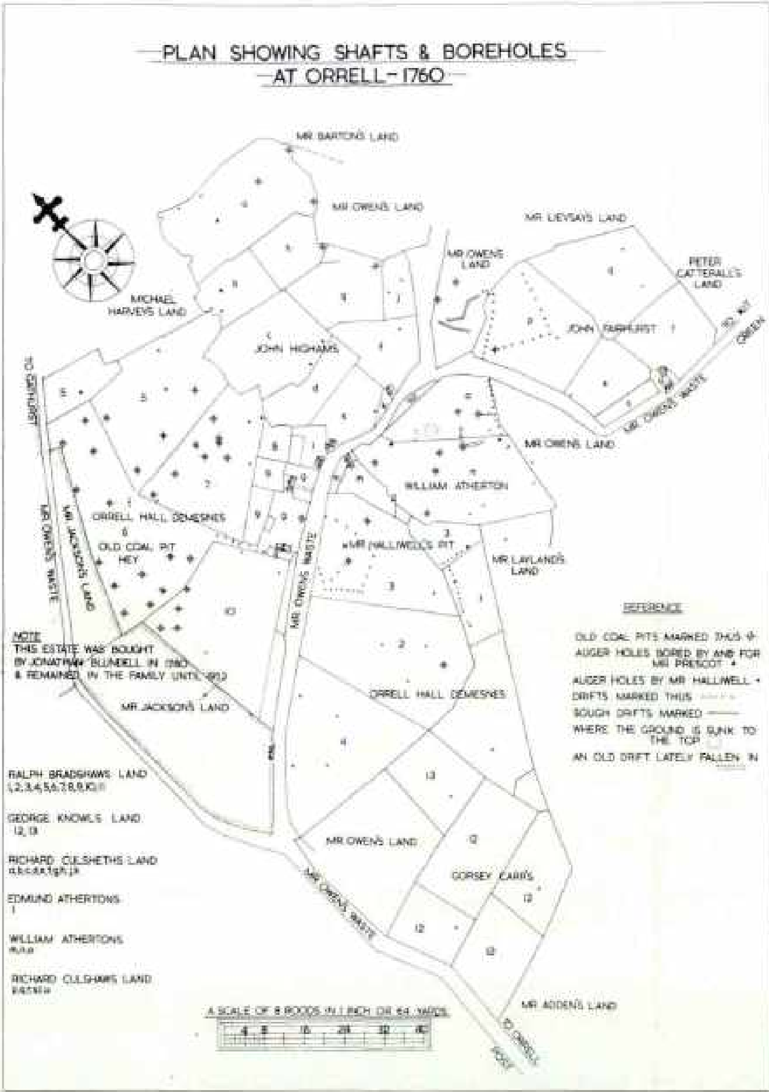


Figure 6.

ORRELL SHAFTS AND BOREHOLES, 1760

Based on an Orrell Hall estate plan of 1760.

Winstanley Park for the working of Summersales Colliery. The tools used comprised the following:

1. Bore rods 1 inch square and 6 feet or 9 feet long with lengtheners 6 inches to 30 inches long. These had male and female screw joints at each end. They were made of wrought iron in the early days, and later of steel.
2. Steel chisels 18 inches long with a 2 inch or 2½ inch cutting edge.
3. The wimble 3 feet long, hollow and cylindrical with an opening in the side, was used for bringing up borings and for boring in soft clay.
4. The sludger, similar to the above without the opening, but fitted with a clack at the bottom for retaining and bringing up borings.
5. The bĕche was used for recovering broken rods. It was hollow and slightly bell shaped, 2 feet in length.
6. The bracehead consisted of two pieces of ash 3 inches in diameter, tapering towards the end, and fixed through two eyes, set at right angles, formed in a piece of iron which screwed on to the top rod.

The method of boring was to erect first a headgear or 'three leg', consisting of three larch poles, approximately 12 feet long and 4 to 6 inches in diameter and fixed as a triangle. A small pulley was slung from the large bolt fastening the three legs at the top, a rope was passed over the pulley, one end of which was attached to a 'crab' or hand winch which was fitted with a pawl and brake. This was used for removing and replacing the rods in the hole. Four men stood, one at each end of the bracehead to lift and turn the rods, and by this means a depth of 80 feet could be reached. For greater depths a Brakestaff was used. This was a wooden lever approximately 16 feet in length and 6 inches by 6 inches in section. The fulcrum was 18 inches to 2 feet from the end, where an iron strap hook was bolted on to it. Sometimes, a Springpole was used for deep holes instead of a Brakestaff. This method is said to have been used by the Chinese 3,000 years ago: they used bamboo for the springpole, but at Blundell's Collieries larch poles, generally about 20 feet long, were used.

The boring operation was performed simply by raising the rods, turning them slightly and allowing them to fall by their own weight, so that the chisel bored a circular hole and did not jam. At intervals the wimble or sludger was substituted for the chisel, and, by means of the flap valve at the base, the cuttings and sludge at the bottom of the hole were worked into the barrel of the sludger by reciprocating it in the hole. The sludger was then brought up and its contents were examined, this being the only evidence obtained of the strata penetrated. Gripping or retaining keys were used to prevent the rods falling back into the hole when unscrewing them. Borers were paid on contract, the rate increasing with the depth, which is still the case.

More modern methods of boring were invented, especially for boring deep holes, but in the 190 years existence of Blundell's

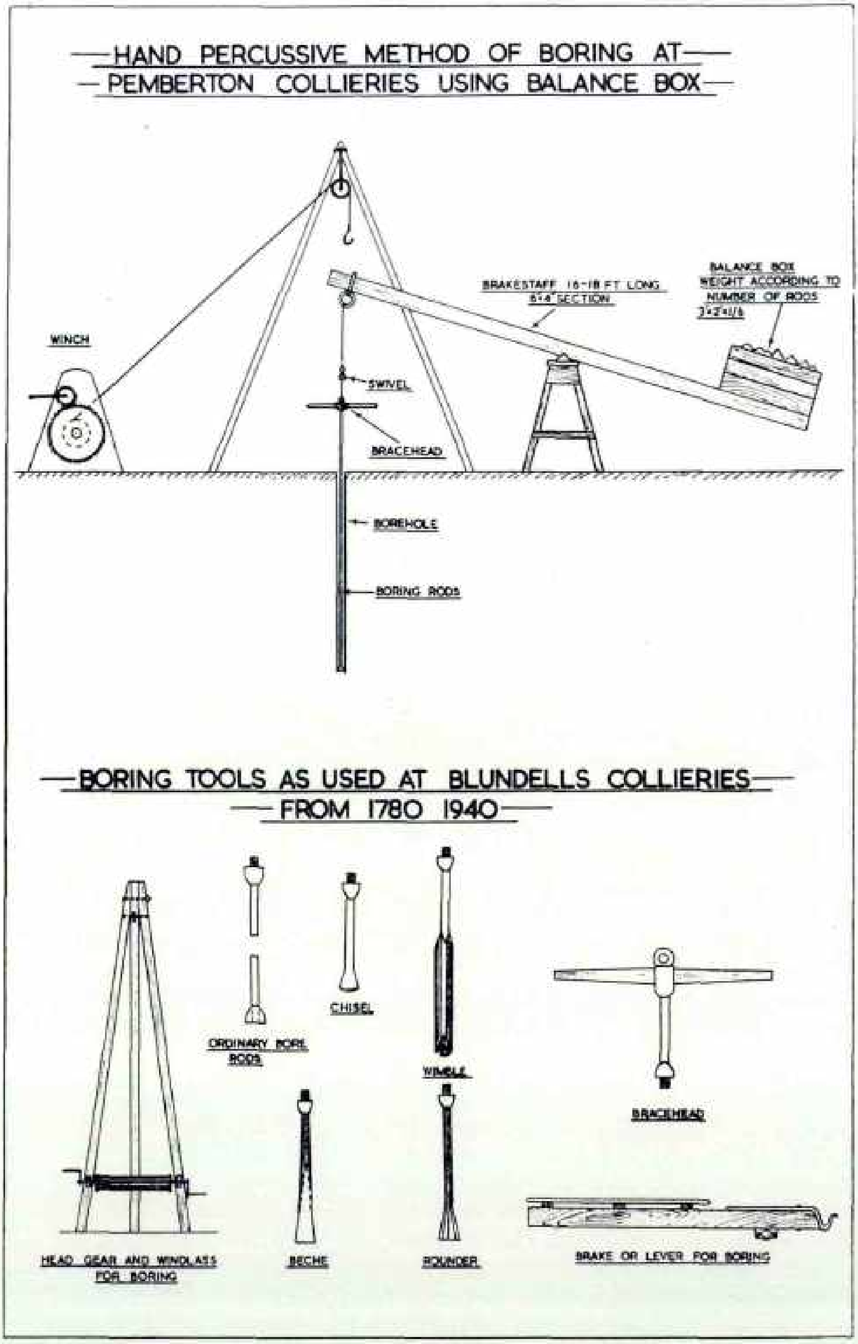


Figure 7.
HAND BORING RIG AND TOOLS

Collieries only the ancient hand percussive method was used for boring vertical holes from the surface as it was never found necessary to drill deep holes. Probably one of the deepest vertical holes bored by this system at Pemberton was that put down from the Lower Mountain Seam in the New Venture Pit in 1913, which reached a depth of 286 feet 6 inches and which was hurriedly abandoned when the borers rushed to the shaft bottom to escape miraculously from the great torrent of water which had broken through from the Venture Orrell Five Feet workings into a tunnel 400 yards higher up the shaft.

From the beginning of this century horizontal holes to tap water in old workings, or drill forward as a precautionary measure to make sure that roads being driven in the vicinity of old flooded workings did not hole through to them, were sometimes drilled by compressed air machines with extension rods. But the 10 inch holes drilled in 1938 from the new pump level tunnel in the King Pit, to the sump of the Old Engine Pit, were bored 57 and 54 feet by hand through blue shale. Boring towards old workings had been practised for a long time—William Greener, the manager, noted in 1858 that he

> told John Parkinson to put in two holes into Thomas Bean's place going by the side of Hawkley and Moss House old workings, one hole to go slant to the left hand side and the other front, to be bored 10 yards and never less than 6 yards in [the 1954 Mines and Quarries Act requires 5 yards] . . . and in all cases the man that bores to have the plug and cleat with him. John Clark and John Ashurst in when this order given.

II SHAFT SINKING

Many shafts had been sunk in Orrell, Winstanley and Pemberton before Blundell's began operations there. The majority of the early shafts in Orrell were sunk to work the Orrell Five Feet seam. This seam, over the greater portion of Orrell lying to the west of the Pemberton Fault, is nowhere more than 60 yards deep and is often found at much shallower depths. However, with the opening up of the Orrell Four Feet Seam 63 yards below the Five Feet during the second half of the eighteenth century, much deeper shafts became necessary. Blundell's Chain Colliery Engine Pit, sunk towards the end of the eighteenth century, was 360 feet deep and rectangular in section, approximately 9 feet by 6 feet. Other shafts sunk at Blundell's Orrell Collieries were generally 6 feet to 7 feet in diameter, although there was at least one oval one 8 feet by 5 feet. All these shafts were unlined, except for a few yards at the top lined with stonework or 9 inch brickwork.

Galloway states that gunpowder was not used for sinking in the north east coalfield before the last quarter of the eighteenth century. It is obvious from an account book of 1788 onwards that Blundell was using gunpowder at that time and presumably for sinking:

	£	s.	d.
1789 To Jonathan Blundell Senr. for Pine Balks and gunpowder	51	6	9
1790 To Jonathan Blundell Senr. for timber and gunpowder	37	17	3

A surprisingly large number of shafts were sunk by Blundell's, up to at least No. 58 in Orrell. The policy seems to have been to keep well ahead with shaft sinking, so that when a particular shaft became uneconomic, owing to long drawing, bad ventilation *etc.* a new one was down to the coal to replace it. As his Orrell Collieries became exhausted, during the first quarter of the nineteenth century, Henry Blundell began to open up his new coalfield at Pemberton and 11 shafts were sunk there before 1827. A quoted rate for sinking in that year was 18s. per yard. Depths were again increasing, the Pemberton Engine Pit being 426 feet to the sump and Farrymans Pit 555 feet. The Bye Pit, 390 feet deep, took 179 weeks and 3 days to complete—an average progress of just over 2 feet per week. It must be remembered that this shaft was sunk through a 200 feet thick bed of hard sandstone, known as the Pemberton Rock, from which issued heavy feeders of water. This pit was sunk before the invention by Bickford of the patent fuse, and the shots would have to be fired by means of squibs made of straw or paper and filled with fine gunpowder. It is clear that there would be many mis-shots in a shaft as wet as the Bye Pit. Diameters increased with depth, the Engine and Bye Pits being 9 feet 6 inches in diameter. Both of these shafts were unlined except near the top.

The Venture and other pits sunk in the 1840s were 12 feet in diameter and for the most part lined with brickwork. The Low Venture was lined or partly lined with special bricks curved to the diameter of the shaft, 3 inches thick 6 inches wide and 9½ inches at the front or side looking into the shaft and 10½ inches at the back. The shafts at Amberswood, sunk through several beds of rock, were only partially lined. A report by Grimshaw, a mining engineer, dated May 1868, states that:

> In No. 9 shaft the rock was so broken and dislocated that it was positively dangerous in passing through; in fact during our descent the underlooker had to signal to the engineman to stop while we moved pieces of dislocated rock before we could continue forther down.

Blundell's did not have to contend with quicksands like the owners of some Lancashire pits. Rainford colliery, for instance, where their manager, William Greener, was Consultant Viewer, was sunk in 1860 through 16 feet 6 inches of wet gravelly clay and 21 feet of quicksand. One shaft had to be abandoned, but two others were successfully sunk by using cast iron drums fitted with cutting shoes and built up in segments. The actual sinking of King and Queen Pits at Pemberton seems to have been carried out by a syndicate as the following appears on the fly leaf of the sinker's paybook:

December second Eighteen Hundred and Sixty Seven. The first sod was taken up at Pemberton New Sinking Pits. On the eighteen of December 1867 the first shot was put in by Thomas Aspinall And Thomas Tyson of Pemberton.
March 2nd 1868 the Engines began at the Big Pit Pemberton
March 19th 1868 the Engines began at the Little Pit Pemberton

Pay Book for Sinkers belonging to Matthew Holding and Thomas Jackson at Pemberton New Sinking Pits

Matthew Holden	£6	6	0
William Holden	3	3	0
John Leach	6	6	0
Henry Howarth	6	6	0
Richard Thompson	6	6	0
William Barns	6	6	0
Joseph Johnson	6	6	0
Rothwell Rothel	6	6	0
John Mick Cowel	6	6	0
James Townsend	6	6	0

1867
Nov. 30

Joseph Johnson	1	6½
James Townsend	1	6½
William Holden		11
Rothwell Rothel	1	6

King Pit was 18 feet in diameter and Queen Pit was 16 feet, hence the terms Big Pit and Little Pit. The cost of sinking these pits averaged £24 11s. 0d. per yard. To stop water from the Pemberton Rock leaking into the shaft, 69 yards of cast iron tubbing (a cast iron lining built up in segments) was put in the King Pit and 52¾ yards in the Queen Pit. The tubbing was placed at some depth in the shaft, beginning about 50 yards down and extending 10 yards below the Pemberton Five Feet in the King Pit. Originally it was only intended to put 30 yards in each shaft where the strata was very wet, but 'with the price of iron being cheap, it was decided to take advantage of it'. The thickness was also increased on the advice of Mr Cockson, mining engineer of King Street, Wigan. Altogether it cost £5,972 10s. 3d. In the Queen Pit there was English type tubbing with the smooth side towards the shaft, whereas the tubbing in the King Pit was of the 'German' pattern with the flanges facing towards the shaft. The spaces between these flanges were built up with firebrick.[4]

[4] The size of the tubbing segments was 4 feet in length by 3 feet in height. Elsewhere King Pit was lined with firebrick lumps 11 inches long and 6 inches deep. Queen Pit had a similar firebrick lining 10 inches in length.

A Furnace drift was constructed near the top of the King Pit. This was used for ventilating the shaft during sinking and for the initial development near the shafts. 'Furnace to 18 ft. shaft,' cost £1,100. 'Dumb drifts, staples etc. cost £3,600.' Drifts were constructed from one shaft to the other in the various seams as they were reached. This occupied about 6 months and the time actually taken in sinking, including the insertion of the tubbing, was 2 years and 3 months. King Pit reached the Orrell Four Feet seam at a depth of 629 yards 1 foot on 2 September 1870.

Staple pits were used from early days for drainage and transport purposes in the pits at Orrell and in the Venture, Wood and Bye pit; but at the time of the sinking of the King and Queen Pits a 64 yards deep staple pit was sunk from the Orrell Five Feet to the Orrell Four Feet, and a second one from the Wigan Four Feet to the Wigan Nine Feet. The latter staple pit was raised from the Wigan Four Feet to the Wigan Five Feet at the beginning of this century.

The last pit sunk at Pemberton by hand drilling was Prince Pit, put down to act as upcast for all the seams instead of King Pit and to increase the winding capacity of the colliery. Sinking commenced in 1898 and the first coal was wound in January 1901. It was 18 feet in diameter for 440 yards, to a point just below the King Coal and Cannel seam, and below that it was reduced to 15 feet as it was only intended for use as a ventilating shaft below that level. From the surface to the Pemberton Four Feet level (130 yards) it was lined with a 14 inch wall of engineering bricks set in cement mortar and below that with blocks 16 inches by 12 inches by 6½ inches, shaped to the diameter of the pit and supplied by Ormrod and Company of Orrell Brick Works.

The master sinker for Prince Pit was Martland of Skelmersdale. The sinkers' tools used were almost exactly those in use at the beginning of the nineteenth century. These consisted of heavy picks for loosening the rocks and chipping back the sides; shovels for filling the loosened rock into the kibble or hoppet (a large iron bucket used for hoisting the debris to the surface); wedges for forcing out the rock by driving them into the joints; and sledges or heavy hammers with long handles for use with both hands in driving in the drill, breaking up large pieces of rock, or for striking the wedges. The drills were usually made of steel and were bars of different lengths with a cutting and a striking end. Generally a three man team drilled each hole into the hard strata. One man held and turned the drill after each blow and the other two struck it with sledges one

Plate I.
SINKING BY HAND DRILLING, WIGAN, 1900

after the other. Jumpers were used with two hands, the operator raising it and letting it fall with considerable force in the hole he was drilling. This was used for soft and moderately hard rock. A scraper was used for removing chippings from the hole. The method of sinking pits at Pemberton was rather different from that normally adopted. Instead of a circular sump being blown out first, in the centre of the shaft, the whole of the middle of the shaft was blown out from side to side. The two remaining segments were then blown off after filling out the middle. No guides were used for the hoppet and the small quantity of water met with was raised in a water barrel fitted with a valve at the bottom. The bricking scaffold was in two halves and was slung from chains at the side of the shaft when not in use. A low temporary head frame and pit brow with a bogey or 'running jetty' and a temporary winding engine were fitted up at the surface, but the permanent head frame and engines were put into use as the sinking proceeded. The only thing new about Prince Pit's sinking was the kind of explosive used. In all previous sinkings gunpowder was the only explosive, but for the first time a high explosive manufactured by the Roburite Company of Gathurst was used. The firing was carried out electrically also for the first time.

New Venture Pit, 14 feet in diameter and 511 yards deep, was sunk between 1910 and 1913 with a view to proving a large area of Mountain Seams under Winstanley, Pemberton and Orrell. For the first time at Pemberton, power drills were used and guides were fixed for the hoppet. Water was wound at weekends in two tanks with conical bases fitted with valves. Thomas Brooks, one of the two winders employed on the sinking, described the procedure:

> First the headgear and engine are fixed. Then they begin to dig a hole the size the shaft has to be until it is about 7 ft. deep. The sides are then lined with planks of wood, which are placed upright, and held in position by iron segments bolted securely together. This is called putting in the cribbing.
>
> When rock is reached the compressed air drills are brought into operation and about 16 holes are drilled in one half of the pit bottom. These are then charged with explosives, time fuses are attached, which are coupled to an electric cable lowered from the surface. All the sinkers now ascend to the top.
>
> The chargeman connects an electric battery to the cable then he calls out 'fire' turns the battery handle and the shots go off like clockwork. Sometimes there is one misfires and this means no one shall descend the pit for one hour. After the shotfiring the safety lamp is lowered to the bottom to test for gas. The rock which is blasted up is now filled into the hoppets and sent to the surface whilst another 16 holes are being drilled in the other half of the pit bottom. When the shaft is about 24 yards deep, preparations are made for lining the shaft with brickwork. The bricks used are blocks about 11 ins. long and 5 ins. thick slightly curved. Holes are now drilled in the pit sides near the bottom, at equal distances and bars of 2 in. round iron are driven into them, and are left projecting about 10 ins.
>
> On these projecting portions, cast iron segments are fixed and securely

bolted together. These are called "bricking rings" and are put in every 24 yards until the required depth of the shaft is reached. A strong wooden scaffold is now lowered to the pit bottom and is fixed on the cast iron segments and is held in position by strong moveable iron bars. A hoppet of mortar is now sent down which is turned over onto the scaffold. This is done by the winding engine man in the following manner. The men in charge at the bottom unhook the chains from the top of the hoppet and hook them to rings near the bottom of the hoppet. Then they signal to the winder to stretch up and the hoppet is turned bottom upwards. They signal to lower down and the hoppet is turned right way up whilst being lowered.

This is also done with a hoppet of bricks. The winder is now kept very busy, raising lowering and winding up and down. When about 4 ft. of brickwork is put in all round the shaft, the scaffold is raised up and fixed on top of the finished brickwork and a further 4 ft. of brickwork is put in all round the shaft. This goes on until all the brickwork is put into the top and when finished, sinking is then restarted, and all this goes on until the shaft is down to the required depth, 24 yards sinking and 24 yards bricking up.

The last shaft sunk at Pemberton Colliery, Summersales, was 12 feet in diameter but only 51 feet deep. No drilling or blasting was required in this shaft as the strata sunk through was weathered and soft enough to excavate with pneumatic picks. The shaft lining was 9 inch brickwork which was built in one length from the bottom of the shaft. Great strides have been made in methods of shaft sinking during the past twenty years. For example at Kellingley Colliery the average distance sunk and lined per month was 339 feet, and in South Africa a distance of 1,251 feet per month has been attained. Fortunately for the owners, none of the more complicated methods of shaft sinking, like freezing the strata and cementation of the strata, ever had to be resorted to at any of Blundell's pits.

III METHODS OF WORKING

There can be little doubt that the top seam in Jackson's estate at Orrell (which after 1780 became the property of Jonathan Blundell) was worked in a similar manner to that adopted across the road on the Orrell Hall estate. A plan of about 1760 shows 28 shafts in three fields with a total acreage of 28·9, immediately adjacent to Jackson's estate. Thus an average of one shaft was sunk for every acre and this system would appear to be not very far removed from that of working bell pits, where shafts were sunk to a shallow seam and the coal removed all round the bottom of the shaft until it became too dangerous to work, after which it was abandoned.

The system developed and always used at Blundell's Orrell and Pemberton Collieries from the late eighteenth century up to the middle of the nineteenth century was that known as the 'Lancashire system'. Shafts were sunk from 150 to 200 yards apart on the level and at Orrell the same distance apart on the

Plate 2.
LATE EIGHTEENTH CENTURY MINERS' TOOLS FOUND AT ORRELL

dip. At Pemberton this distance on the dip was increased to 300 yards. This method was entirely different from the pillar and stall of the North of England and the conventional longwall of Shropshire and Staffordshire. As illustrated in Figure 8 it combined a form of pillar and stall work and retreating longwall faces. It was an extremely good method of working and, when properly carried out, was highly successful. The dismissal in 1853 of Sherratt, the agent, and the appointment of William Greener from Durham in his place, led to an alteration in the method of working to that prevailing in Durham—the traditional pillar and stall.

The methods of working in the 1880s were the pillar and stall and the longwall. Figure 9 shows the pillar and stall or straitwork method of working. The pillars were 20 yards by 30 yards, level roads being 3 yards wide and upbrows 4 yards wide. Pillar extraction was accomplished by taking three level 5 yard lifts or 'ratches', along the whole 20 yards of the pillar, and then taking 4 short upbrow lifts from the level. The sequence and method of timbering is also shown in Figure 9.

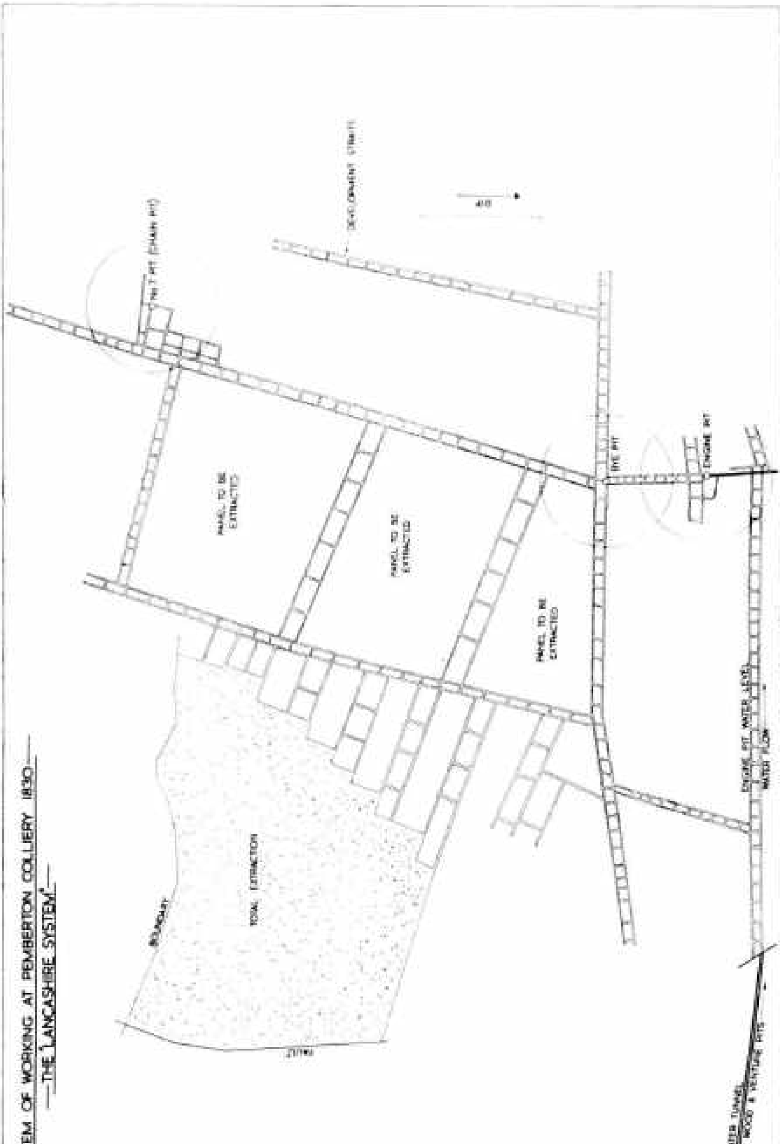


Figure 8.
THE LANCASHIRE SYSTEM AT PEMBERTON, 1830

Where old pillar roads or straits were fallen close, three yard wide ribbings or strips were taken along the fallen road and lifts were afterwards taken out in the ordinary way. All timber was delivered to the haulage shunts where the drawer picked it up and took it in to the working place in his empty tubs. Pemberton was in advance of some local collieries where, according to William Greener, colliers had to saw their own timber in the surface saw mill and arrange its transport to the face. The method of driving a strait was to undercut the face with a pick to a depth of 2 feet 6 inches or 3 feet. The coal was then brought down either by hammer and wedges or by drilling holes and blasting with gunpowder.

Figure 10 shows a typical longwall face at Pemberton Colliery in the 1880s when the system was first introduced there. The method of bringing down the coal by holing with a pick and wedging, or drilling and blasting, was similar to that practiced in pillar and stall work. Four men worked in each gateroad, two on each side of the road. Sometimes they did their own drawing, but sets of two colliers often employed a youth to draw the coal for them. The fireman in charge of the district set all the chocks and looked after 20 or 30 men. A contractor did the ripping in the gateroads and built the packs with material from the rippings. He also timbered the gates where required. A special class of men put up the main road timber in the night shift.

Coal getting by machinery was introduced at Pemberton in 1902 when compressed air 'Diamond' disc machines were put to work in the King Coal seam. These machines had been designed by W. E. Garforth and made the deepest cut of any rotary machine—from 5½ to 6 feet. The cutter wheel was made in halves to facilitate transport and a complete set of picks could be changed in 5 minutes. Two 9½ inch diameter cylinders with a 9 inch stroke were employed for driving the cutting disc, through gearing in the ratio of 22 to 1. The height of the cut was adjusted by fitting extra wheels of different size, or by turning the machine over. One of these machines cut 3,014 linear yards in one month. In 1907 bar coal cutting machines were introduced and an article published by Mavor & Coulson (who made these machines), after the death of Arthur Ashurst, foreman coal cutter at Pemberton Colliery, gives us a clear indication of the growth of machine-cutting at the colliery.

> Arthur Ashurst was employed at Pemberton Colliery all his life and prior to the introduction of Lancashire's first bar machine had been engaged on coal-cutter faces, where disc machines had been grinding away with a measure of success, which at that time made this colliery one of the finest in the country.
>
> Subsequently Arthur went through all the phases of the evolution of our coal-cutters, from the original Pick-Quick, to the modern turbine chai

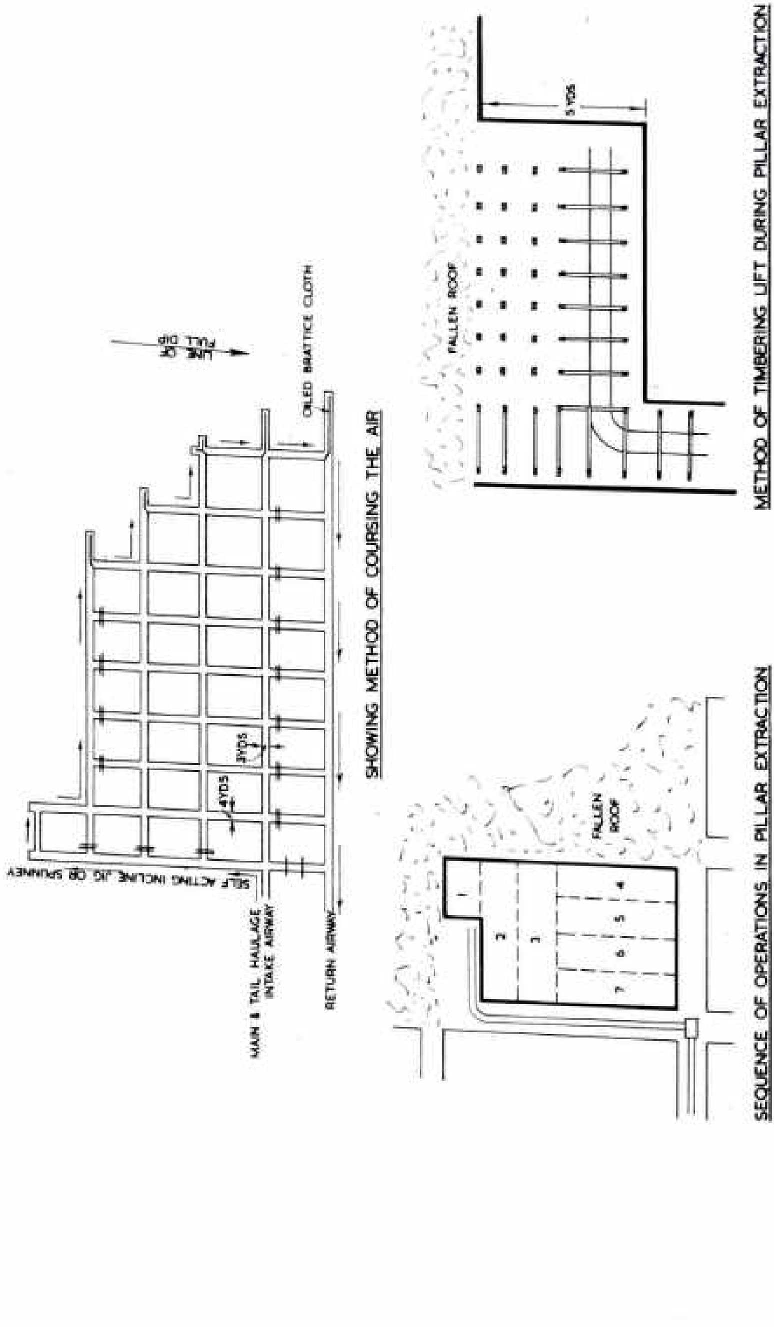


Figure 9.
PILLAR AND STALL SYSTEM, PEMBERTON, 1880

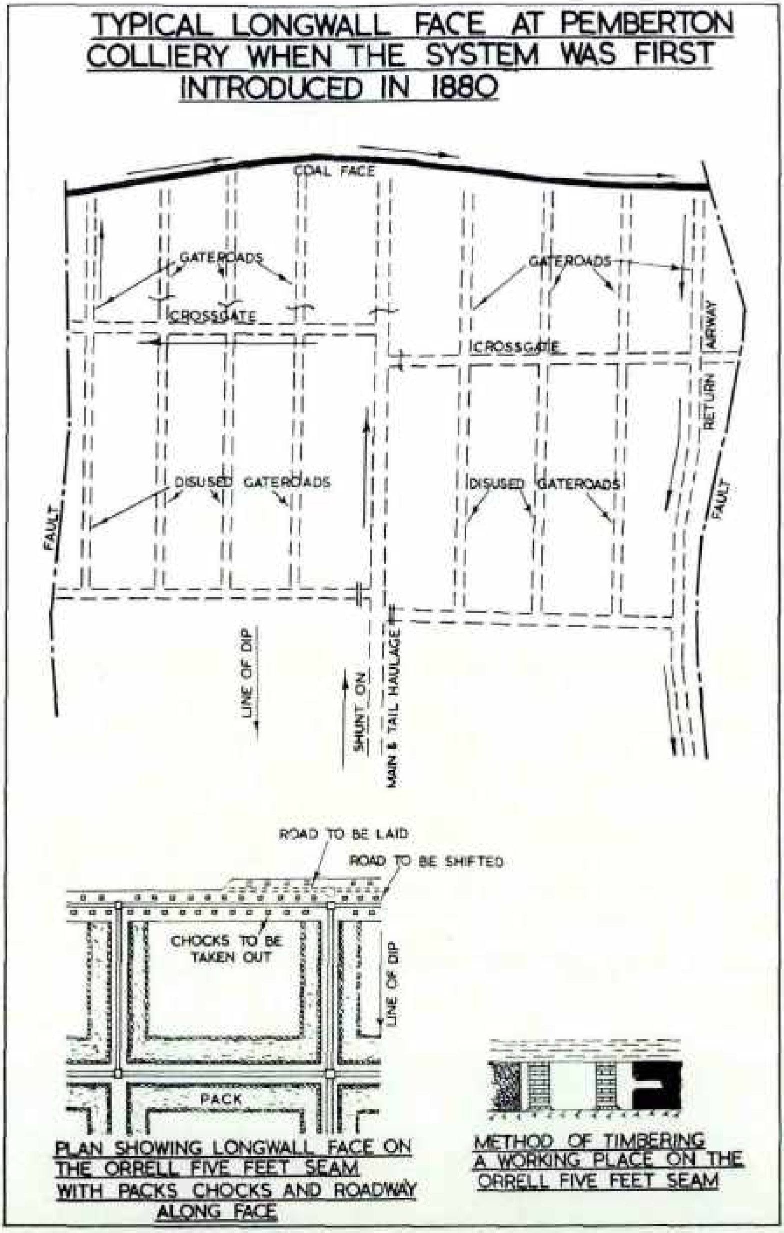


Figure 10.
LONGWALL FACE AT PEMBERTON, 1880

machine. As foreman in charge of a coal-cutting contract for twenty-three years, he was an expert on many kinds of compressed air appliances including all types of longwall machines and air drills. He was indefatigable in his work, beloved by the men who worked for him and by all the colliery officials. He represented that fine type of miner that is not surpassed in any industry; always 'mauling and scrawling' as he would say, but carrying on with that loyal purpose and perseverance in the fearless and cheerful manner so characteristic of the best type of British miner. It was only a few weeks before his death, that the last of Arthur's first three machines delivered in 1907 was finally scrapped—it contained parts of its other two mates and was still Arthur's favourite, despite the turbines. A cost sheet of a contract on which Arthur was foreman has been published and the figures are a lasting tribute to his energy and grip on his job. Another article on flitting a coal cutter gave a picture of 'Owd Arthur' as we knew him best. He was a champion flitter with twenty or so men pulling by hemp rope a coal-cutter which had to be split up into several sections to get it from one end of the face to the other, some two miles, for in those days Arthur had a coal face just a mile long in semi-circular form with five machines following one another round. Arthur would personally drive a coal cutter with patience and that almost uncanny instinct of the experienced miner, beneath roof which he himself reported to be 'unfit for a cat to scrawl under', and shared in many accidents in his time.

Smaller Patterson percussive machines were also introduced in 1902 and used in the Bye Pit. Similar Hardy and Siskol type percussive machines were used in the Wigan Nine Feet in later years, and pneumatic picks were used in the King Coal Hawkley area. Although a Jeffrey chain machine was tried in the King Coal in the early 1920s, it appears to have been unsuccessful as in 1929 there were no chain machines in use, but there were 9 bar machines, 34 percussive machines and 44 compressed air drills. Very many hand drills were still used. After 1929 the more efficient chain coal cutting machine was introduced, until in 1937 there were eight of these in use and only one bar machine and 15 percussive machines. With the introduction about 1930 of thin seam mining in the Pemberton Two Feet, Upper Orrell Yard and to a very small extent the Wigan Two Feet, shaker face conveyors were introduced. In 1934 the 300 yard long face in the Venture Orrell Yard seam was equipped with the latest Samson type chain coal cutting machine and face and gate belt conveyors made by Mavor & Coulson. Two Samson machines were used on the main face whilst a Universal bar machine was used to drive a shortwall face ahead of the main face. Up to 900 8 hundredweight tubs per day were filled off from this face.

At Summersales a large proportion of the coal was extracted by the pillar and stall method, using compressed air percussive coal-cutters and drills. In the early days there a longwall face in the Trencherbone proved unsuccessful, but during the last two years of the colliery's life all the output was obtained from conventional longwall machine cut faces in the Trencherbone and Arley Seams. Pemberton Colliery was never to experience the very latest methods of getting coal with disc shearer machines, ploughs, panzer conveyors, hydraulic self-moving chocks and props, not to mention remotely and electronically operated faces.

IV UNDERGROUND TRANSPORT

During the last quarter of the eighteenth century the only means of transporting coal underground at Blundell's Orrell Collieries was by 'sleds' fitted with iron runners, on which the baskets were dragged generally by women or children, using belt and chain harness. The baskets (generally at that time they were 1½ hundredweight) were dragged from the coal face to the pit eye or pit bottom, where they were hooked on to the winding rope and sent up the pit. The 1½ hundredweight baskets used at the Hulton Pits near Bolton in the eighteenth century were 31 inches by 21¾ inches by 8 inches deep. Similar baskets have been found in eighteenth century workings in the Ince Yard Seam near Ben Jonson Pemberton. A human 'guss' harness made from hemp rope and discovered in old workings at Atherton is now preserved at the Wigan Mining College.

An article in the *Gentleman's Magazine* for March 1795 described how the baskets were drawn from the collier to the shaft and hooked onto the rope there. The story is concerned with an Upholland family and the colliery mentioned is almost certainly one of the Orrell Collieries.

> This honest man not having employment for his children above ground, took Betty at nine years of age and a brother of seven, into the pit with him. These little folks soon put their strength to their baskets, dragging the coals from the workmen to the pit and by these efforts, they did the duty as it is called, of one drawer.

The baskets used were made and repaired at the colliery. In 1790 £18 0s. 2d. was paid by Henry Blundell for a chestnut horse and basket rods supplied to Orrell Collieries. These basket rods were put in a cylinder, into which steam was blown to make them pliable for bending to the shape of the basket.

Sometimes wooden rails were used on which the sleds were drawn, and some of these were found 40 years ago in the Orrell Five Feet workings near Dean Wood at Orrell. They were about 5 feet long, 5 inches wide and 1 inch thick. Along one edge a strip of wood 1 inch square was nailed. Presumably this was to prevent the sled runners coming off. Baskets were gradually increased in size and eventually trams or 'rolleys' with disc wheels, running on angle iron rails, were introduced. Empty baskets were placed on these at the pit bottom from whence they were taken to the face by the drawers, loaded there and drawn back again to the shaft, where they were hooked on to the winding rope. This was the system in use at Blundell's collieries in 1841, as reported by a Government Commissioner. Mr E. W. Binney, F.R.S., at a meeting of the Manchester Geological Society at Wigan in 1871 said that

> within a short distance of this place in this county, there were formerly thousands of women employed in carrying coal, and at the instance of Lord Shaftesbury and Mr Brotherton, I went down numerous pits to get drawings of the women to see how they were employed. It was most astonishing and wonderful to me to see the power which some of these women had in drawing the corves in which the coal was then conveyed. The women went on all fours with a chain or rope round their necks and under their bodies and by this means they dragged the corves in something the same way as bullocks would. The immense power which was developed in the limbs of some of these women was indeed wonderful. It is singular to think that it is not thirty years since in this district thousands of women were employed in such work and the greater part of the coal wrought in Lancashire was conveyed along the bottom of the mines by women on all fours.

Rails were gradually improved and after 4 feet and 6 feet bridge rails had been introduced it was possible to use trams with flanged wheels. This soon led to the introduction of tubs, and William Greener, the manager of Pemberton, wrote that 'the Bye Pit commenced with tubs and cages, Sept. 11th 1855.' The Venture Pit was likewise converted to tubs and cages in 1858. The tubs in use in the Bye Pit had a capacity of 6 hundredweights whilst those in the Venture Pit carried 5 hundredweights.

Although William Greener mentions at this time the old spunney above the Lady Lane Pit, worked by Sherratt who was dismissed in 1853, it would appear that self-acting inclines were not in general use at Pemberton Colliery until after the middle of the nineteenth century. Armstrong, the Consultant Viewer, noted in 1853

> the disregard of the most favourable conditions, for the use of self acting inclined planes to economise labour, the extraordinary number of pits, and the small produce from each, with the necessity from the distance over which the coal is taken by the drawers, of an excessive number being employed. Baskets of unequal dimensions with little check on the weight carried.

In the same year three horses or pit galloways were in use underground at Pemberton for drawing the basket trams along the main levels to the shafts. Five horses were similarly employed at their Amberswood Colliery at the same time.

The only mention of an underground haulage engine was a suggestion in 1852 that one be placed in the Venture Pit for hauling the dip coals to the shaft. Very soon afterwards, however, egg-ended boilers were placed down the Tanpits and the Lady Lane Pits to drive haulage engines. A steam range down the Bye Pit fed a large haulage engine of two cylinders, 16 inches in diameter by 3 feet stroke geared 1 to 2¼, with two 5 feet

8 inches diameter drums fixed in a brick-arched engine house. This hauled long sets of tubs from the dip area, which was eventually over 2,000 yards from the shaft. It was equipped with branch ropes to a rise area. A similar engine, worked by steam from the surface boilers, was fixed in the Pemberton Five Feet seam to work the dip coal and a branch to the Hawkley area.

After the opening up of the Wigan Four Feet, the Wigan Nine Feet, King Coal and Cannel, and Orrell Five Feet and Four Feet seams, in the King and Queen pits, inclined planes delivering coal from rise areas on to main horse levels were used. But as the distance of the workings from the pit shaft increased, haulage engines were installed.

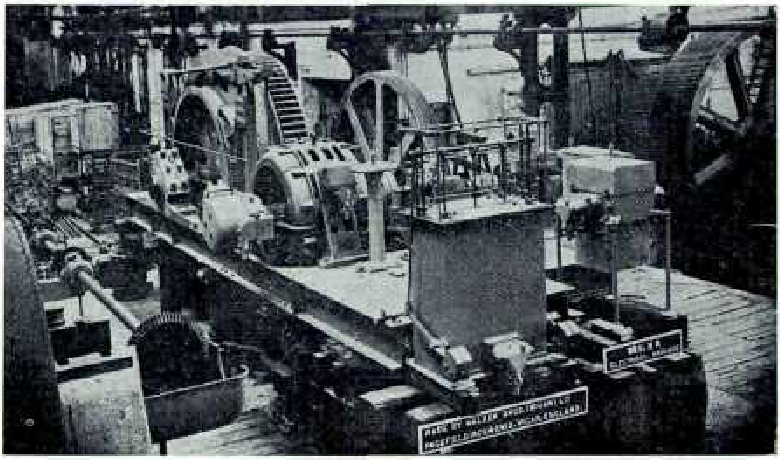


Plate 3.
HAULAGE ENGINE
Built by Walker Bros., Wigan, and similar to those rebuilt for Pemberton Colliery in 1935.

The number and size of these engines varied at different times, but in its heyday Pemberton Colliery was noted for the efficiency and length of its main and tail haulages. They were said to be the fastest in the county and sets or trains of up to 60 tubs were run. The old name for these sets was 'burn', probably an abbreviation of burthen or burden.

The main and tail engines for the Orrell Five Feet, Orrell Yard, King Coal and Cannel and Wigan Nine Feet seams were situated on the surface near the pit head, but the Orrell Four Feet and Wigan Five Feet engines were underground and driven by compressed air. Typical of these was the Orrell Five Feet engine at the surface of the Queen Pit, which had two cylinders

16 inches diameter, with a stroke of 30 inches, and worked two 6 feet diameter drums through gearing at a ratio of 1 to 2¼. The two ropes, which were generally ¾ inch diameter, passed over pulleys set in a frame at the pit head, and from thence down the shaft to the mouthing of the seam 580 yards below, where they again passed round pulleys into the main haulage road. In the shaft itself the ropes ran in wooden pipes 5 inches square inside and constructed of 1 inch thick redwood boards. These pipes were 15 feet in length and were joined together by 'clawp' boards 4 feet long and 4 clamps made from flat pieces of iron bolted together. At 30 yard intervals pieces of timber 2 feet 6 inches long and 9 inches by 3 inches were secured to the pipes with iron clamps, and these sat on 2 inch steel rods fastened in the shaft wall. Long spiked hooks also in the shaft wall prevented the pipes from sagging.

Generally, one engine did duty for all the main roads to the different working districts, except for the districts to the north west of the pit. When the 'burn' had arrived in the shaft sidings and was in its place in the shunt there were joints in the ropes at the junctions of the main haulage with the branch haulage roads. Each of the branches had its own ropes, which lay idle when the haulage was running to another district. A rope changer was stationed at each of these junctions, whose duty it was to uncouple the ropes and recouple them according to which district it was desired to work next. He was provided with a 'rack' or hand winch with which he stretched the ropes to obtain slack for coupling.

All the curves were extremely well laid out with drum sheaves, pulleys, and check rails, and it was delightful to watch the long snakelike 'burn' of 40 or 60 tubs flying along the superbly laid track, round turnings, up and down inclines, and along the straight stretches. All the track was laid to a gauge of 2 feet, and during the latter half of the nineteenth century flat-bottomed rails of 18 lbs. to the yard were used, but 25 lb. rails became the standard later on. Large main and tail haulages like these were unusual in Lancashire as the majority of Lancashire pits used the more popular slow moving endless rope haulages.

The remaining main haulages on the colliery in the Wigan Four Feet and Wigan Five Feet tunnel districts, the Ravine seam and the Venture Orrell Yard district (which also eventually served Summersales) were of the endless rope type known at Pemberton as the 'motion'. Branch ropes to the different districts were driven by the main rope through clutch wheels. The engines were at first driven either by compressed air, as in the Ravine seam, or by steam at the surface in the case of the

Wigan Four Feet and Five Feet. Finally electric endless haulages were installed to work the Wigan Five Feet and Venture areas.

A very large number of boxes or tubs were in use by the 1920s. A report from the Foreman Carpenter, dated 21 December 1921, stated that there was a total of 4,689 tubs, 3,341 being wooden ones and 1,348 steel. The steel ones had a capacity of 6 hundredweights and were used in the Queen Pit, whereas all the tubs used in the King, Prince and Bye Pits and at Summersales carried 8 hundredweights. Summersales coal had been sent down tunnels to the Wigan Five Feet to be wound up King Pit. This system was abandoned when the new Summersales shaft began winding coal in 1945. All the haulages at Summersales were either of the direct or endless rope type driven by electric motors, although there was one self acting jig.

The manual drawing or putting of tubs from the working faces to the haulage shunts was largely done away with in 1906 when Ernest Douglas introduced pony putting on a large scale, the low gradient in the seams in the main area at Pemberton making it ideal for that method. Before this there were only 70 or 80 ponies, but for the following 25 years an average of 250 ponies worked underground at Pemberton Colliery.

A large staff of stablemen, horsemen, and shoeing smiths attended to these ponies and they were very well looked after. A head horse-keeper was in charge and the whole organisation was centred on the Stable Yard at the surface. Wild ponies of from 10 to 14 hands in height were bought at about 4 years of age as they were required and they generally came from Durham. These were put in loose boxes at the stables and broken in at the colliery by being made to pull railway metals round the pony field, and when they became quieter a set of empty tubs along the length of Foundry Lane from the pits to the old Iron Church. The road was roughly paved with stone sets and the tubs made considerable noise. It generally took two to four weeks to break a pony in.

Sick and injured ponies were also kept in the Stable Yard in stalls. For the preparation of the ponies' food, a small vertical boiler provided steam for a small single cylinder engine which drove a line shaft on the first floor. From this a corn crusher and hay chopper, which were on the first floor, were operated. The bags of raw food were drawn up to the mixing room by a horse pulling a rope over a 'cathead' pulley, but in latter days this was performed by a winch. From the corn crusher 'proven' dropped down a shute onto an iron floor, where it was mixed and filled into boxes for despatch underground. This provender

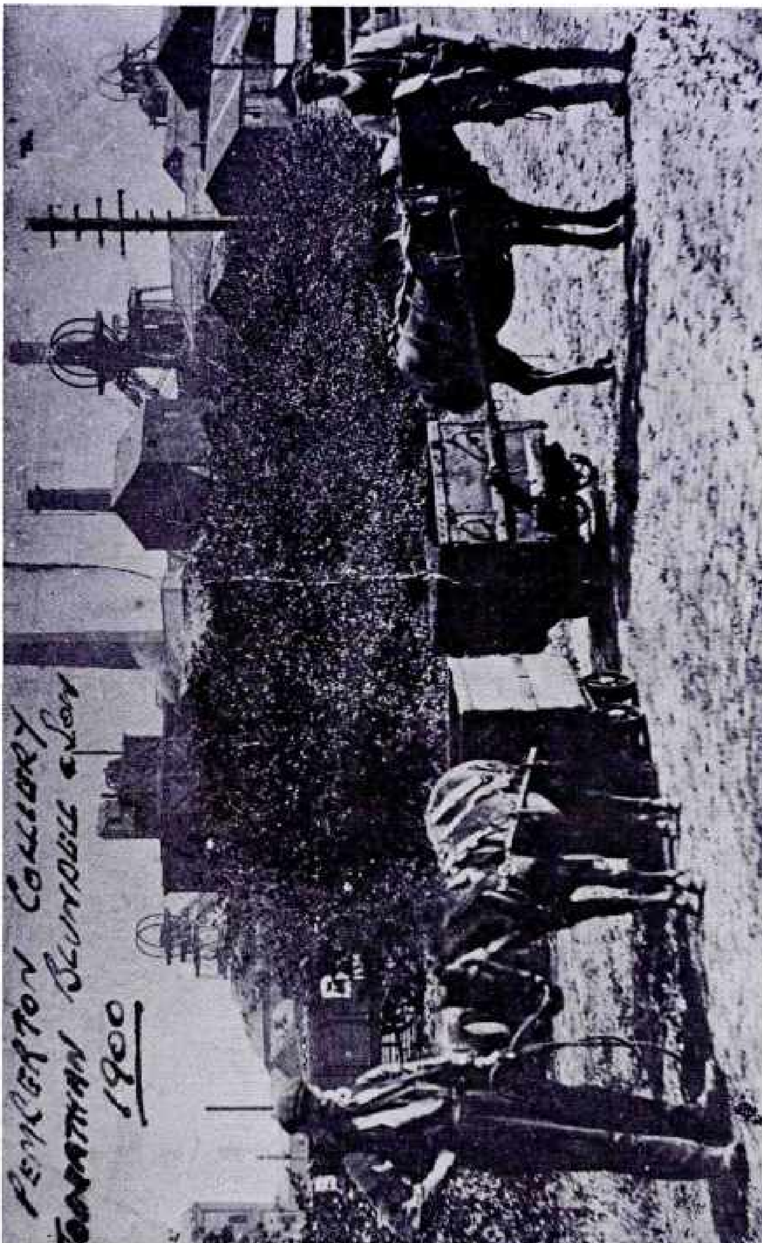


Plate 4.
PIT PONIES BEING_BROKEN IN

was made from a mixture of oats, Indian corn, bran and peas. The chopped hay also came down the shute from the chopping machine and was bagged there ready for sending underground.

A saddler was constantly employed repairing harness, and during the peak years he had an assistant and an apprentice working with him. He made complete sets of gears and collars. All the ponies wore blinkers or a skull cap with eyeholes, and, contrary to popular belief, they did not go blind. There were water carts and 'chop' boxes in every inbye shunt where ponies were employed. The daily consumption of food varied according to the size of the horse and the work it had to perform, but generally averaged from 20 to 30 lbs. of provender and hay.

Extensive stables were maintained in the seams near the shaft siding. These were divided into stalls approximately 6 feet wide and 7 feet long, separated by strong wooden partitions, paved with bricks and drained by means of gutters to a tank at the lowest point. They were all kept extremely clean and comfortable for the ponies and were whitewashed and electrically lit. Each stall was equipped with a wooden manger 2 feet 3 inches by 11 inches deep by 13 inches wide at the top tapering to 9 inches at the bottom. All the manure was loaded into boxes and sent up the pit. The ponies were sent down the pit about the age of five and, generally speaking, worked for about 12 years underground. Some of the ponies lived considerably longer than this. In January 1940 six of them were 22 years old, 3 were 21, 15 were 20, 12 were 19 and 14 were 18 years old. This was out of a total of 108 at that time.

V WINDING

During the last quarter of the eighteenth century most of Blundell's pits were over 70 yards in depth and it is most unlikely that ordinary winches or the cog and rung gin were used at these pits. The whim gin or whimsey was capable of much more rapid winding and would no doubt be the standard equipment at that time. An illustration on an early nineteenth century plan of coal mines in Orrell depicts a whim gin. Water wheels, fed directly by streams or by water, pumped from the pits by Newcomen engines, were in use after 1760, but so far we have no knowledge of these machines being used at Orrell although it is quite possible that they were. An early nineteenth century specification of a well-constructed gin gives the following particulars:

Drum shaft	13 feet 6 inches long, 1 foot 2 inches square, hooped and fitted with 2 inch diameter spindles at each end.

Span beam	39 feet long, 16 inches deep by 8 inches thick, supported by a triangular frame at each end, with bases 13 feet long.
Horse arm	35 feet 8 inches long and 12 inches by 7 inches in section. This passed through a mortice in the drum shaft and was braced by 4 inch by 4 inch stays from the lower part of the drum shaft.
Drum	9 feet diameter by 2 feet 6 inches deep, divided into two parts by a fillet in order to separate the ropes. 12 horns at the top and the bottom prevented the ropes coming off. The lagging was made of elm.
Pit head frame	This was 24 feet 6 inches from the gin frame. It was constructed of oak and was braced and stayed. Two 3 feet diameter cast iron pulleys were fitted directly over the pit shaft.
Jackanapes	Two large poles connected the gin frame and the pit head frame and carried the jackanapes or arms on which were mounted friction rollers to keep the ropes straight.
Striking bar	This was fitted across the two uprights of the head frame. The banksman leaned on it when he drew the basket from the shaft on to the bank with a long iron hook.

Ropes were sometimes tarred or payed over with coarse canvas in order to preserve them, as they were a costly item. During some excavations in the 1920s a paved circular gin horse-walk about 30 feet in diameter was uncovered at the site of one of Blundell's old pits at Orrell.

It is not yet clear when Blundell's adopted the steam winding engine, but an item in the colliery accounts for 1789 states that Henry Blundell paid £3 13s. 6d. for 'two models for drawing coals'. We can only conjecture what these models were, but after 1780 many atmospheric engines were adapted for rotary motion by means of a second cylinder, crank, connecting rod and flywheel and some of these were used for winding coal. An excellent example of an atmospheric winding engine was erected at the William Pit at Whitehaven as late as 1806. In 1790 and 1791 five 'pirate' Watt winding engines were erected by John Wilkinson of Bersham and at least three of these were put to work in Lancashire. In 1793 it was stated that Bateman & Sherratt of Salford had

> improved upon and brought the steam engine to perfection. They are now used in cotton mills and for every purpose of the water wheel where a stream is not to be got and for winding up coals from a great depth in the coal pits which is performed with a quietness and ease not to be conceived.

This firm made both atmospheric and 'pirated' Watt engines. Watt's first winding engine was erected at Walker Colliery on the Tyne in 1784, but according to the lists of their engines in the Birmingham Record Office they did not supply any winding engines to Lancashire.

About 1790 the steam driven endless chain system of winding was introduced and was probably the method used at Blundell and Menzies extensive Orrell Chain Colliery, which commenced in 1799, and at their Pemberton Chain Pit sunk in the 1820s.

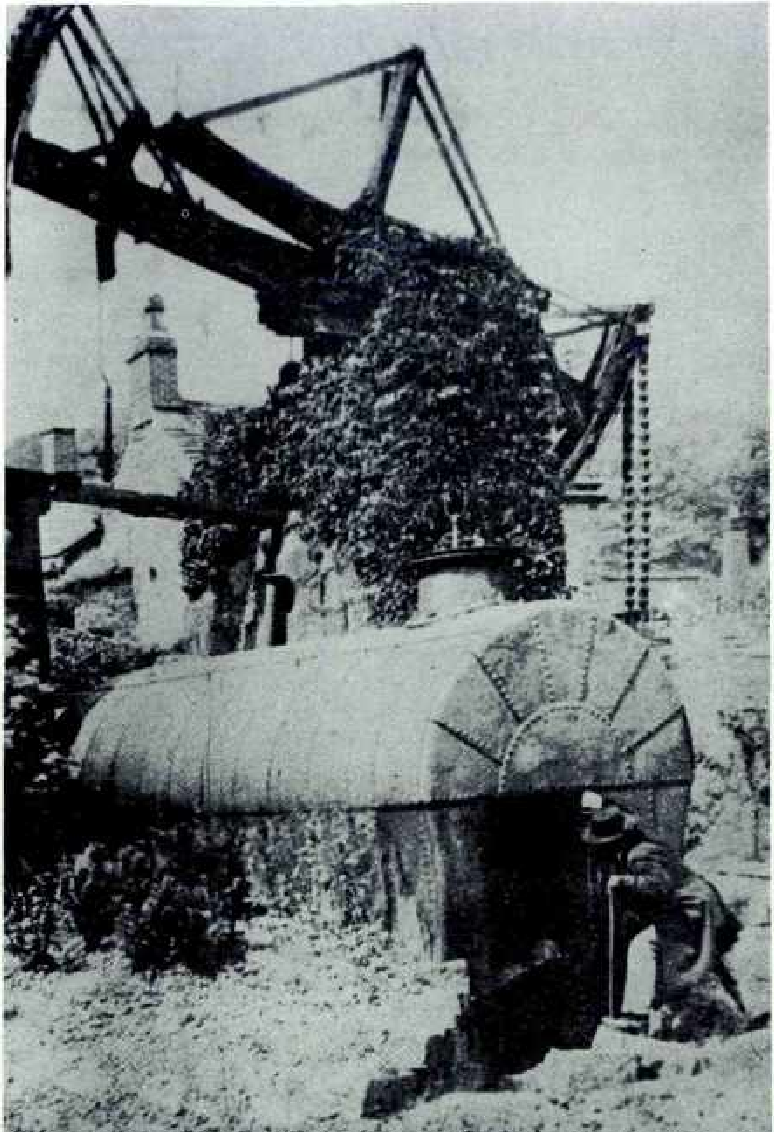


Plate 5.
FAIRBOTTOM 'BOBS'
Newcomen-type engine, photographed about 1880, but similar to atmospheric engines Blundell probably used at one time.

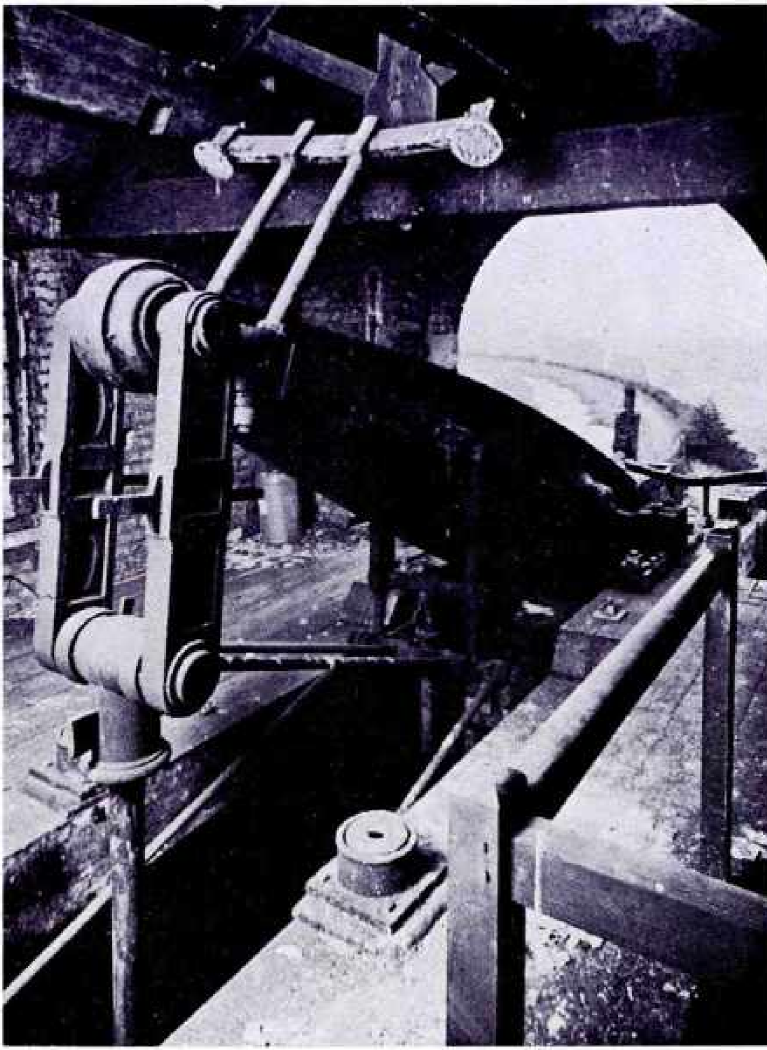


Plate 6.

A BOULTON AND WATT ENGINE

First installed at Old Engine Colliery, Oldham, in 1790. Removed to canal duty in 1810. Similar to the first steam engines at Orrell.

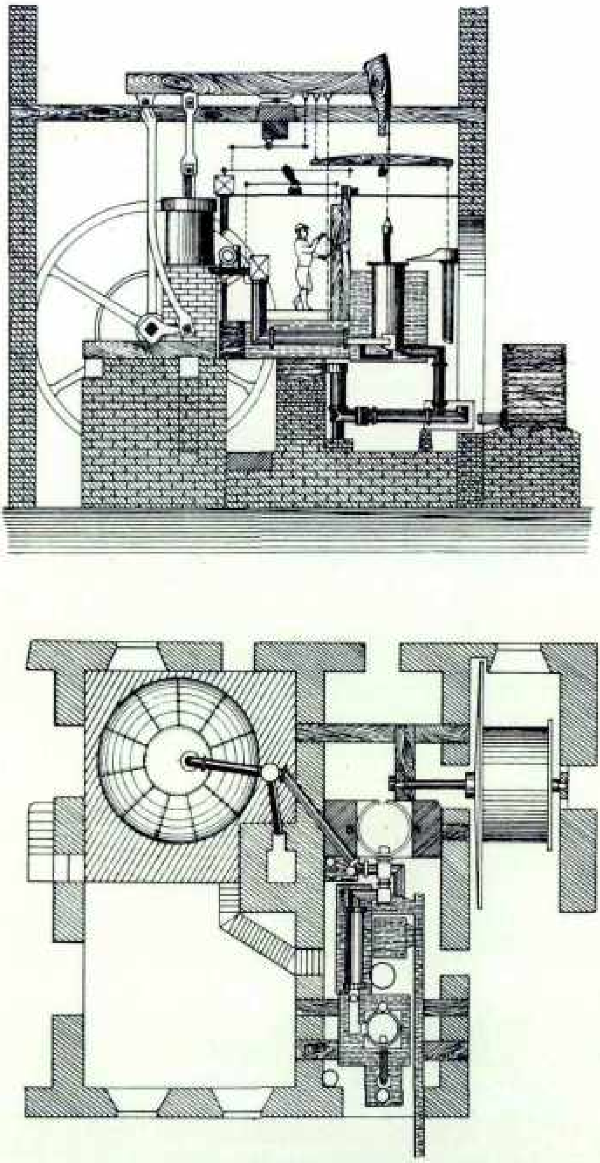


Figure 11.
ENGINE AT WILLIAM PIT, WHITEHAVEN, 1806: PLAN AND ELEVATION
This winding engine was similar to Henry Blundell's.

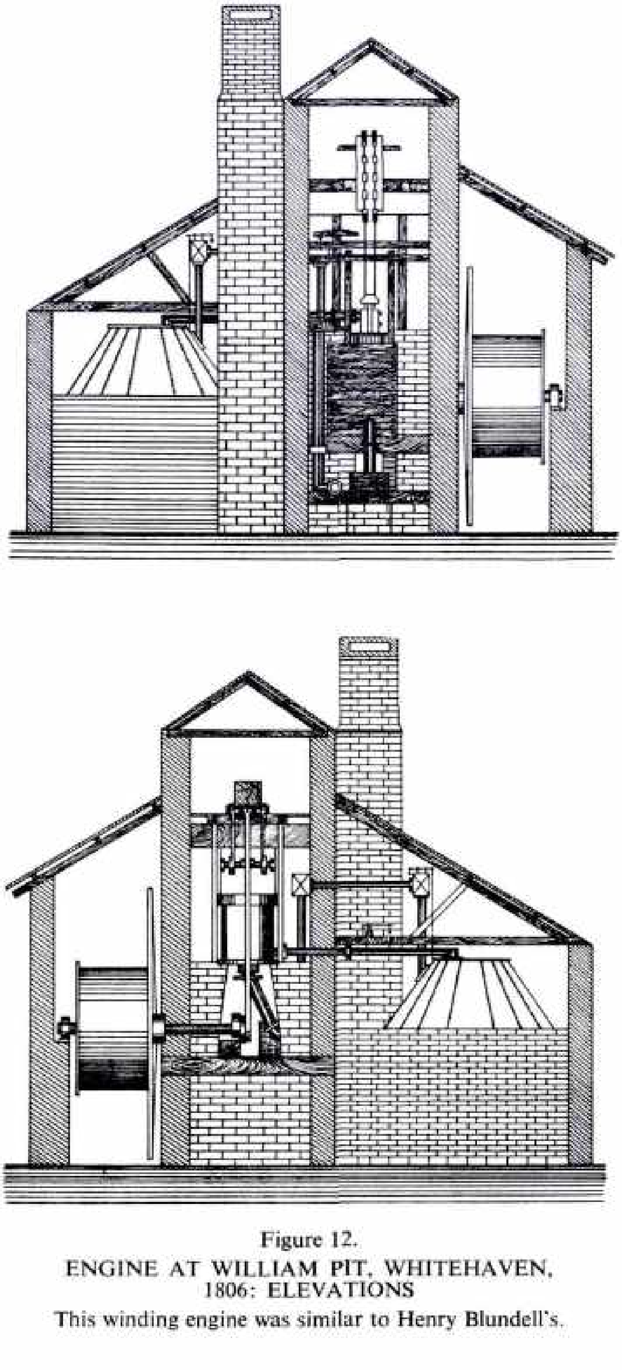


Figure 12.
ENGINE AT WILLIAM PIT, WHITEHAVEN, 1806: ELEVATIONS
This winding engine was similar to Henry Blundell's.

The Orrell Chain Colliery finished in 1820 so perhaps the same apparatus was transferred to Pemberton. This system was in use in East Lancashire until the end of the nineteenth century but with tubs instead of baskets. A description of one of these is given:

> A small engine supplies the necessary motive power and by means of a chain drive and gearing, operates a pair of large sprocket wheels erected vertically over the pit shaft. The sprocket wheels work what might be described as gigantic bicycle chains, each of course being endless and hanging vertically in the shaft and passing round pulleys at the bottom. The chains are kept steady by the pulleys which are, as a matter of fact, supported by the chains, the axles being free to move vertically in slide bars. At regular intervals, horizontal bars connect the two chains and to these bars, the tubs are attached being suspended singly.

Gins were still in use in some of Blundell's pits in the early nineteenth century. In a Pemberton Colliery wages book for 1827 'R. White Gin driver at No. 8 pit' is mentioned, which may have been a reference to a sinking gin. Early nineteenth century plans of Pemberton Colliery show engine houses, boilers and chimneys at Farryman's Wood, Lady Lane, No. 11 and Bye Pits. Apart from the beam type, which according to Thomas Barton, the engineer at the turn of the century, was used originally for winding at the Bye Pit, the engine most commonly used for this purpose during the first half of the nineteenth century was a single cylinder vertical steam engine with the drum mounted above the cylinder on stone pillars.

Flat hemp winding ropes had come into use about 1790. A special drum slightly wider than the flat rope was used, on which the rope was coiled lap upon lap, being kept in position by 'verticals' or horns radiating from the shaft on each side of the drum. That these were in use at Pemberton is clear from a paragraph in Vol. 2 of the *Mining Journal* where we read that

> an early instance of the installation of flat wire winding ropes was at Pemberton Colliery, Lancs. where a pair of ropes were at work in September 1841, which was stated to have exceeded all expectations in the practice of winding and raising coal, and promised to be one of the finest inventions for working very deep mines ever yet discovered.

James Tonge, a Lancashire mining engineer, said it was common to see shafts without guides or lining in 1850. It was also common to see men and boys standing in a small tub or basket which was suspended by chains from the end of a rope and having to be carefully balanced lest they fall out where there were no guides or conductors. The tub, during its slow descent or ascent, would be constantly turning round, having a tendency to make persons dizzy. Many cases have been known of them actually falling out of the tub and being killed under such circumstances.

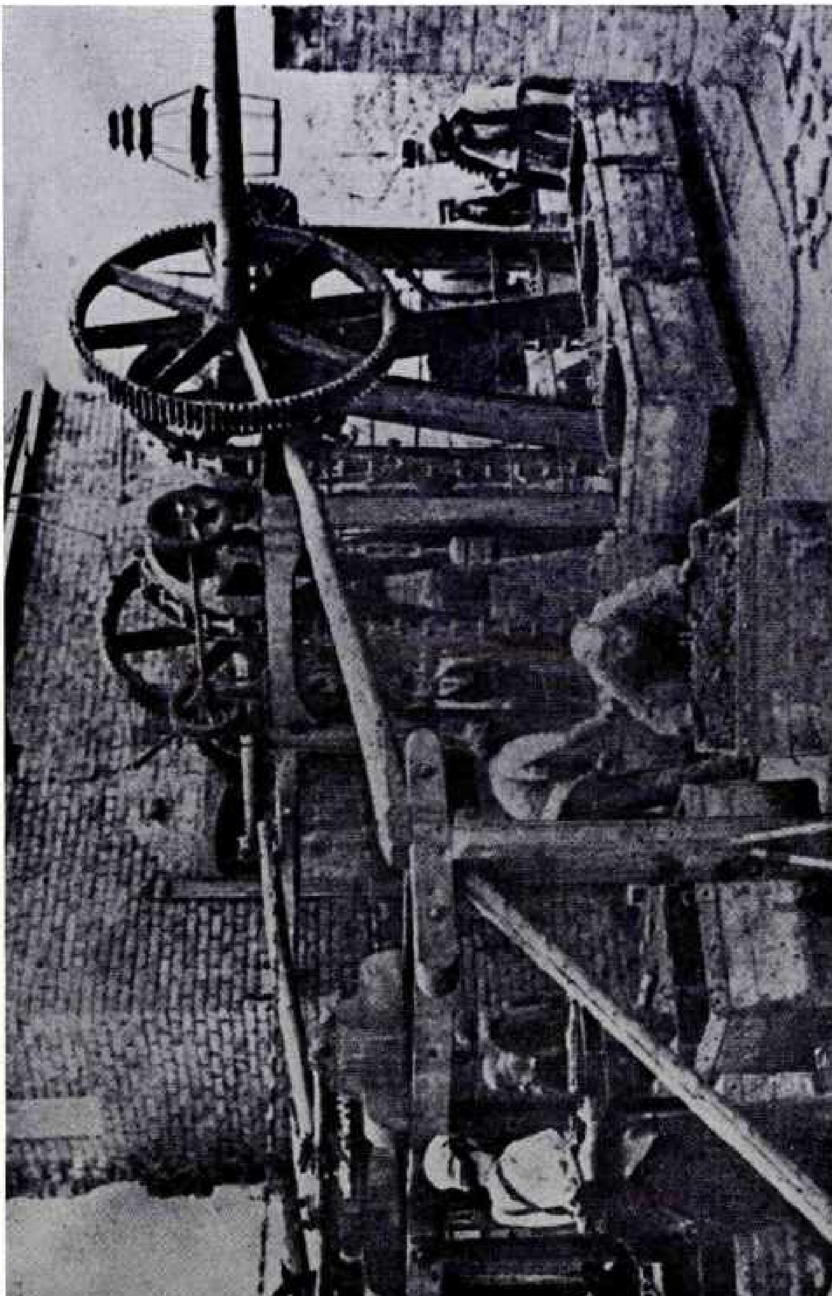


Plate 7.
A CHAIN PIT: BRIDGE PIT, BARDSLEY BRIDGE, NEAR ASHTON-UNDER-LYNE

At this time, however, at least some of the pits at Pemberton were fitted with guide rods for the baskets as William Greener mentions 'taking the rods out the Wood Pit' when that pit finished in 1858. In 1856 the Bye Pit was fitted with tubs and cages to replace the baskets previously in use. The engine erected at the time had one horizontal steam cylinder 21 inches in diameter with a stroke of 3 feet 6 inches. The engine was directly coupled to the drum shaft to which a flywheel was fitted. The drum itself was 9 feet in diameter. There was one loose eccentric with gab hand reversing gear, the slide valve being on top of the cylinder. On top of this slide valve there was a vertical cylinder 2 feet high within which there was a disc with an equal area to the valve and this was connected to the valve by a rod. The steam, acting on the underside of the disc, relieved the pressure on the back of the valve to a certain extent. This was to facilitate moving of the valve by a hand lever. The ropes were 220 yards long, 1 inch in diameter and 11 hundredweights 2 quarters 12 pounds in weight. The cages weighed 19 hundredweights 1 quarter and held two tubs weighing 12 hundredweights 3 quarters each when loaded. There were two pitch pine conductors, 3 inches by 4 inches in section, to each cage. The pit was 140 yards deep to the sump.

The Low Venture Pit was fitted up in a similar manner in 1858. The engine was almost identical with the one at the Bye Pit and at the end of the century was to be seen driving the slack wash, elevator and crusher. Another winding engine of the same pattern but of slightly more antique appearance was fixed under the King Pit winding engine after that pit had been sunk, to wind the men out of the Orrell Four Feet and Five Feet seams in an emergency. This may have come originally from the Tanpits, which had a similar engine, or Lady Lane. One of the winding engines at Blundell's Amberswood Colliery was fitted with a crank for the purpose of working a ram pump through an 'ell' leg.

The many deep pits that were sunk in Lancashire and various other parts of the country after 1860 required much larger winding engines than those previously used. These were often housed in most imposing buildings. The one constructed for the King and Queen Pit engines at Pemberton, an outstanding example of industrial architecture, was built by Prestons of Wigan and was approximately 120 feet long 60 feet high and 40 feet wide. The bricks from which it was built were made by a man called Belshaw in open clamps on the colliery brick field. It had a Staffordshire blue brick plinth, white sand stone quoins and other stone dressings, an ornamental parapet composed of blue and yellow bricks, and the semi-circular heads of

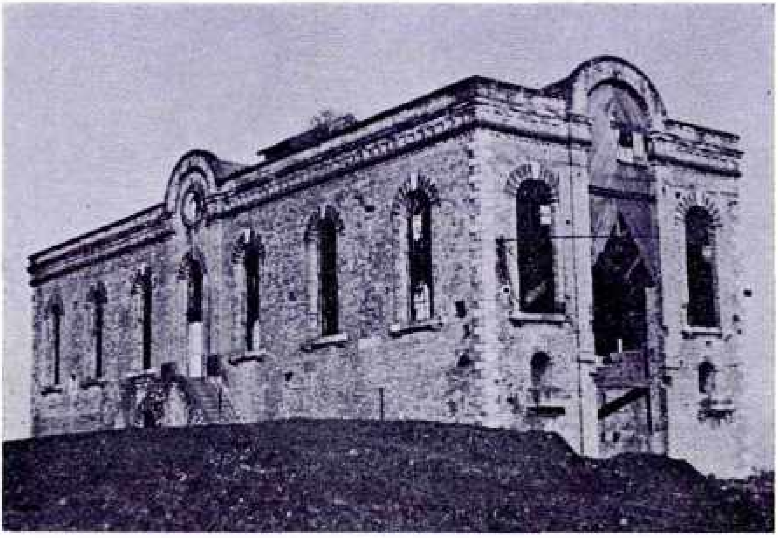


Plate 8.
DERELICT ENGINE HOUSE, PEMBERTON COLLIERY
Built in 1870, demolished in 1965.

doors and windows of similar yellow and blue bricks. At the front, leading up to the main door, there was an ornamental stone staircase with a cast iron balustrade. A large clock was fixed centrally with one dial over the main door and one over the central window at the back. This building cost £4,015.

The two engines were magnificent examples of their time and were identical in size except for the drums. The Queen Pit engine was built by Robert Daglish of St Helens Foundry in 1870, and the King Pit Engine at Haigh Foundry, Wigan in the same year. Both of these engines had two horizontal cylinders 36 inches in diameter with a stroke of 72 inches fitted with Cornish or double beat valves, link motion and two fast eccentrics for each cylinder. The valves were actuated by levers which in turn were moved by the link motions and this allowed for a certain variation in the rate of expansion. Full steam could be given at starting and the quantity reduced afterwards. The Queen Pit had a spiral or conical drum, 48 tons in weight, minimum diameter 19 feet 8 inches maximum diameter 30 feet 10 inches. A steam brake engine, which actuated a strap brake on the larger part of the drum, could be put into use by moving the slide valve upon its cylinder. The steam pressure was 60 lbs. per square inch and the exhaust steam originally passed through

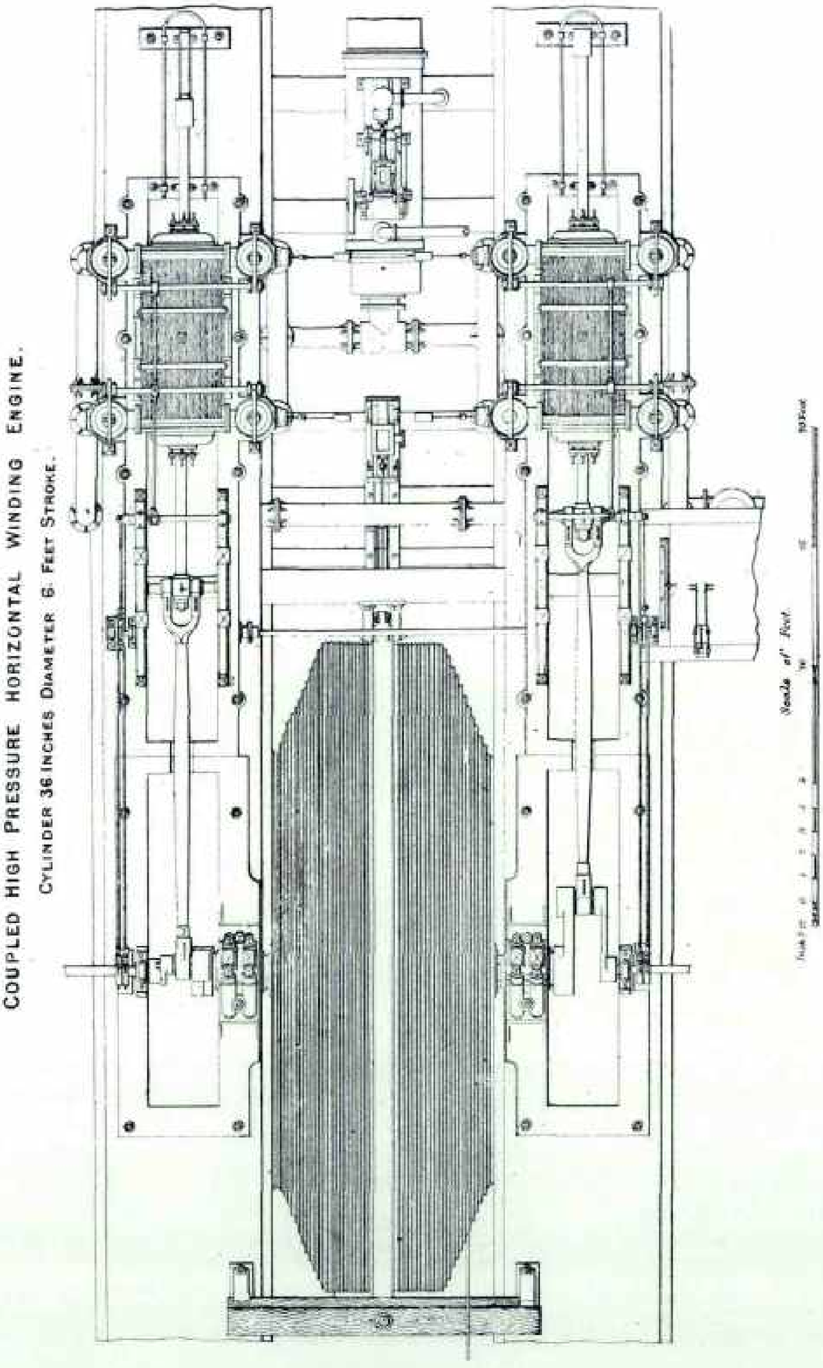


Figure 13.
PLAN OF QUEEN PIT WINDING ENGINE

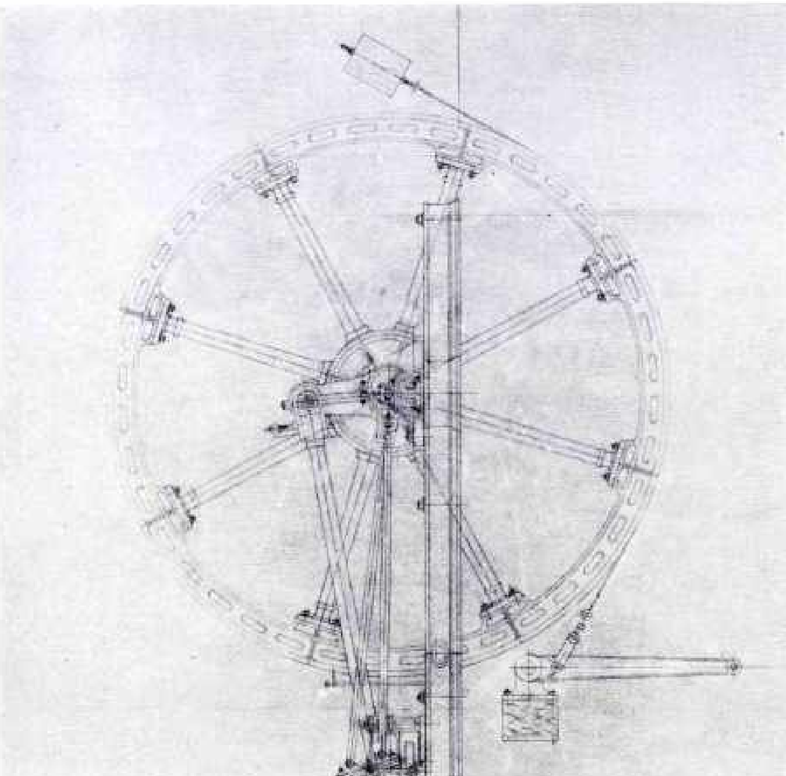


Figure 14,
KING PIT WINDING ENGINE: ELEVATION

a feed water heater on its way to the atmosphere. A small donkey pump pumped this water back to the boilers. Mr Daglish wrote to J. W. L. Watkin, the agent, on 18 June 1875 asking for particulars of the performance of the Queen Pit engine. The following details were given to him:

Diameter of tapered rope	1½ in. to 1¾ in.
Steel or iron	Steel
Weight of rope	59 cwts.
Weight of cage and chains	29 cwts.
Weight of coals	46 cwts.
Number of tubs	6
Weight of each	3 cwts. 0 qrs. 14 lbs.
Steel or iron	Steel
Distance from centre of crank shaft to centre of pit	94½ ft.
Diameter of shaft	16 ft.
Depth of pit (from brow)	638 yards
Pressure of steam in engine house	53 lbs. per sq. in.
Time of each winding	55 secs.
No. of revs.	22
Winds per hour	40

Steam is shut off from 2¾ to 3 revs. from the top or 80 to 96 yards. The engine is reversed at this point. Full steam is put on against the cylinder. When the engine runs the distance in 55 secs. the steam is full against the engine for the last 11 secs.

Time taken to change the tubs	35 secs.
Height from railway track to level of brow	23½ ft.
Height to pulley centres	68½ ft.
Greatest quantity of coal hoisted in 10 hrs.	610 tons

Can do 800 tons and change the men or 90 tons per hour for 9 hours.

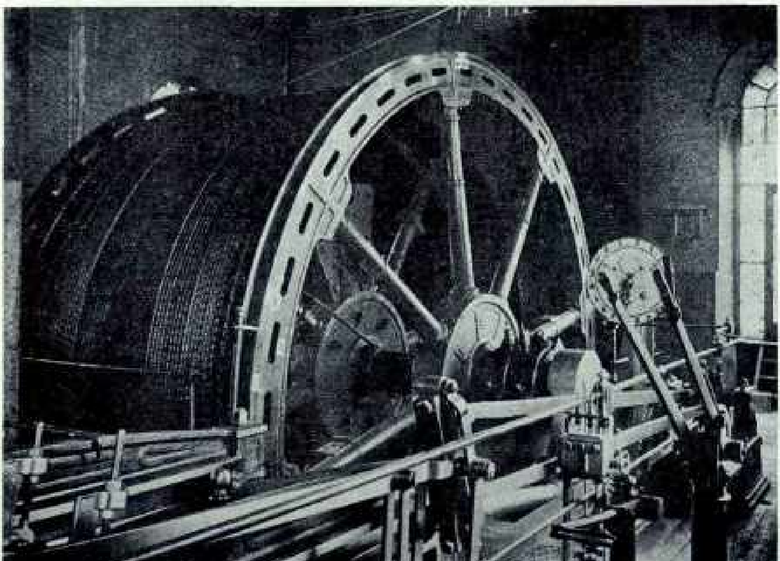


Plate 9.
KING PIT WINDING ENGINE

The King Pit engine drum was 19 feet 4 inches overall diameter but for more than thirty years, in order to wind from two levels (the Wigan Nine Feet and the King Coal and Cannel) at the same time, the actual lagging was 15 feet 2 inches for the Wigan Nine Feet and spiralled up to 19 feet 4 inches for the King Coal and Cannel. Other particulars were:

Length of King Coal and Cannel rope	520 yards
Weight of ditto	2 tons 6 cwts. 2 qrs.
Length of Wigan Nine Feet rope	430 yards
Weight of Wigan Nine Feet rope	1 ton 18 cwts. 2 qrs.
Safe working load of rope	14 tons 1 cwt.
Weight of cage and chains	1 ton 18 cwt. 2 qrs.
Weight of empty boxes	1 ton 3 cwts.
Weight of coals	2 tons 10 cwts.
No. of boxes in each cage	6
No. of revs.	22
Diameter of pit shaft	18 ft.
Conductors	iron wire, 4 to a cage
Time to wind	39 secs.
Time to change boxes	46 secs.

Both of these engines were outstanding examples of the engineering craftsmanship of their day and were delightful to see in motion. The valve pillars were made in the form of Grecian columns, and valve chambers and cylinders were originally lagged with polished mahogany secured by brass rings. They cost £3,500 each.

Up to the sinking of the King and Queen Pits all the pithead frames at Blundell's pits, and indeed all over Lancashire, had been constructed of wood with the exception of one small one at Tyldesley. Some of the old wooden headgears were rather crudely built and an old photograph of the Venture and King Coal and Cannel pits shows quite quaint erections. Those designed for the King and Queen Pits, however, were very imposing. They were constructed of wrought iron lattice girders and built up girders and consisted of two main legs, carrying the pulleys and a pulley platform, with stays anchored to large stones corbelled out from the engine house wall. Two shorter legs connected to the main legs by cross members carried the frame to which the guides and receivers were secured. The King Pit headframe legs were supported on four sandstone pillars about 13 feet high. Those at the Queen Pit were secured at ground level. The diameter of the pulleys in each case was 18 feet.

An overwind device known as the 'visor' and invented by A. Bertram, engineer to the Wigan Coal and Iron Co., was fixed to both engines and also to the Bye Pit engine in 1892. A test carried out at Queen Pit by Bertram on 26 November 1892 showed that this device could stop the engine in one and a quarter to one and seven eighths revolutions after automatically shutting steam off at 3 revolutions from the top, if the engineman let it run out of control. The speed of the cage then nearing the top was from 37 to 40 miles per hour. The guides for the cages in the Queen Pit shaft were flat bottomed iron rails (later changed to steel), two to each cage at 50 pounds to the yard, secured by square bolts, attached to chairs and 12 inches by $3\frac{1}{2}$ inches or $4\frac{1}{2}$ inches pitch pine buntons at intervals of 8 feet. These buntons were later changed to oak. The cages were not centrally placed in the shaft and the larger section buntons were required on the longer span. The conductors in the King Pit were $1\frac{1}{2}$ inches diameter iron ropes (or rods) of 7 single rods or wire strands. There were four of these to each cage and they were suspended from the headframe. These guides were kept in tension by 'cheese' weights totalling 2 tons 15 hundredweights on each of them. They were kept in position by buntons below the bottom winding mouthing at the King Coal and Wigan Nine Feet.

Prince Pit winding engine was a hybrid, built and erected by Messrs Wood & Gee of Wigan, from two 30 inch by 5 feet single cylinder Daglish engines with Cornish valves, formerly installed at Rose Bridge Colliery, Wigan. The 15 feet 6 inches diameter parallel drum and drum shaft were new. It was again rebuilt by Worsley Mesnes Iron Works in 1939, with the exception of the drum, which was however fitted with post brakes. The new cylinders were equipped with piston valves. The original 65 feet high headframe, built on the colliery from Oregon pine, was replaced in 1939 by a steel one 73 feet high to pulley centres. Summersales, the shallow shaft sunk by the company in 1945, was equipped with a novel form of electric winding engine worked by a 30 horsepower slip ring motor. It was operated by the banksman through push buttons, was protected by automatic overwind and reversing safety devices, and wound up two 8 hundredweight tubs 80 feet in 25 seconds at each wind.

VI MINE DRAINAGE

Level drainage tunnels, or soughs as they were known in Lancashire and adjacent counties, were used from early times to keep mines free from water. These were particularly suitable in hilly country, but where seams were fairly flat, as they were in Orrell, Pemberton and Winstanley, soughs drained quite large areas of coal down to the lower levels of the local brooks, even though the surface did not generally rise steeply away from the brooks. There were quite a number of these soughs opera-

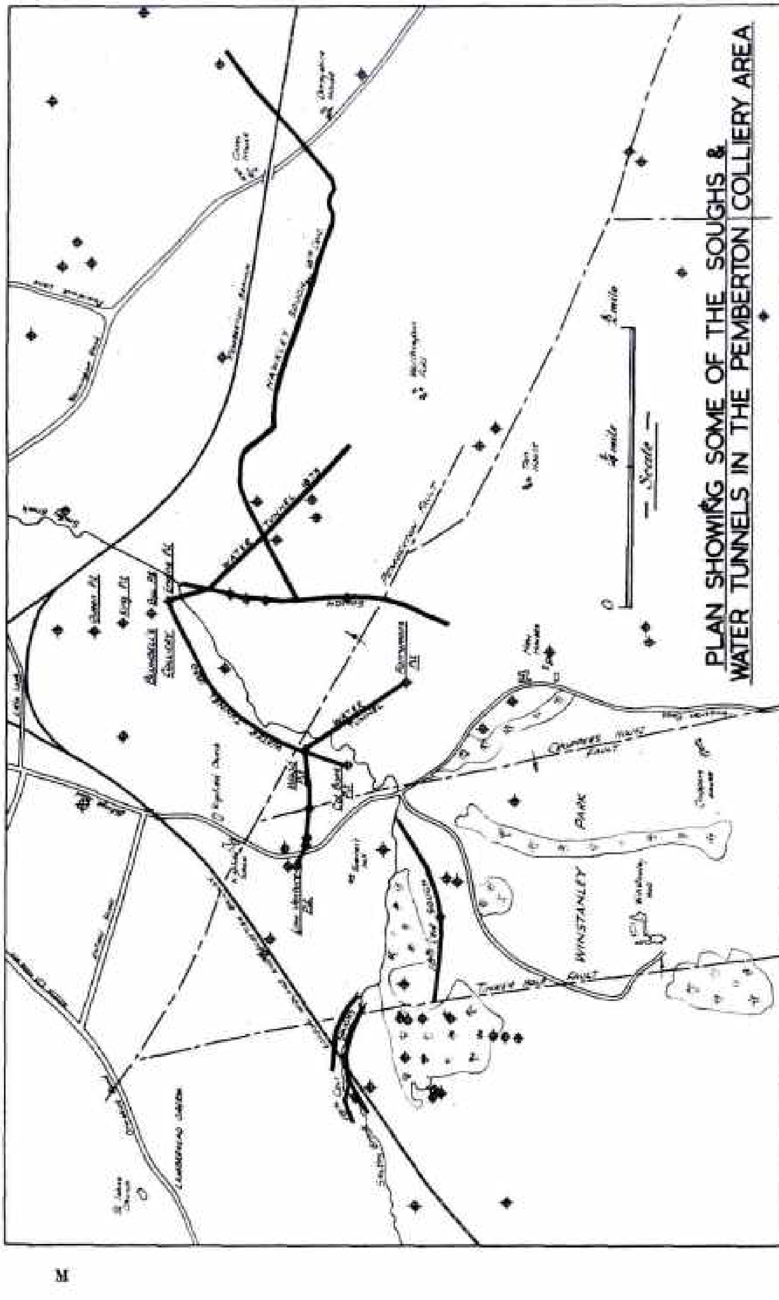


Figure 15.
PLAN OF PEMBERTON SOUGHS

ting locally both before and after Blundell's came on the scene. One of the longest was the one that drained the seams from Hawkley to Smithy brook near the Bye Pit at Pemberton, and this was $1\frac{3}{4}$ miles in length. Its construction was begun by William Mollineaux of Hawkley about 1797. William Bankes's eighteenth century sough, discovered in recent years during the working of the Wigan Five Feet seam, at Summersales Colliery, Pemberton was over half a mile in length and was driven 4 feet square in stone and about 2 feet wide and the same height as the seam when in coal. These soughs were driven on contract by gangs of men who specialised in this work. The road still known as Sougher's Lane, not far from the Pemberton boundary at Park Lane, seems to indicate that a community of soughers lived there once.

When the seams above the level of the soughs were exhausted and it became necessary to sink the pits deeper, pumps were installed which, whenever possible in order to save power, delivered the water into the sough and not to the surface of the pit. Before the introduction of atmospheric engines and steam engines various methods of raising the water were in use: winding in tubs, rag and chain pumps and bucket pumps worked by men, horses or water wheels. On 30 October 1769, seven years before Jonathan Blundell and his partners leased the colliery there, John Jackson of Orrell House, or Salters Ford as it was then known, wrote to Sir Robert Holt-Leigh saying that he would not be able to get nearer his coals 'until I have been at the charge of sinking so as to fix a pomp or have the water laded by scope and so we shall so soon as any quantity of rain falls to play the water out by the engine.' It appears that the water powered engine referred to was not capable of dealing with the water met with. Five years later an advertisement concerning the sale of the property mentions a 'fire engine' on the colliery. The engine or pumping pit at Saltersford was approximately 76 yards in depth and worked until about the year 1800.

Between 1780 and 1800 Blundell erected another four steam pumping engines at Edge Hall, Slycroft, Dukes and Chain Collieries in Orrell and possibly a fifth one at Higher Carr or Catteralls, Kitt Green. Edge Hall and Dukes Engine Pits were approximately 80 yards in depth, Slycroft was 98 yards whilst those at Higher Carr and Chain Colliery were 120 yards deep.

The latter was situated 350 yards north west of the Old Engine public house and against a 40 yard upthrow fault known as the Grand Dyke Fault (see Fig. 16). The water was not raised to the surface but was delivered into 2 stone drifts, 4 feet square and 300 feet in length, which were driven through the Grand

Plate 10.

Typical surface arrangement of a pumping engine pit similar to Orrell and Pemberton. This engine house was at Pentrich, Derbyshire.

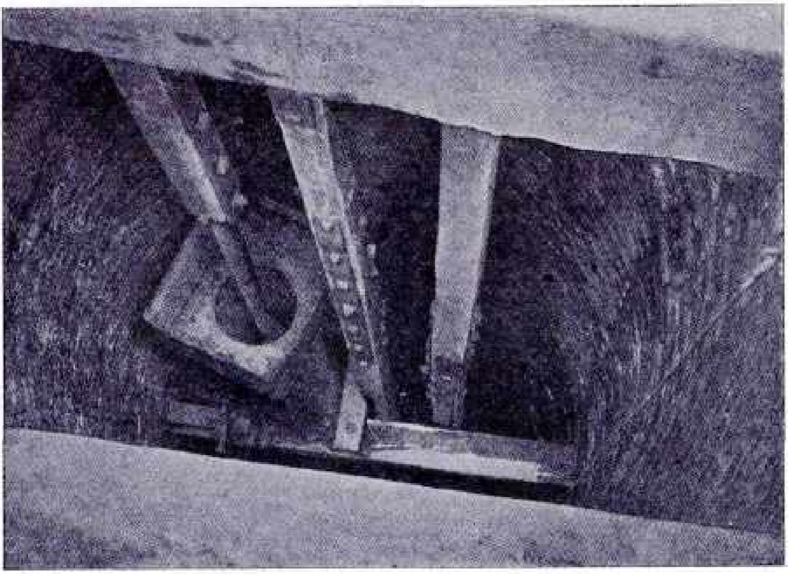


Plate 11.

View down typical late eighteenth century pumping shaft, showing pump rods, pipes and burtons, Pentrich, Derbyshire.

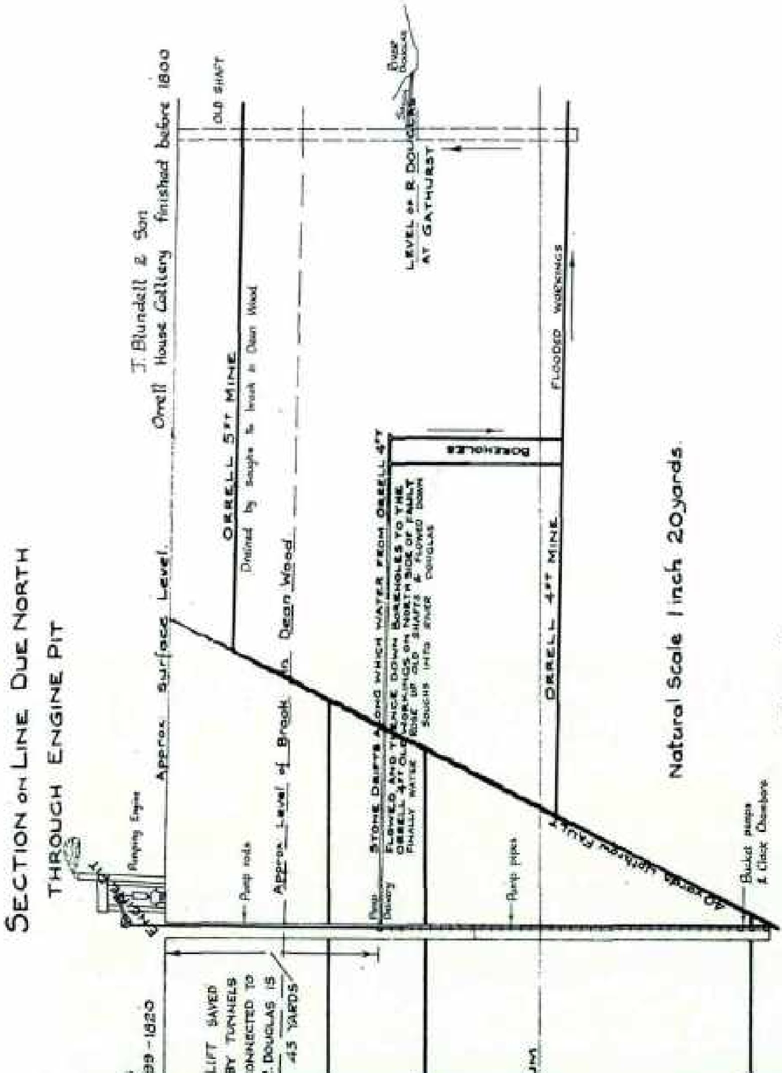


Figure 16.
DRAINAGE AT ORRELL CHAIN COLLIERY
Scale reduced from the original.

Dyke Fault to the Salters Ford area previously worked by Jackson's and Blundell's. Bore holes had been put down from the end of these tunnels to connect with the old Orrell Four Feet workings, which in turn were connected by shafts and soughs to the River Douglas at Gathurst. The stone drifts were 5 yards above the level of the Douglas and 43 yards 1 foot down the shaft, saving the engine that amount of lift. This old Engine Pit was cleaned out about 1939 by Orrell UDC and pumps were installed for the supply of drinking water to Orrell. The make of water averaged 288,000 gallons per day and it can be assumed that this would be very little different from the average make at the end of Blundell's 21 year lease, in 1820, when the colliery was abandoned. An atmospheric engine capable of raising 288,000 gallons 76 yards 2 feet to the bore hole tunnels, in 16 hours, would be quite a large one, probably with a cylinder of about 40 inches diameter. There would be about 50 yards of dry rods between the tunnels and the engine beam. There being two separate tunnels and bore holes, it is possible that two sets of rods, buckets and pump stocks were worked from the beam, unless, as at Clarke's Engine Pit, and later at Blundell's Pemberton Engine Pit, there were two engines.

No information has come to light on the places of manufacture of the early fire engines in Orrell, where at least one was in operation in 1760. However, from 1789 they were being made at Haigh Foundry, Wigan, as it was in that year that a boring machine was set up for the manufacture of engine cylinders and cannons there. An advertisement in the following year stated that 'having engaged engineers and able workmen, they are enabled to undertake the complete construction of fire engines of every kind.' The other principal suppliers of fire engines to Lancashire in the 1780s and '90s were Joshua Wrigley of Manchester, Bateman and Sherratt of Salford, Francis Thompson of Ashover and John Wilkinson of Bersham. There were quite a number of furnaces and forges in Lancashire earlier in the century, but, as far as we know, they were not equipped with boring machines for the manufacture of cylinders and working barrels. It is even possible that the cylinders for the early Orrell engines were supplied by the great iron works at Coalbrookdale, which sent cylinders to many parts of the country.

The opening of Pemberton Colliery saw the erection of two large Cornish pumping engines, the first one to be erected presumably used for the sinking and worked until 1873 when it was dismantled. The second engine, built in 1820 by James Lindsay and Company of Haigh Foundry, Wigan, survived

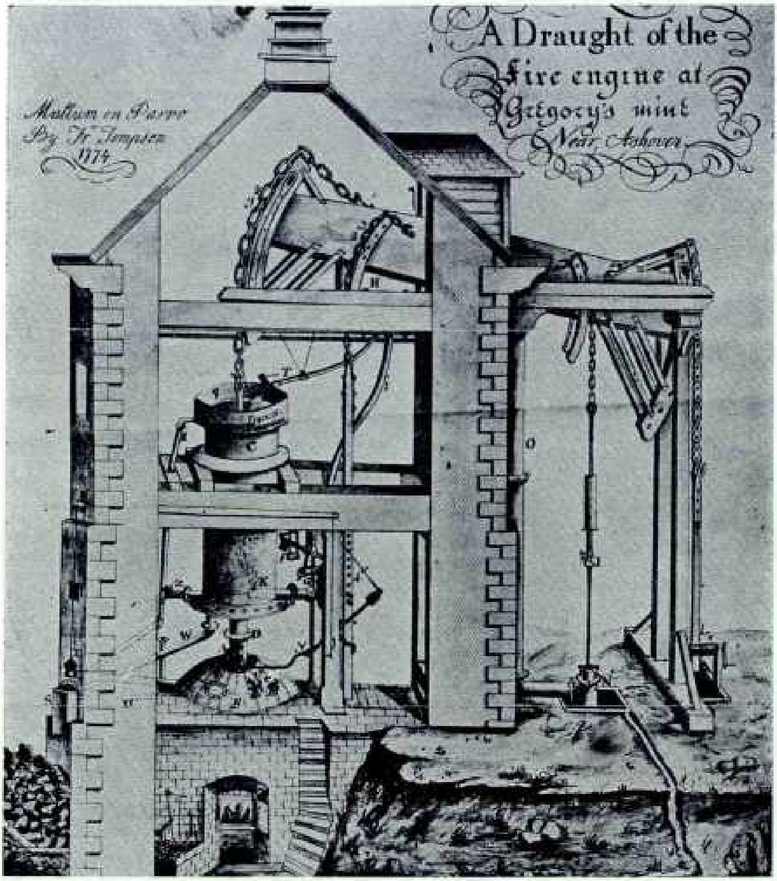


Figure 17.
THOMPSON'S FIRE ENGINE AT THE GREGORY MINE, NEAR ASHOVER, DERBYSHIRE
Similar duty and date to Blundell's first atmospheric engine.

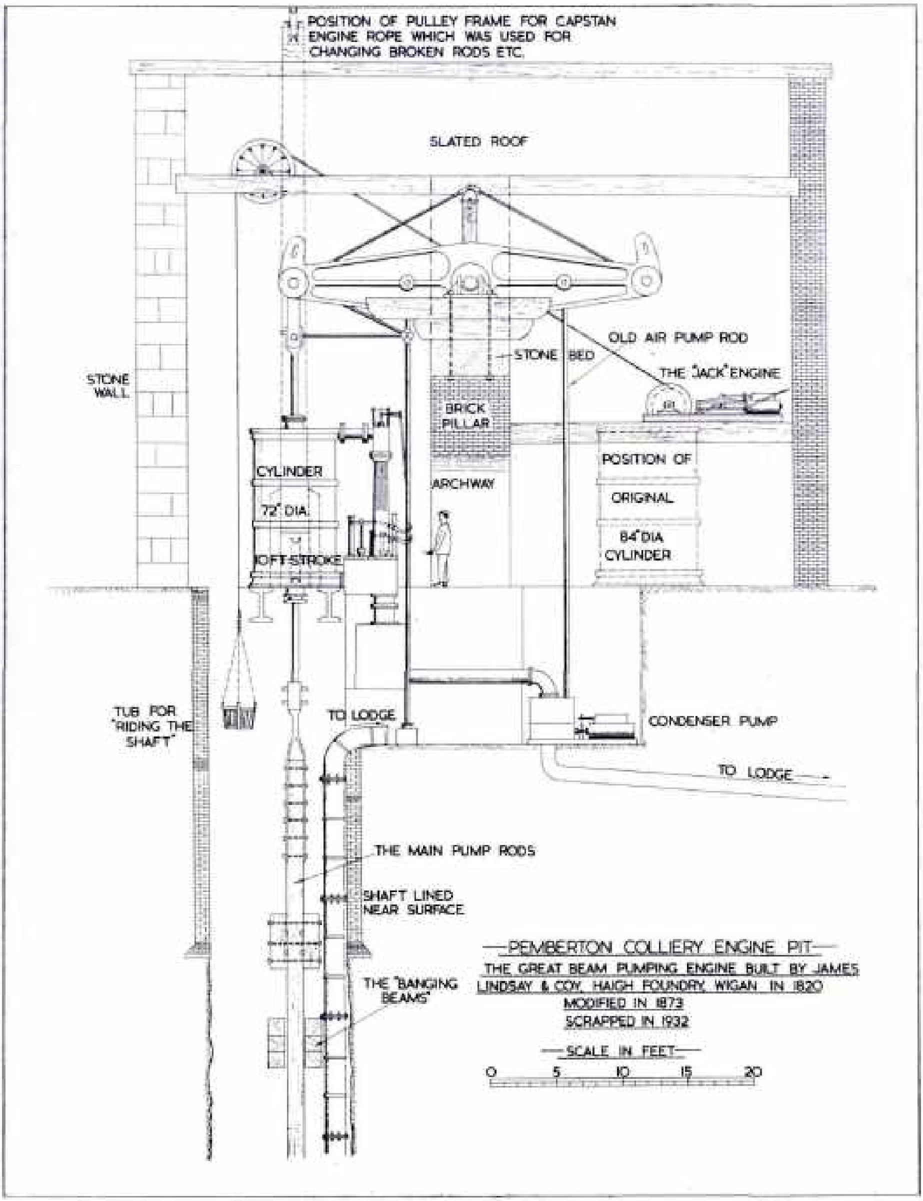
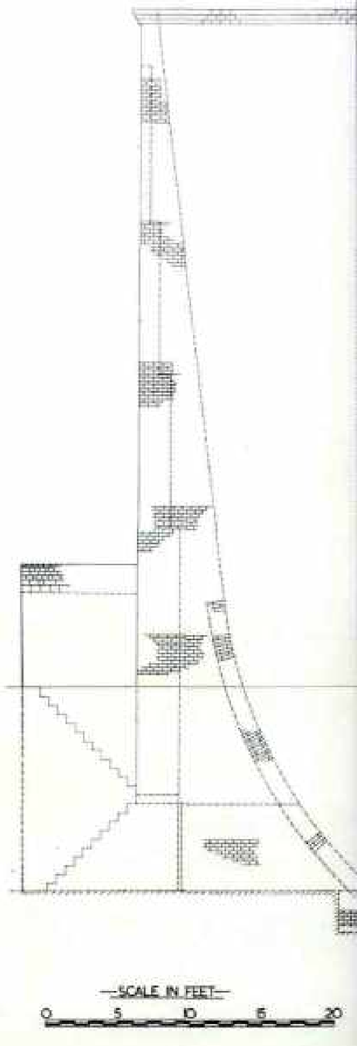


Figure 18.

PEMBERTON BEAM ENGINE



—SCALE IN FEET—
0 5 10 15 20

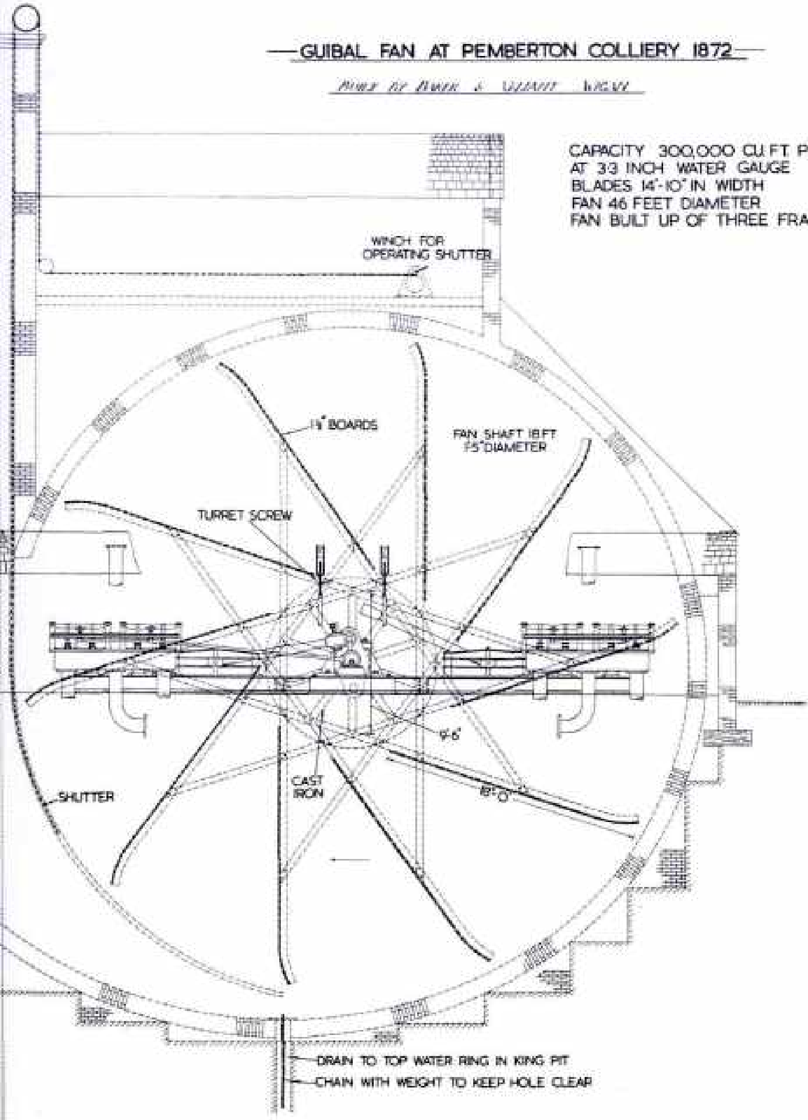


Figure 19.
GUIBAL FAN

until 1932 and was in regular use until 1917. A notebook handed down in the Ainscough family of Pemberton records the setting to work of this engine, 'started hingin Pemberton September 29th, 1820'. Armstrong informed Henry Blundell in 1853 that these two engines worked six 'setts' of pumps. These were all bucket or lift pumps. The sump of the Engine Pit was at that time only about 10 yards below the Pemberton Four Feet seam, the lowest seam then worked. A long drainage tunnel with branches brought the water to these pumps from the Wood Pit and Venture Pit areas.

Work began in 1873 on the deepening of the sump to 192 yards to enable a slightly rising tunnel to be driven to drain the lowest point of the dip coal in the Pemberton seams. This tunnel, 650 yards in length, had a number of staple pits up to the seams to drain the different areas. It acted as a lodge for the water to build up in whenever the engine was stopped for repairs, the water being kept out of the shaft by a vertically sliding door, known as the 'flap'. This was 3 feet 8 inches high, 2 feet 9 inches wide and 4 inches thick, made of English oak bolted through and planed up. It was operated by the capstan engine rope.

At the same time as this work was carried out, the old engine was partly rebuilt. A 72 inch diameter inverted cylinder over the shaft replaced the old 84 inch diameter cylinder at the other end of the beam, and new valve gear and a condenser pump were fitted. A new self-contained geared engine, built by Wood & Gee of Wigan, was set up as a capstan in place of the gin. The beam was 29 feet long and 6 feet wide with semi 'horse heads' at each end. It was strengthened by a King Post truss. The axle was square where it fitted into the beam and it was keyed into it. The two ends worked in an open topped pedestal. The speed, which was 7 to 10 strokes a minute, was controlled by a Watt Cataract governor.

At the bottom of the shaft there were two bucket-lift pumps, one of which was a standby. They were 20 inches and 18 inches in diameter respectively. The make of water, which varied from 400 to 800 gallons per minute, was lifted 72 yards by the bucket from the shaft sump to the lodge of the 20 inch brass ram. This forced the water the remaining 120 yards to the surface. The pump rods were 14 inches square down to the ram, which was secured to an offset. There were two other offsets from which two 10 inch square 'wet rods' went down inside the pipes to the bucket pumps below. The cast iron pipes which formed the rising main were 18 inches in diameter and 9 feet long with strengthening rings at 3 feet intervals and bracketed flanges. The rods were 50 to 60 feet long and were joined together by wrought iron plates on all four sides, bolted through both ways. These plates were 11 feet long, 9 inches wide and 1¼ inches thick in the middle tapering down to ¾ inch thick at each end.

Buntons and pudlocks were fitted in the shaft at 20 yard intervals and four sets of 'banging beams' (3 or 4 baulks set one on top of the other) prevented damage to the pumps in the event of a breakage of the rods. The capstan engine was used for changing rods, pipes and any other heavy work in the shaft, but a small antique winding engine with gab hand valve gear known as the 'Jack engine' was used for raising and lowering the tub in which the shaftsmen made their perilous descent and ascent. The shaft was only 9 feet 6 inches in diameter, and, having so much equipment in it, it was impossible to get a vertical run down and up again. The tub, being light, was easy to push from one side to the other as it ascended or descended. The pit was unlined and very wet and in winter bitterly cold. For this reason 'backskins' or sleeveless leather jackets and sou'westers were provided for the pit men to wear.

Large pumping engines placed on the surface and working pumps through rods in the shaft were very expensive, both in initial cost and in maintenance, and attempts were made to introduce powerful yet compact pumps which could be placed underground. One of the most successful of the early types was the Worthington Duplex pump, developed mainly for water works and oil pipe lines in America. In 1899 a large pump of this make was installed at the Pemberton Four Feet level at the Engine Pit. The 20 inch brass ram of the old engine was taken out, but the engine was still used to lift the water from the sump to the new pump lodge. The new pump was fed with steam from the surface. It consisted of two high pressure steam cylinders 23 inches in diameter and two low pressure cylinders 38 inches in diameter. The double acting water pistons were 12½ inches in diameter, the stroke 24 inches and the speed 110 feet per minute.

Early in the twentieth century large electrically-driven pumps were introduced in mines and in 1917 two 175 horsepower Rees Roturbo Multistage electric pumps were installed in the Bye Pit. The Worthington pump was dismantled and the old beam engine which had been in continuous use for four generations ceased to operate. In 1928 a Mather and Platt multistage electric turbine pump was added. These were all superseded in 1938 by two 220 horsepower Mather and Platt multistage turbine pumps situated in a special tunnel driven from King Pit and connected by bore holes to the sump of the Engine Pit. Bore holes and staple pits were made much use of at Pemberton for conveying water to pump lodges, and, when required, dams were built, as in the Ince Seven Feet tunnel, to impound water in disused workings and thus reduce pumping.

Other pumps which generally delivered water to the main pumps comprised two horizontal ram pumps in the Wigan Four Feet and Nine Feet seams in the early days. These were replaced by a three throw ram pump and a turbine pump in 1934. Two turbine pumps at the Wigan Five Feet level dealt with the old Venture Pit water, and there were numerous compressed air piston pumps. Hand pumps and syphons dealt with small quantities of water in the Wigan Five Feet, Four Feet and Nine Feet seams. Below the Nine Foot level the seams were completely dry. At Summersales there were four main pumps, all of the same type, which operated until the colliery closed in 1966. They were Mather and Platt 'Medivane' centrifugal pumps with a capacity of 300 gallons per minute, driven by 30 horsepower AC motors.

VII VENTILATION

In speaking of noxious mine atmospheres and gases the miner frequently refers to them as various kinds of 'damps', from the German word 'dampf' meaning vapour, fog, or fumes. The two most common of these 'damps' met with in coal mines are black damp and fire damp. The former is a mechanical mixture of the extinctive gases carbon-dioxide and excess nitrogen. It is also sometimes referred to as 'choke damp' or 'stythe'. Fire damp is synonymous with methane or a mechanical mixture of gases, chiefly inflammable, given off naturally from coal and consisting for the most part of methane.

Various methods of ventilating mines and diluting these noxious gases were tried out during the late seventeenth and eighteenth centuries, comprising either iron fire baskets lowered into special air shafts, or a furnace at the bottom of a high chimney at the surface which was connected with the air shaft, or, thirdly, furnaces at the bottom of the shafts. John Buddle is said to have introduced the first underground furnace at the Wallsend Pit in 1787. Be that as it may, during the 1920s two furnace shafts, the sides of which were coated with thick soot, were discovered underground on the site of Blundell's Chain Colliery worked under a 21 year lease from 1799. These shafts were approximately 5 feet square.

The quantities of air circulated by the early small furnaces were generally inadequate to ventilate the mines properly. As late as the middle of the nineteenth century, the furnace at Winstanley No. 1 pit circulated only 5,400 cubic feet of air per minute, and those at Blackleyhurst Seneley Green Pit and Little Delph Pit 8,652 and 4,763 cubic feet per minute respectively. However, a large furnace on the surface at Laffak Colliery, Garswood, produced 17,500 cubic feet per minute. At the larger and more up to date collieries bigger furnaces were introduced, and by 1858 the Venture furnace at Pemberton Colliery circulated 44,740 cubic feet per minute, that at the Bye Pit 40,340 cubic feet per minute and the one at the Tan Pits 44,850 cubic feet per minute. All the brickwork of these furnaces in contact with the flames was of firebrick set in ground fireclay, but this was generally backed up by ordinary brickwork, sometimes with a cavity of a few inches interposed between. In the gassy pits it had become necessary to use dumb drifts (which were always constructed at an inclination of not less than 1 in 6), whereby the return air passed into the upcast shaft without passing over the furnace, thus avoiding as far as possible the danger of ignition of firedamp. This was the case at the furnace pits at Pemberton. Early in the century, however, the return air had passed directly over the furnace giving rise to most dangerous conditions.

In a paper read before the North of England Institute of Mining and Mechanical Engineers in 1860, William Armstrong described a series of experiments with the furnace at the Tanpits at Pemberton Colliery,

> where the return air from the Arley Mine seam was so charged with gas as to render it expedient that the furnace should be wholly fed with fresh air. Fresh air is forced through the fire bars, but from the contiguity of the return the double furnace was placed 50 yards back from the shaft. They were fed exclusively with fresh air below the bars, the upper section of the furnace being shut off with doors. With 14,100 cu. ft. of fresh air passing over and under the fire, the doors being open, 57,436 cu. ft. was realised, with a consumption of 3½ tons of coal in 24 hours, whilst by closing the doors and forcing the air through the grate, 65,400 cu. ft. per minute was obtained with 4 tons of coal. The temperature of the air at the bottom of the shaft was 302 F. and 108 F. at the surface.

In order to avoid the danger associated with furnaces, various other means were sought to provide good ventilation. The first practical proposition was the use of high pressure steam jets at the bottom of the shaft, provided with steam by underground boilers. This method was tried during the reopening of Blundells' Blackrod Colliery in 1849, which had been closed for some time on account of an underground fire. During this operation, however, a disastrous explosion took place and the colliery was abandoned. In 1852 William Armstrong conducted a series of experiments at Pemberton Colliery using steam jets to provide the motive column. These experiments proved beyond all doubt that in shafts of all depths the consumption of an equal weight of coal produced higher quantities of air from the furnace than from the steam jet.

Although the ventilation for the sinking and opening out of the King and Queen pits from December 1867 was accomplished by a furnace situated in a drift near the surface at King pit, in 1872 a permanent fan was installed. This was built to the design developed by M. Guibal, the celebrated professor at the Hainaut School of Mines. According to a list published in 1878, this fan was then the second largest in diameter and the largest in width in the country, being 46 feet in diameter and 14 feet 10 inches wide. It ran at 40 revolutions per minute (at that time), producing 200,000 cubic feet per minute at a water gauge of 3 inches. It had been at work 5 years without stopping except for lining brasses. In 1899 the revolutions had been increased to 48, when it produced 314,000 cubic feet per minute at a water gauge of 2·8 inches. It was a most impressive piece of machinery, composed of wrought iron angles 6 inches by 6 inches by 1 inch thick, and iron flats 6 inches by 1 inch built up on cast iron decagonal bosses 9 feet 6 inches in diameter. The fan blades were made with boards 11 inches wide, 1½ inches thick and 14 feet 10 inches long. The size of the fan blades was 14 feet 10 inches in width and 18 feet in height or length. The fan shaft was of forged iron 17 inches in diameter by 23 feet long. It was driven by an engine and a back to back duplicate engine alternately. Each had one horizontal cylinder 36 inches in diameter with a stroke of 42 inches. The inlet and exhaust valves on the Cornish principle were all on one side of the cylinder. On the stand-by engine the connecting rod was suspended over the crank by a polished turret screw with right and left hand threads, the crank being a double one with a hole for a new pin and a new pin was always kept ready. These engines and the fan were constructed by Baker & Valiant of Wigan, and the workmanship was of a very high order. In 1893 a writer in the *Colliery Guardian*, referring to this fan, said 'Furnace ventilation is entirely discarded with its heavy consumption of coal and attendant dangers. As regards the work achieved by this noble fan and engines erected 20 years ago, no example of furnace ventilation is known to equal it.'

In 1910 a standby to the Guibal fan was installed. This was a single inlet Sirocco fan made by Davidson & Co. Ltd of Belfast. It was a multi forward blade fan 14 feet 7 inches in diameter and 6 feet 2 inches wide driven by a 175 horsepower electric motor through eight 1½ inch diameter cotton ropes. At

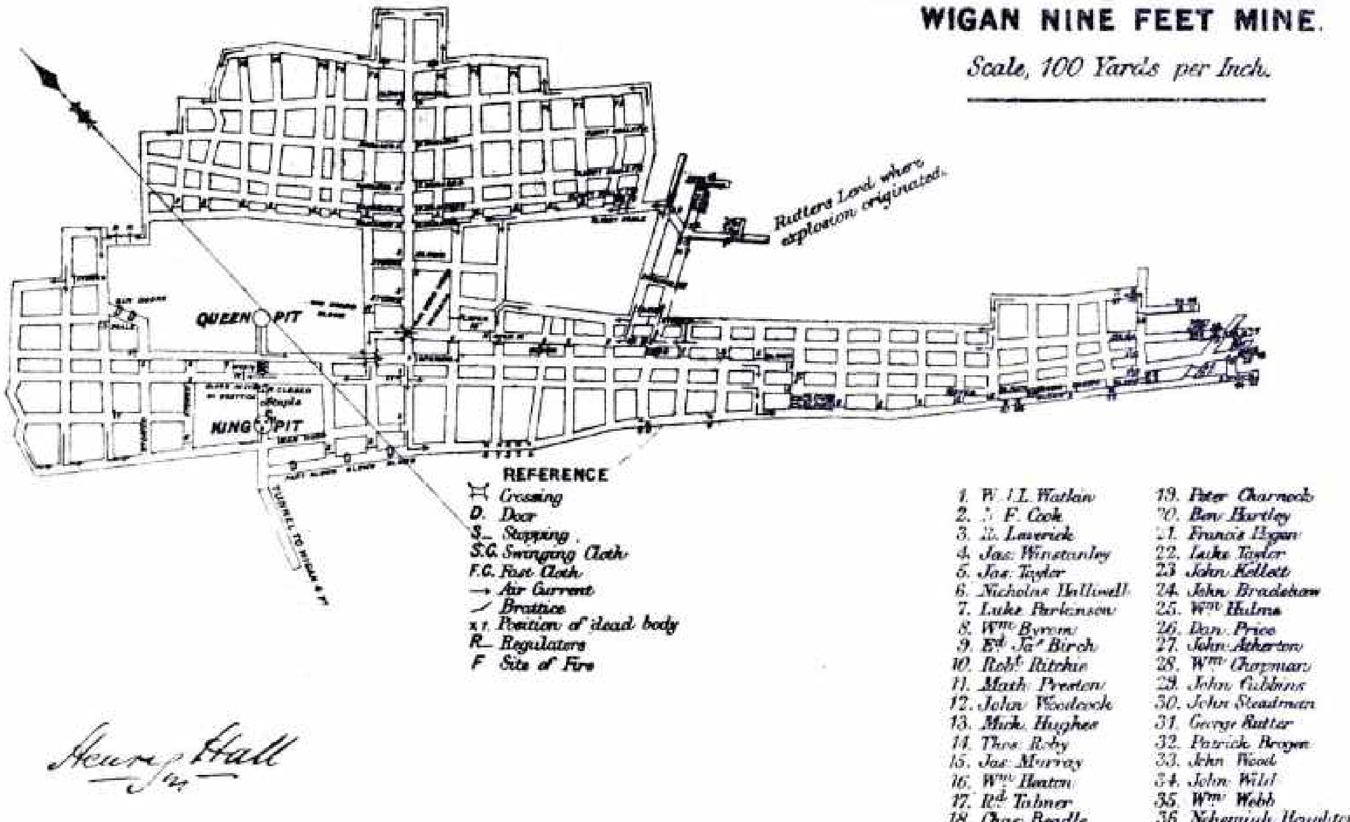


Figure 20.

PLAN OF WORKINGS AFTER EXPLOSION IN KING PIT IN 1877, SHOWING METHOD OF COURSING THE AIR a water gauge of $2\frac{1}{2}$ inches it produced 300,000 cubic feet per minute. It was worked alternately with the Guibal fan, but was never considered as satisfactory.

The King pit fan drift was arched top and bottom 14 feet high and 12 feet wide, and the Prince pit drift was 14 feet in diameter. These drifts were equipped with two large doors 3 inches thick and operated by winches on the surface for reversal of the ventilation in an emergency. Both evaseé chimneys or fan outlets were also equipped with doors worked by winches assisted by balance weights. The fan installed at Summersales in 1937, although small, was the latest type at the time. It was made by Walker Brothers of Wigan and was an axial flow fan.[5] The fan was an Aerex two stage fan, the propellers being 35·3 inches in diameter, and it was designed to produce 30,000 cubic feet per minute at a water gauge of 8 inches when running at a speed of 2,150 revolutions per minute. A 50 horsepower electric motor drove it through 6 V ropes. A few years before the colliery finished it was superseded by two simple Woods type propeller fans producing 30,000 cubic feet per minute each. These were driven by 45 horsepower motors.

In early days at Orrell and Pemberton the system of coursing the air seems to have been the rule. This was the method by which the air was made to traverse all the underground roads before it passed up the upcast shaft. Some time during the first half of the nineteenth century however, splitting the main air current in order to provide separate districts of each seam with fresh air was adopted. This method was certainly used by William Greener from 1854 onwards. Brick stoppings, oiled cloth brattices and wooden doors were the means used to direct and regulate the air currents.

VIII THE 'SHOPS'

From the earliest days of Blundell's Collieries there were small carpenter's and blacksmith's shops and, judging by the amount of leather purchased and the great number of horses in use, there is no doubt that a saddler was employed.

During the first half of the nineteenth century, however, a considerable central establishment for all the pits was built up at Pemberton. Armstrong described it in 1853:

> I find there are 14 smiths (men and boys) 5 joiners, 5 mechanics (men and boys) and 2 saw mill men with a basket maker and a saddler; besides a

[5] With such a fan the air is pushed in an axial direction and the blades are inclined to the direction of rotation of the axis. This pitch, as it is called, provides a thrust to the air as in the propellers of ships and aircraft.

Foundry in constant work, and then besides a few additional hands kept at the Chorley and Ince collieries. This establishment is most excessive, I found the stock of iron and timber to be most extravagant. A large tonnage of iron and metal with engines in an unfinished state. Old materials not again applicable, all exposed to oxidation and this with the immense stock of timber in every stage of rot is the most disgraceful exhibition of waste in the county.

I suggest that the Foundry be laid off and advertised to let with the necessary engine power for the Cupolas and Forge, and that from this or some other respectable foundry, all future castings be obtained from fortnight to fortnight at current prices.

Under the advice of your engineer, the establishment should be reduced and limited to the necessary repairs of the engines and stock. New engines or the principle parts of old ones being obtained elsewhere and only when required and such of the tools retained for facing up the spare stock as he may hereafter judge advantageous. That the iron work and joiner work for the waggons be let, the materials being supplied by the colliery. Similarly, tenders should be taken for boat repairs under a specification and superintended by the Engineer.

And that all loose metal and scrap iron not immediately available, be forthwith sold.

To take charge over the several departments and to look closely into the observance of the contract an engineer from our district (Durham) should be appointed acting under and responsible to the Resident Viewer.

A wooden shop ought to be erected near the Yard for the Waggons and the whole concentrated into a narrow compass. The present coke ovens might be attached to the Foundry or reserved for inferior coke.

These central workshops were known in later times as the 'Old Foundry Yard', and up to the late 1940s they were still used as Major C. L. B. H. Blundell's Estate Workshops, also partly as the Stable Yard. The boat repairs mentioned by Armstrong were carried out in the colliery boat yard at Seven Stars, Wigan, adjacent to the colliery railway terminal, where boats were loaded with coal. The proposal to appoint an engineer 'from our district' was carried out when John House Senior was appointed to the post.

At the time of the sinking of King and Queen Pits, Wildes Cotton Factory near the colliery offices became vacant. This was on the colliery estate and was taken over and converted into workshops for the enlarged colliery. The carpenters, wagon shops, loco repair shops and machine shop were on the ground floor, and the fitting shop, with a store for patterns *etc.* above it, was on the first floor. A large smithy building with 14 hearths and two 5 hundredweight steam hammers, which were converted later to compressed air, was constructed near the old factory and the whole of the new workshop site was enclosed by a high wall.

There were two Lancashire boilers, an engine house and a chimney placed centrally in the main building. The chimney was octagonal, 90 feet high, with a dentilled stone capping and stone plinth similar to those at the new pits and was built by the colliery masons. The cylinder of the vertical engine was 16 inches by 30 inches and through a line shaft drove lathes (one of which was a very large one, with a 4 foot diameter face plate, used for heavy work), screwing machines, planing machines, shaping machines, grindstones and drilling machines in the fitting and machine shops, a planing machine and circular saw in the joiners' shop and a very large boring machine in the wagon shop. A tunnel from Smithy Brook brought water to a lodge under the boilers and this water was pumped up into the boilers. The lodge and tunnel were reached by a spiral staircase in the well shaft. A mortar mill, saw mill, locomotive engine shed, saddlers, tinsmiths, and lamp repair shop and stores, were also erected here, as well as the Engineer's office. Early this century a large smelting furnace and 15 hundredweight compressed air hammer were added and also a large shed under which timber was stored, and a commodious locomotive fitting shop.

About 1932, when the colliery output was declining, it was decided to close the Foundry Yard and to move the workshops nearer to the pits. The old compressor house was enlarged by the addition of a building of a similar size and this was fitted up for use as shops for carpenters, fitters, blacksmiths and saddlers. A separate building was erected as the locomotive fitting shop. For many years there had been a separate coal cutting machine shop, first near Queen Pit and later at Prince Pit, and this was continued. After nationalisation in 1947 the NCB established large central workshops, but each colliery still had its own shops for carrying out general maintenance and running repairs.

IX POWER PRODUCTION

From the time they began coal mining at Orrell in 1776 Blundell's used steam. Boilers in those early days were almost invariably fixed below the cylinder of the engine and those in use at Orrell would most probably be of the 'haystack' type, or of the 'wagon' type introduced by Watt. These were heated on their undersides, which were concave and provided with flues spiralling outwards. About 1800 the egg-ended boiler 5 to 6 feet in diameter and 20 to 35 feet long was invented by Woolf, and in 1806 Trevithick introduced the Cornish boiler, a long cylindrical one with a single internal flue and furnace. Fairbairn improved on the latter in 1844 with the highly successful Lancashire boiler, similar to the Cornish type but larger and fitted with two flues and two furnaces which could be fired alternately. All these types were used by Blundells and indeed some ancient boilers were to be seen 40 years ago doing duty as water tanks.

At Pemberton colliery in 1895 there were 23 Lancashire boilers, 4 egg-ended boilers and 2 small vertical boilers. By 1920 an immense steam raising plant consisting of 36 Lancashire boilers was in use. Many of these were modern and fitted with forced or induced draught systems. The great billowing plumes of thick black smoke from the high chimneys, the clouds of steam and staccato sounds from the numerous exhausts and all the hissing, blowing off, roaring, grinding, banging and clanking gave an impression of power not to be experienced and difficult to imagine today.

The first electric lighting set at Pemberton was installed in 1891 by Mercier, Corlett and Co. of Wigan. It consisted of a Crompton dynamo driven by a steam engine with an inverted 12 inch cylinder placed on a stand. In about 1900 a small engine house was erected near Prince Pit and two identical high-speed single cylinder engines driving DC generators were placed in it. Some years later the same two lighting sets were installed in a new power house adjoining the by-product plant, which also housed two 550 volt AC generators driven by Bellis and Morcam compound steam engines. These in their turn were replaced in 1918 and 1928 by two much larger Crompton generators driven by 300 and 400 horsepower gas engines built by the National Gas Engine Co. and supplied with waste gas from the coke ovens. These were discontinued in 1937 and subsequently all the electricity required was supplied first by Wigan Corporation and later by the NWEB. In 1912 the shaft sidings underground were lit by electricity at 220 volts. The only motors were on the surface, the total horsepower being 381 and the voltage 550. By 1935 the aggregate horsepower of the motors in use underground was 1,187, while those on the surface totalled 816.

Compressed air was first introduced for power purposes underground at a colliery in France in 1845. The first compressor at Pemberton Colliery was erected 30 years later in 1875. It was built at the Haigh Foundry. The two horizontal steam cylinders were 30 inches by 60 inches and the air cylinders which compressed the air to 50 pounds per square inch were similar. Four air receivers were used in connection with this compressor. The fly-wheel was 20 feet in diameter and 20 tons in weight. It burst in 1899 and badly damaged the end wall of the engine house. The fly-wheel was put back into position and two bosses, in halves, were clamped to the spokes, the spaces between the spokes and the bosses being cemented with iron filings and sal ammoniac. Two underground haulage engines and two pumps were supplied with compressed air by this machine, but when it was decided to introduce coal-cutting machines and secondary haulage engines a second compressor became necessary. This, built by Longbotham of Wakefield, had two steam cylinders 19 inches by 30 inches working through gearing, two air cylinders 20 inches by 60 inches. This was not a success and it was soon replaced by a Daglish compressor similar to the Haigh foundry machine. More and more power was required underground and in 1911 and 1914 two mixed pressure turbo compressors built by C. A. Parsons and Co. were installed. These operated at 90 pounds per square inch and also with the exhaust steam from the winding and fan engines. They

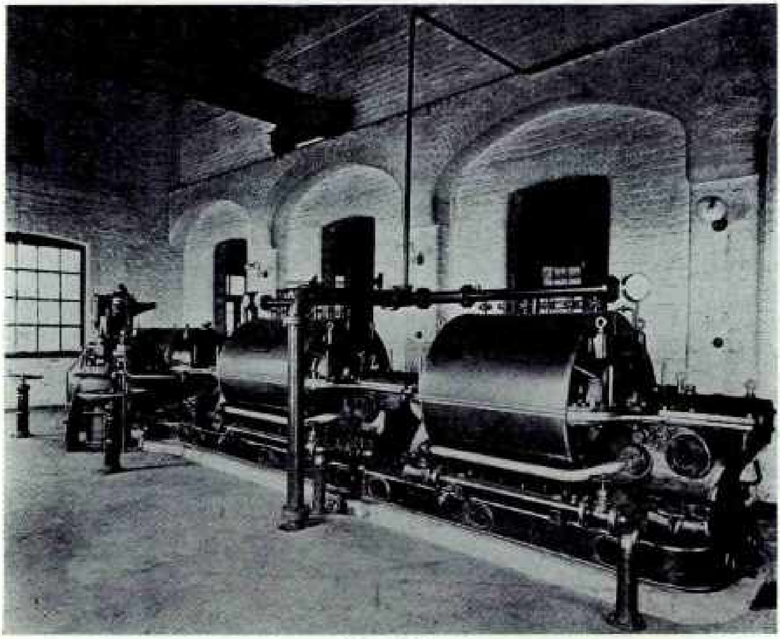


Plate 12.
PARSONS COMPRESSOR, PEMBERTON, 1911

each delivered 5,000 cubic feet of free air per minute. On grounds of economy these Parsons' machines were taken out in 1938, and a 1,075 horsepower electrically driven turbo compressor of 5,000 cubic feet per minute capacity installed. This was supplied by BTH of Rugby. Until its closure in 1966 Summersales, the last of the Pemberton pits, was served by two 199 horsepower 1,000 cubic feet per minute reciprocating compressors built by Alley and McLellan.

Gas was used for lighting from 1863 to about 1900. Armstrong, the Consultant Viewer, told Captain Blundell in 1863 that 'there cannot be a doubt of the economy in many ways of lighting up the colliery shops, pit heaps, and bottom of the Bye pit with gas'. Although deep consideration had been given to manufacturing gas on the colliery, arrangements were made with the Wigan Gas Co., who supplied gas for 4s. 3d. per 1,000 cubic feet.

X PREPARATION OF COAL FOR THE MARKET

Although some of the coal owners in the north east coalfield had introduced screening in the second half of the eighteenth century, the practice in Lancashire seems to have been the riddling of the coal at the coal face by the collier until well on into the nineteenth century. This was definitely the case at Blundell's collieries, where the colliers used a riddle of one inch mesh. Much of the slack was stowed underground, but there was a limited market for it which increased very considerably after 1794. During 1788, for instance, house coals brought in £9,737 9s. 11d. and 'sleck' £7 17s. 10d., but in 1800 sales of house coal had almost trebled to £27,308 5s. 3d. whilst slack sales had increased 140 times to £1,111 11s. 3d. This would most likely be Orrell Five Feet Slack which had a high calorific value. Some Orrell Four Feet Slack was raised for coke burning and sales of 'coal charcoal', as it was known, brought in £136 19s. 3½d. in 1792. Orrell Five Feet was often sold separately as 'Smiths Coal' and during the same year £798 18s. 0½d. was realised from this.

The coal had to be riddled a second time on the surface before it was loaded into wagons or carts. As late as 1853 Armstrong remarked on this—

> The coal all riddled underground by hand labour and again reriddled from the heap on the brow with the waste occasioned. I would advise that the riddling cease underground and three or four screens be erected on the brow at an elevation to admit of wagons receiving the slack, over which screens the round coal may be more effectually cleaned and separated. An apparatus worked by the Engine and communicating with the Heap would be useful for rescreening these coals—this might be attached to one screen and be made self-acting.

However, riddles were still in use at the coal face at Pemberton in 1858 and at the Winstanley No. 5 pit the colliers were riddling the coal as late as 1891.

Screens were erected at the Venture Pit at Pemberton Colliery in 1858. William Greener noted in his diary for 22 May that year that he had 'stopped work in the Low Venture to erect the screens'. On 24 May they put up the 'Out Sett'. He went on holiday and on his return on 16 June noted that they had got both screens and the gangway up. These would be simple bar screens. An old photograph of this pit shows that the small coal from the main screen was drawn up an incline in a tub and tipped over a second screen. The tub was drawn up by a rope connected to an extension of the winding drum shaft. Earlier in the year Greener had raised the pit brow at the Top Venture Pit, probably in order to fix screens there.

It has been stated that the Marsh House washery erected by Wigan Coal and Iron Co. between 1880 and 1885 was the earliest coal washery in the country. More than 20 years before this Greener installed a washery. On 16 January 1858 he was 'over at St Helens, seeing Robinson about the washery apparatus, got the specifications of Mr Cooper in which James Morrison has an interest, also Mr H. Mackworth.' Three months later he had a washery in operation as Armstrong told him that 'the apparatus I was using was an infringement upon Ball and Green's and advised me to write to Mr Greenwell respecting Mackworths.'

Robinson washers were still in use in the twentieth century. All the slack for the coke ovens was washed. In about 1875 a long trough washer was erected to serve the new pits and was described as follows:

> The first process is to size the coal so that it may afterwards be more effectually cleaned by washing; this is effected by a rotary screen placed at the top of a high building. The rough slack is taken by an elevator up to the screen which divides it into nuts and slack. The nuts are washed separately in a trough 297 ft. in length which is first single and afterwards divided into two; the washed nuts are sold.
>
> The slack troughs are placed three feet lower dividing at the top into two and later on into four troughs; the length of the slack troughs is 374 feet.
>
> The slack is floated by water to the bottom of the troughs but the heavier stones and brasses lodge behind the vertical stops placed in the troughs, the washed slack is afterwards raised by a travelling band of gauze and delivered to the crushers, which consists of two pairs of edge runners and a revolving pan. The crushed coal is raised from thence by a bucket elevator to a hopper and may then be run at pleasure into V shaped tubs of iron adapted for charging the ovens at the top. A horizontal engine is placed in the high building which works the first elevator and the rotary screen, another engine at the lower end works the gauze belt, the crusher and the second elevator. The coaly water discharged at the lower end is run back in pipes to a point at the upper end where it is raised by a pulsometer pump to the head of the troughs to be used again.

Up to 800 tons per day were put through this washery. It had superseded a very old trough washer where the coal and dirt was agitated by men with rakes. King and Queen Pit brows and screen buildings were very well designed and architecturally pleasing. They cost £6,760 to erect in 1870. King Pit buildings were mostly of the yellow sandstone from the sinkings, with red sandstone dressings, whereas Queen Pit buildings were an elegant wrought and cast iron structure.

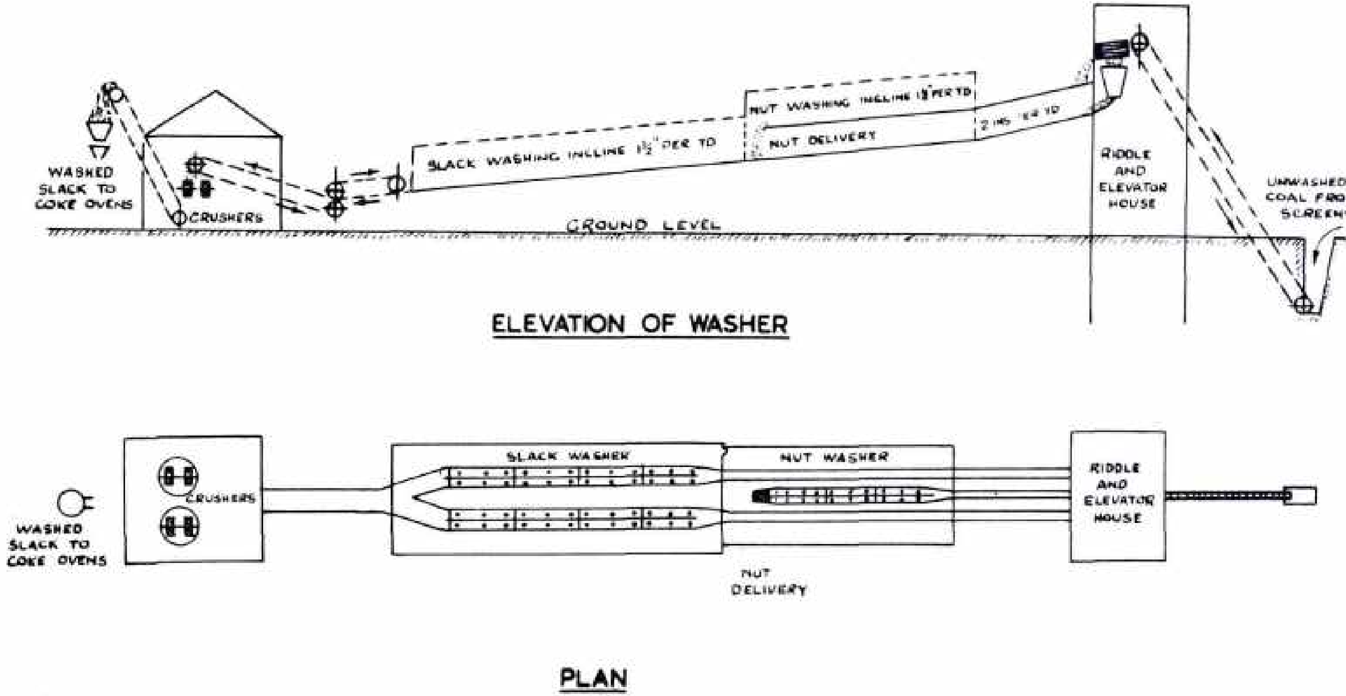
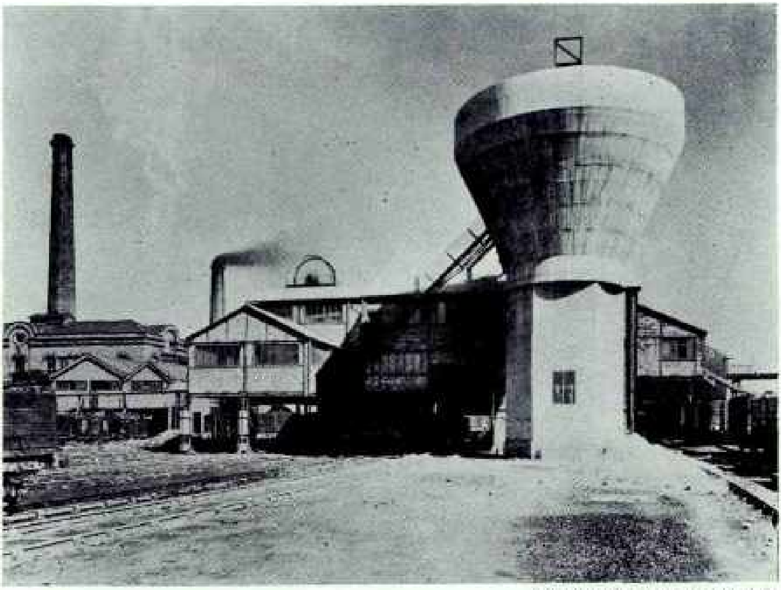


Figure 21.
TROUGH WASHER AT PEMBERTON, 1880

The original screens at King and Queen Pits were of the fixed bar type, three on each side of the shaft. The picking belts at the foot of these screens were an innovation at the time. They were fourteen feet long and consisted of flat endless hemp ropes fastened together by iron bands. As each tub was discharged over the screen the belt was thrown into gear. A door at the bottom of each screen controlled by a lever allowed the coal to fall thinly on to the belt. Two women, one at each side, picked out the dirt from the coal. The small coal dropped through the screen into a pit from whence it was removed by a screw conveyor. It was then lifted up to a second screen by a bucket elevator where the duff was taken out.



Photograph by courtesy G.E.C.

Plate 13.

CHANCE COAL WASHING PLANT, PEMBERTON, 1935

Improvements were made from time to time. After 1893, mechanically operated tipplers, shaker screens and long woven wire picking belts fitted with loading booms were all introduced. The washery was improved by the installation of moving stops or scrapers which travelled against the stream of water and coal and carried the dirt to the top end of the trough. An additional washery was erected at King Pit to wash the Wigan Four Feet slack. This was similar in principle to the other except that travelling trays instead of stops carried the dirt up against the flow of water and coal. In 1935, to clean the dirtier seams then being worked, a Chance-Rheolaveur washery with a duty of 135 tons of minus 10 inches raw coal per hour was erected. The last screening plant put up by Pemberton Colliery Co. was that at Summersales. It was manufactured by Norton-Harty and consisted of a mechanical tippler and double deck screen driven by a 30 horsepower motor. The slack dropped into a hopper, the cobbles on to a plate picking belt and the large coal on to a bar picking belt.

XI COKE BURNING AND RECOVERY OF BY-PRODUCTS

The manufacture of coke, coal charcoal or cinders as it was known locally, was carried on by Blundell's from the late eighteenth century. The simple form of Beehive oven came into use during the last quarter of the eighteenth century, but coke was also made in mounds or heaps in the open air, a portion of the heap being allowed to burn away completely to supply the necessary heat. The low yield of coke, however, condemned the open mound, and attempts were made to improve the process by confining the coal within walls, the necessary air for combustion of a portion of the charge being better controlled by means of dampers and flues.

In the enclosed beehive type of oven the volatile matter, hitherto completely wasted, was burnt inside the chamber supplying a great portion of the heat, formerly obtained at the expense of the coke itself. A battery of twenty of these ovens was erected at the Bye Pit at Pemberton in the early nineteenth century. In 1853 Armstrong, the consultant engineer, suggested the erection of new ovens at the Low Venture Pit—

> These I would construct after our 'North country plan' say 10 as an experiment from which excellent coke would be manufactured from the 4 Foot Orrell smalls—each oven capable of turning out 6 tons per week and if sold at 9s per ton would form a most profitable investment.

These ovens were eventually built near the Bye Pit instead of near the Venture. Ten years later Armstrong again advised the erection of more ovens—

> To coke the 5 foot small 20 additional coke ovens should be erected near the present plant to avoid surface damage, these should be flued and chimneyed in the usual way. It would be desirable if all the Orrell small and any other small convertible into merchantable coke be put into this shape thus avoiding the accumulation of unsaleable slack.

This beehive coke plant was extended and some of the old ovens were replaced until, in 1890, there were 118 ovens, 11 feet in diameter and 7 feet high. They were arranged in two double rows, each row having a middle flue which was connected to two high chimneys after passing underneath two egg-ended boilers. The connection of each oven to the flue was controlled by a damper. The inner lining was of refractory brickwork (these bricks being obtained from Pease and Partners of Durham), and to retain the heat the space between the lining and the outside walls was filled in with solid brick work, although at other plants a cheaper filling of brickbats or slag was used. The doorway was partly built up, and to make coke a charge of slack was fed into the oven through a hole at the top by the hopper trucks. The heat retained in the oven brickwork was generally sufficient to start the action, but the burner always placed a red hot railway fishplate in the charge. The charge was then levelled and the door built up. For a few hours the gas came off slowly but was not of a quality to ignite, but after a while the gas came more freely and at this stage a little air was admitted above the charge to burn the gas, the heat from this combustion being reflected by the roof on to the charge below. The heat from the oven gradually increased and the whole of the volatile matter was finally expelled. This required about three days, and during the last portion of the coking the door was thoroughly daubed with a mixture of clay and ground ash to exclude air entirely in order to avoid undue loss of coke. When all traces of gas was absent the mass of incandescent coke was quenched inside the oven and the charge was then raked out.

Attempts were made to recover by-products in ovens of the beehive type and about 1870 extensive trials were made by the Wigan Coal and Iron Co. and later on experiments were made at Pemberton Colliery. However, the retort type of oven with narrow chambers was being developed on the Continent at the same time and proved so successful that in 1870 the first battery of these in Britain was put into operation near Sheffield. Various types were developed, one of the most successful being the Semet-Solvay. About 1893 J. H. Darby,[6] who was managing director of the Brymbo Steel Co., obtained a licence from the Belgian firm of Semet-Solvay to build their by-product ovens in this country, and in 1904 he erected a battery of 23 ovens of that type at Pemberton Colliery for the production of furnace coke. Plant was also installed for the recovery of tar, ammonia *etc.* The ovens were chambers covered by strong arches carried on solid sidewalls. They were slightly over 30 feet long 6 feet 6 inches high and about 16 inches wide. The whole battery was

[6] A descendant of Abraham Darby, the iron master reputed to have been the first, in 1709, to use coke to smelt iron ore.

built on a raft of concrete 4 feet thick. The system of ironwork ties and supports was very thorough and substantial, and the door-frames were heavy castings extending to within touch of each other and held by buckstaves and strong tie rods in such a way as to form a complete shell of ironwork enclosing the battery. Two cranes, for lifting the doors to open the ovens, ran along tracks on top of the ovens at each side.

The original battery at Pemberton cost over £20,000 and the output of each oven varied from 40 to 50 tons a week. The washed slack was compressed by stamps in a charging machine which charged the ovens. The track for this charging machine, or ram, was fixed on a very old battery of beehive ovens which had been filled in and made solid. The gases leaving the ovens were conducted into a hydraulic main which was fixed on top of the ovens and through which a large circulation of liquor was maintained. A gas exhauster drew the gases out of the hydraulic main, when they were further condensed and the remainder of the tar and liquor extracted. The gas was afterwards returned under a slight pressure to heat the oven flues by means of burners. The heated gases passed through the side flues along the sides of each oven, thence through the flue under the oven floor to the chimney. The surplus gas remaining after this was eventually used for driving two large gas engines. The battery was extended until by 1923 there were 40 ovens, and plant had been erected by Simon Carves for the recovery of Benzol and Toluol and the extraction of sulphates and napthalines.[7] The gas exhausters were of the Rateau turbo type made by the Bryan Donken Company of Chesterfield, and other plant for the recovery of the by-products was supplied by R. &. J. Dempster of Manchester. The plant ceased operations at the beginning of the Second World War and was then dismantled.

XII TRANSPORTING THE COAL

Mention of Blundell's first wagon way in a contemporary advertisement dates its construction sometime before November 1776. The gradient was in favour of the loads and 28 horses worked this line in 1780. There were 13 coal wagons with iron wheels, three 6 inch wheel carts, one wagon with broad and narrow wheels, a lime wagon and a 'weigh engine'. Angle or flange rails may have been used on this road as a large quantity of these were found in one of Blundell's old shafts on the site.

[7] The liquor which remained after the ammonia was recovered contained various free acids. After filtration it was conveyed into old workings in the Ince Seven Feet Seam at the outcrop near the Bye Pit lodge. These workings did not connect with other workings at the colliery.

They were 3 feet long, and 3½ inches by 3½ inches angle, 1 inch thick. They contained three spike holes, one at each end and one in the middle.

Plate 14.
STONE SLEEPERS
Orrell-Winstanley colliery railway, close by and similar to Blundell's early railways. Lancashire's first steam locomotive ran on this track in 1813.

Several other wagon roads were constructed by Blundell in Orrell. Some were joint lines with other coal owners. For instance there was an agreement between Hustler and Blundell for the construction of wagon ways over the lands each other had in lease 'for the purpose of conveying the coals of each to the River Douglas and Leeds canal.' A dispute arose in the 1790s when Holt-Leigh objected to Blundell's conveying of coal from the colliery on the Duke of Bridgewater's estate in

Winstanley over his land. The first railway at Pemberton was constructed in 1827 of iron rails and stone sleepers to a gauge of 4 feet. There was a gradient in favour of the loads which averaged 1 in 80 from the Bye Pit to the Pier head at Seven Stars, Wigan. There were branches to the bottom Venture, No. 11 and Farrymans Pits, the distance from the latter to the canal being 3,300 yards. A wagon way belonging to Martha Ann German, a neighbouring coal proprietor, ran closely parallel to Blundell's line through what is now known as the Newtown district. When the Liverpool-Bury line was built in 1841 Richard Blundell constructed a new system of wagon roads to the standard gauge of 4 feet 8½ inches. These roads were originally laid on stone sleepers, some of which are still to be seen near the site of the Tan House Pits at Pemberton.

Locomotives were purchased to replace horses,* and by 1852 three were in use at Pemberton. At that time the rolling stock consisted of 389 wagons, mostly with a capacity of 3½ to 5 tons. *Henry* was one of the early locomotives, a four wheeler with two 9½ inch by 14 inch cylinders. Hunslet locomotives *Queen* and *Pemberton* were purchased in 1870 for the new pits, and *King* was built in the colliery workshops in the 1890s. All these were four wheelers with 14 inch by 20 inch cylinders. Other locomotives were *Prince*, a Peckett six wheeler bought soon after 1900, and Avonside locomotives *Douglas* and *Blundell* purchased in the 1920s, also six wheelers. By 1900 most of the wagons were 8 and 10 tonners, although a few 5 and 7 ton wagons were still used. During the peak years at Pemberton nearly 2,000 wagons were owned by the company, and 17 miles of sidings were maintained by a staff of six plate layers, mostly main line trained.

ACKNOWLEDGEMENTS

I am greatly indebted to my father, Mr James Anderson, whose detailed knowledge and experience of Pemberton collieries was most valuable. He worked at the colliery from 1896 to 1946, nearly forty years of which he spent as an official.

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* Horses were still used for shunting at the Miry Lane Depot until it closed in the early 1930s.