Henry Baker's brief History of Conisborough, Brinsworth and Kilnhurst

This document has been copied from Henry's original typescript apart from pages 5, 6, 8 and 11 which had faded and which have been retyped and reworked to resemble the original as closely as possible.
When John Baker started at Conisborough in 1874 he set out to forge his own axles and make his own what were called cold spoke wheels with cast iron bosses. He erected a small cupola to melt his blast furnace pig iron. The spokes were bought in long lengths thus and had to be sawn into suitable lengths.

These were rolled wrought iron bars about 3 1/2 inches wide and thickened in places to form the rim of the wheel.

They were heated and bent in a press to form spokes. They were then assembled together in a cast iron mould and molten cast iron from the cupola was poured into the centre to form the boss, the hole for the axle being sand cored out. Rolled steel tyres were bought from the big Sheffield firms like John Browns, Vickers Sons & Maxim, and Cammell Lairds. These were machined in the bores and shrunk on to the wheel centre which had been machined on the sides and rim. From time to time spokes came a little loose so to strengthen the wheel John Baker invented and patented a glutting process where a triangular piece of iron or glut at welding heat was put into the circumferential joint, also at welding heat, between the spokes and pressed down. But at this time George Owen of the Patent Wheel & Axle Company, Phoenix Works, Northfield Rotherham, John Baker's former boss, had an even better idea which he patented to overcome loose spokes and that was to make the boss of wrought iron. As for cast iron bossed wheels the cold spokes were put into a bottom die. Two lumps of wrought iron, each about 5 inches diameter and the same length, at welding heat, were dropped into the centre. These had been formed by what was called bustling or welding together under a hammer a mass of W.I. scrap, usually turnings. The dies were closed by bringing down a top die in a press with a load of 500 tons. This press had a ram and cylinder in its base also capable of a force but lower than the top ram, about 400 tons. This ram, when pressure was put into it, forced a punch into the wheel boss centre to within about an inch of the top of the boss. Pressure water was then taken off both cylinders and the press lifted. The punch was now fast inside the boss. A punch was now put on top of the boss of the required boss hole diameter with a smaller follower. Pressure water was then admitted to the top cylinder and the one inch thick plate like disc sheared with the punch below it forced out of the wheel bore, thus completing the operation.
With cooling the boss sides became clear of the bottom die and ejection of the wheel made easy.

When John Baker moved to Brinsworth Works in 1884, due to Owen's Patent, he could not make W.I. bossed wheels. However, when the patent expired he put down a special building to forge these wheels. In it he installed a wheel press as described and used, and a bustling hammer, the hammer which had made W.I. axles at Conisborough and was still making them at Brinsworth. I remember, as a small boy of 5 in 1910 this hammer working. The firework display was spectacular.

My Father, John W Baker, who had been brought up by his Aunt Waudby, his Father's first wife's married sister, until he was 6 years old, moved to live with his Father in Conisborough soon after the latter had remarried and went by train each day to Doncaster Grammar School. At Conisborough in those days there was no piped water and only earth closets and paraffin lamps. All water had to be bucketed from a trough which is still there, alongside the main Rotherham to Doncaster Road and carried 200 yards up to the house. At 14, in 1882, he left school and started at the Conisborough Works. In 1884 he, his Father and Stepmother moved to a large house in Parkfield Road Rotherham, called Florenceville with his brothers and sisters, Henry (Harry), Mary Ann (Siss), George (Dick), Edward (Ted) and Ellen (Nell), who had all been born in the large house in Conisborough between 1874 and 1884. The Rotherham site had been bought from a firm called Armstrong who had manufactured railway points and crossings there and this business was continued for a while by John Baker and then stopped as the wheel and axle business was so much more profitable.

As stated axle forging was done on the 2 ton steam hammer at both works. Wrought iron scrap was faggotted into long lengths which were bound together, raised to welding heat, and all welded together to give the forging a lengthwise grain. (See the advertisement of these axles in my booklet, 'The Steel Bakers of Rotherham'.

Three machine shops were erected or converted for wheel turning, tyre boring and axle turning, together with a pressing on press to force the wheels, which were bored to an interference fit, on to the axles. All the latter were belt driven from countershafts in the roof which were belt driven from two large steam engines, one vertical and the other horizontal - this latter had a condenser attached to its exhaust. The works here was called Brinsworth Works, although it was some way from Brinsworth village, merely because it was in that parish.

After 1890, when my Father was 22, he was often left in charge of the works while his Father travelled to Russia and Finland to secure orders and also to indulge in his favourite hobby of fishing.

Here I must refer my readers to my booklet 'The Steel Bakers of Rotherham' of how John Baker, in 1902/3 decided on an enormous expansion of the business following his purchase of the Kilnhurst site. He went to Dusseldorf and there ordered a 1,500 Ton Tyre Forging Press from Haniel and Lueg (which never broke down), an 800 Ton Becking Press, both with integral steam intensifiers, a Tyre Finishing Mill and Disc Wheel Centre Mill (the first in Britain), both from the firm of Breuer and Schumacher. From Davy Brothers, Sheffield, he ordered a 600 H.P. 3 cylinder vertical steam engine to drive both mills - one from each end. An ingot slicer to cut blocks from ingots was bought from Cravens of Manchester. There were no plans of where this plant was to be laid down when he died suddenly in 1904, but a large shed to house it all had been erected, also from Davy Brothers he ordered a 3 Ton axle hammer to forge axles, not from W.I. scrap, but from rolled steel blooms. There were two large 100 foot high brick chimneys in good condition on the site; relics of John Brown's puddling furnaces
and the position of these largely affected the subsequent lay out of
the plant which must have been very crowded in a small shed. One
chimney was used for the two Lancashire boilers necessary for driving
the mill engine and providing steam for the press intensifiers and the
Siemens Furnace gas producers. George Baker did all the layout
designing for the plant, Edward concentrated on putting down a 25 Ton
Acid Steel making Furnace with its associated gas producers.

I understand the first steel was made in 1905 and the first
tyre rolled the same year. I know little about when the first disc
wheel was rolled, but until the outbreak of the First World War this
was very much in the experimental stage.

Then in August 1914 came the Great War. Business languished
until 1915 when the great call came for shells for the Western Front.
Matters were desperate there, the guns were rationed and something had
to be done urgently. George Baker adapted all the hydraulic presses
on the works to the job of shell making and scoured the country for
more, buying even linseed oil cattle cake presses and altering them to
make shells. More men were called up and an acute shortage of labour
developed which was solved by the employment of women on tasks for
which for over a century women had been thought quite unsuited. At
weekends scratch forging teams of local worthies were got together and
"did their bit" at shell forging. The Government of the day
recognised the vital part the Baker family was playing in the war
effort. John William was given the Honour of becoming an Officer of
the Order of the British Empire, a new Order instigated in 1917, and
he was amongst the first batch of recipients to receive his insignia
from His Majesty King George V. The same Honour was bestowed on his
brother George a few months later.

My brother treasures a personal letter of congratulations and
thanks, written to my Father from the then Minister of Munitions, a
certain Mr. Winston S. Churchill, and signed by his own hand.

In this War the Tyre Press was largely used for forging 9.2
inch Howitzer shells.

All this plant was highly labour intensive and after the end
of the 1914/18 War George Baker realized that much of the laborious
work could be obviated by mechanisation and thus cheapen production
costs. A manipulator was installed to extract the sliced lumps from
the furnace and convey them to to upsetting press. Here hydraulically
operated forks centred the lump and a squeeze was taken down to form a
slab, 1/2 inch more than the finished tyre width. This was then
punched and conveyed to the becking press where the hole was enlarged
and the width reduced so that it would fit into the finishing mill
main roll.

George Baker then set about designing a roughing or cogging
mill to perform the tasks of the becking press. He made to scale in
wood a beautiful model which I saw in 1920. This was complete with
base and an upward sliding table to hold the lower of a pair of rolls.
He then had a brilliant idea, which he patented, whereby, with putting
a slight taper on each roll as the table lifted the tyre being roughed
was squeezed on its width slightly and any scale holes from the
initial pressing removed.
The Cogging Mill

Up to 1920 the firm had to generate its own 230 volt DC supply to drive its electric cranes, but in that year a five mile cable was laid beside the Midland Railway Line from Rotherham power station carrying a 6000 volt 3 phase AC supply. Transformers and Rotary Converters were installed to convert this to 230 Volt D.C. for the cranes, slicer motors, lighting etc. This supply was fed direct to the 1,000 H.P. AC motor on the Cogging Mill.

This mill was immensely powerful and a quite impressive sight in use with steam arising from water being sprayed on to the hot tyre to free it from scale. It was built by the firm of Henry Berry & Company of Leeds (still at this date in existence!) and was so well designed that no amendments were needed and it worked well from the start. The rolls themselves were of cast iron and designed to be easily changeable, as was the gap between them to adjust for different tyre widths. End thrust on each roll, which was considerable, was taken on multipad Michel thrust bearings working in oil baths. These were the invention of an Australian and were first used to take the end thrust on ship's propeller shafts. It was an innovation to use them in the steel industry. As I wrote, this mill obviated the use of the becning press but when I arrived at the works in 1925 this was still being used on narrow tyres such as tram tyres for a reason I did not understand.

The tyre finishing mill from Germany, originally driven by the 600 H.P. Steam engine, was altered in 1920 when the new electric supply became available to a 1,000 H.P. A.C. Motor Drive. This mill was not capable of rolling large locomotive tyres so in 1922 another larger finishing mill was bought from Jacksons of Manchester and driven by a 1,000 H.P. 6,000 Volt A.C. Motor. This mill was rather slow in operation, so in 1948 Sydney Baker installed the original 1920 Bessemer Tyre Mill, built by Brightside Foundry, and drove it with a 1,000 H.P. 6,000 Volt A.C. Motor. On this mill in 1961 were rolled the driving tyres on the Gresley Pacific Loco. 'Mallard', which made the steam record speed of 120 m.p.h. in 1938. This loco has these tyres still on it in the York Railway Museum.

In 1932 Sydney Baker decided to utilise the exhaust steam from the 600 H.P. Steam engine driving the top roll on the cogging mill. T.W. Ward of Sheffield were dismantling at Rosyth, Scotland, the
Cruiser H.M.S. Tiger which had fought at Jutland in 1916. The propellors of this old ship were driven by reciprocating steam engines, the exhaust from which went into a turbine which drove a D.C. Generator for the ships lighting and gun control, and then into a condenser. He bought this set up very cheaply and it was installed next to the old boiler which he used as a Steam Accumulator. He intended to run this to supply D.C. current for the works cranes, lighting etc. together of course with the rotary converters.

With my electrical knowledge I knew something about the difficulties of working D.C. generators in parallel. Unless certain precautions are taken the situation becomes unstable and one or other of the Generators takes all the load and breaks down, so I was sceptical about this. However, to Sydney Baker's great credit he solved this problem by arranging switchgear so that this generator only took load when its voltage was greater than that of the rotary converters and no reverse feedback was possible. This needed very little maintenance and must have saved a lot of money in the twenty years it worked.

In 1952 Sydney Baker achieved another big saving by doing away with the 600 H.P. Steam engine to the cogging mill top roll. This drive had to be a variable controlled speed one, so a fixed speed A.C. motor was unsuitable. The original 600H.P. D.C. motor from Bessemer's Tyre Mill bought in 1929, was available and was fixed in position and switchgear provided with a visible load indicator so that the man controlling its speed could adjust it so that it took its share of the load with the 1000 H.P. motor driving the bottom roll. This innovation worked excellently.

Before the first world war the Disc Wheel Mill, driven at one end of the 600 H.P. Steam Engine, had been little used but George Baker has other ideas for it. He had an idea for making Disc Wheel Centres Form Cheap Sheared Square Steel Slabs. How cheap these were will be illustrated that in 1938 we were buying these slabs at 6 a ton delivered Kilnhurst from Appleby Frodingham Steelworks at Scunthorpe. The idea was to round the square slab under a type of fuller tool in the form of a cross with upward sloping sides between the cross arms and a boss cavity in the middle.

![Fig. 1](image1.png)  ![Fig. 2](image2.png)

From previous experience George Baker had found that the 1,500 ton press was inadequate to do this so he sought around for something more powerful and found it. In 1910 Darlington Forge decided to scrap all their steam hammers and replace them with hydraulic presses. One as 15 ton Hammer called "Tiny Tim". This huge relic of Britain's industrial past has marks on one of its legs "Glasgow 1883, Rigby's patent valve gear." That year it was bought and erected at Darlington Forge, County Durham.

Basically it was a 15 ton drop hammer but with Rigby's valve gear, on the first fall of the downward stroke the high pressure steam in the bottom of the cylinder was diverted to the top side of the piston to give added impetus and then after to atmosphere. It was very wide between the legs, about 20 feet. The reason for this
was that Darlington Forge used it for making ship's stern frames so had to swing the forging sideways at times. George Baker bought this hammer in 1910 for only £250 which even in those days was very cheap because the hammer itself excluding it's blocks, weighed over 100 tons. There was a cogent reason for this, the site had to be completely cleared and this meant excavating and lifting the three 40 Ton Cast iron blocks, one on top of another, beneath it and loading on to railway wagons for transport to Kilnhurst Steelworks.

In those days there was no heavy lifting tackle capable of lifting and it all had to be done by the arduous process of jacking. It took 2 years to transport and re-erect and in 1912 the writer as a small boy of 7 was taken to witness its impressive performance: little thinking that 18 years later he would be in charge of the forging team which worked on it and which has resulted in his present severe deafness, for there were no ear muffs in those days and industrial deafness was unheard of. It could be heard 600 yards below in the workings of Kilnhurst colliery and the vibration was so great that drinking glasses at the works canteen 250 yards away used to dance off the tables.

When Baker Bessemer was nationalised in 1951 and later in 1963, bought by a consortium of the United Steel Companies and English Steel Corporation and closed down in 1964 they gave "Tiny Tim" to Beamish Museum County Durham where it now forms an impressive entrance arch to the museum grounds. The three aforementioned 40 Ton blocks still remain "in situ" on site to puzzle some archaeologist in the distant future.

At Kilnhurst "Tiny Tim" was first applied for making a forging from a sheared square slab by striking with a cross on the corners of the slab. Material flowed laterally across the narrow arms of the cross and up the sloping faces of the cross between the Cross as shown in Fig.1 above. A rack mechanism then turned the bottom tool and the material between the arms of the cross hammered down into this bottom tool. Whilst still hot the little surplus flash over the edges of the tool was cut off by a rotary shear rather like a tin can opener. A batch of these forgings were made and the hammer tools changed to those in Fig.2 on page 5 which formed the wheel rim into a shape suitable for rolling. The forgings were then taken across to the Tyre Forge where the Wheel Mill driven by the 600 H.P. Steam engine was still situated. They were reheated and rolled. All this carrying and reheating was very laborious business so I doubt if many disc wheels were made before 1922. In 1920 a new use was found for "Tiny Tim". This was the forging of turbine rotor discs which held the vanes, for turbine makers like Fraser and Chalmers, Hick Hargreaves, and G.E.C. These were forged up to 56 inches diameter and only 2 inches wide by using a narrow, about 6 inches wide by 5 feet long tool used as a fuller and turning between each stroke.

In 1922 the Wheel Mill was moved from the Tyre Forge into the shed with "Tiny Tim". The elaborate bevel gear drive to its two conical rolls was substituted by a direct drive from one of two 300 H.P. 150 R.P.M. A.C. Motors supplied direct at 6000 volts. Because of the slow speed the rotors of these had to be 6 feet diameter. They were made by English Electric at Stafford. The air gap on these was as little as 30 thousands of an inch so wear on the ring bearing had to be carefully watched. A large reheating furnace was built to heat the square slabs which were pushed down the sloping hearth by a hydraulic ram.

A very ancient 1,800 Ton Press was bought from Thomas Firth's of Sheffield erected and made the forgings as shown in Fig. 1. This press was unsatisfactory for several reasons.

In 1915 prior to the Gallipoli landings an effort was made to force the Dardenelles by a number of warships. Prominent among these was the then new Battleship Queen Elizabeth, (28,000 Tons) mounting
15 inch guns. To the surprise of all, these proved ineffective in silencing the guns of and reducing Fort Helles, at the entrance to the straits, which was why a landing had to be made later. So it was decided to fit the Queen Elizabeth with 18 inch guns. To forge the shells for these Hadfields of Sheffield made a 2,500 Ton Press complete with a 6/1 Ratio hydraulic intensifier. The landing in April 1915 resulted in the loss of many lives and resulted in stalemate, so troops were withdrawn in January 1916 before this Press could be used. It was installed at Harper Bean's Works at Dudley and was for sale at £10,000, complete with intensifier, in 1919. It remained unsold for 8 years when, in the depression period in 1926, George Baker bought it for £2,500 - a tremendous bargain. Because it had to punch and draw these huge 18 inch shells it was very high. Shorter columns were made for it and it was installed in 1929 in the Wheel Forge. It had one serious failing. The main cylinder was cast steel and had a flat end. Every three or four years it burst the end off due to Corrosion fatigue on the corners.

A replacement was made in cast steel again but this failed. It was replaced by a forged steel one but this similarly failed and was replaced by a cast cylinder with a domed top. This again failed as shown (page 7) and was replaced by a forged steel one.

This cylinder then failed by bursting longitudinally after about 5 years, although 5 inches thick. This Press had another failing. Although the column ends were bored for about 2 feet with 2 inch diameter holes so that a steam jet could be inserted and the columns heated while the nuts were inserted on them and tightened so as to give a shrinkage when the column cooled, the nuts came loose because, during forging, the compression between the collar on the column and the top entablature lessened permitting sliding between these two surfaces which eventually caused wear. This put the 2,500 ton stress on 2 columns only which broke from time to time.

I decided to deal with both these problems at one and the same time. Two inch thick, five inches wide, steel rings were shrunk over the whole length of the cylinder to pre-stress it. This needed a new top entablature (weight 30 tons) to accommodate the larger diameter cylinder.
At the same time on the old press base and the new top entablature conical seatings were machined on the column holes with a 10 degree cone and the same on the column collars and the nuts. For the next 14 years until the steel works closed, we had neither of these troubles.

Previously in 1942 in the middle of the Second War, when the forge was on three shifts making small wheels for the Churchill Tank the inner cylinder of the intensifier burst its top containing the gland. This weighed 12 Tons. It was decided as a temporary measure to screw in a forged steel gland. This necessitated sending it to Davy Brothers in Sheffield for boring out. Pickfords had no lorry available to handle this weight so sent a steam traction engine and trailer on to which it was loaded. It left at 7 p.m. I was phoned at home by the police who informed me that in climbing the steep hill to Rawmarsh it had slid off the back of the trailer and was lying in the road without lights - would I please remove it - another problem.

In 1952 the top entablature of the dishing press with its integral cylinder broke in half, this press was used to put a dish or cone and corrugation on the web of the wheel to give lateral stiffness and diametrical resilience. A replacement was found at Brinsworth and fitted in 5 days.

In 1927 George Baker had bought the failing wagon building and wheel assembly business of Harrison and Cam alongside the Meadowbank Road Rotherham. It was failing because a young man of 30 called Craven from Craven's Railway Carriage Works at Darnall had been brought in to manage this business and had set about a profligate expansion scheme. He devised a process to make solid wheels with out the rolling process. He designed and had made by Hadfields a multiram 4000 Ton hydraulic press consisting of a group of 3 cylinders cum rams one inside the other.

He had made a model of this press and did experiments on it using lead instead of hot steel. It seemed to work. Placing a hot lump of steel sliced from an ingot on to the bottom tool placed a
plain slab of steel on top and with the hydraulic feed pipe lifted he applied water pressure to all three rams at once and forced steel into the bottom die and formed the bottom boss. The flat slab of steel was removed. The feed pipe had a division in its centre dividing it into two. One half had it's bottom end closed and a slot part way down on side connected it with the exhaust and enabled the outer cylinders to be emptied. The next stage was to lower the feed pipe so that water pressure was applied to the innermost cylinder and central ram only. This central ram was forced down and formed the top boss of the wheel. As far as I could see there appeared to be no stroke limiting devices. The feed pipe was then lifted slightly and water pressure applied to the intermediate cylinder and it's ram was forced down to form the web of the wheel. Then the feed pipe was lifted again to feed pressure to the outer cylinder and ram which was forced down and formed the tyre portion and flange of the solid wheel. In theory this was an ingenious device but it was a complete failure. Craven cannot have had even an elementary knowledge of high pressure hydraulics for, of course, the whole idea was preposterous. All the water seals were simple U leathers and all repeatedly failed. You cannot seal high pressure water in at 2 lbs per square inch pressure with simple U leather seals. Craven had put down high pressure hydraulic pumps (so did not need an intensifier,) an ingot slicing machine and a 15 Ton Acid Steel Furnace to make his steel. When the wheel making process failed so did the whole business which had cost a lot of money.

George Baker bought it cheaply in the middle of the trade depression in 1929. Kilnhurst Steelworks got the new ingot slicer and the 4,000 Ton Press which was fitted with a single 50 inch diameter close grained cast iron ram. The top entablature, which formed the integral top cylinder, was bored to form a proper gland or stuffing box capable of being tightened as the packing wore. This press did yeomen service for the next 37 years but was only just powerful enough to make the blanks of rolled steel solid wheels which really requires 6/8 thousand tons. Yet it was used to forge the small, only ten inch diameter Churchill Tank bogie wheels during the Second World War. Then, however, due to all its, 4,000 tons being concentrated in the centre of it, the base broke in half at a critical time when the forge was on three shifts. The broken base was tied together by 12 inch diameter tie rods each side joined by two 18 inch square beams 9 feet long.

![Diagram of 4,000 Ton Press Base with fracture and dimensions](image)

The tie rods were heated by gas flame on tightening the nuts. This patch was completely satisfactory and worked for the next three years until a new base was obtained and fitted after the war.

In those days all heavy lifting had to be done using a 70 feet
long steel lattice pole which, at every breakdown, had to be lifted vertically using a 40 feet long wooden pole. The lattice pole was held upright with guys attached to hand winches to enable us to alter the position of the load. With this we could lift 30 Tons but it was a slow business. Of course there were then no mobile cranes one could hire as can be done today.

In 1931, when I had been in charge of the Wheel Forge a year, an order was taken for solid wheels - that is tyre and wheel centre and boss all in one piece. This order was taken for brake vans which had always suffered from loose tyres, due to braking heat expanding them, and solid wheels seemed to offer a solution. Considerable alterations and to be done to the presses and mill to enable us to make these.

Until the War came in 1939 we had always made disc wheel centres from the cheap square sheared slabs from Scunthorpe. Converting these to round wheels involved many weight calculations to ensure filling the boss, web and rim of the wheel all at the same time. These had to be extremely accurately done. The supply of these slabs ceased once the War started and I had to learn how to make disc wheel centres from round lumps sliced from ingots in which my knowledge of making solid wheels was very helpful. It was much easier than making them out of square slabs.

In 1937 George Baker heard of a 10,000 Ton Press available for sale at the Butler Works of the American Rolling Mills Company. It was one of two identical presses designed and built in 1918 to make the forgings for solid wheels, prior to their rolling, out of square sheared slabs by a similar method by which we made disc wheel centres. This process failed because sometimes the pipe of the ingot, due to not cutting off an adequate discard, came out on the tread of the wheel and the result was not acceptable to the railways. Only once did I find a similar happening in our disc wheels made from slabs; but with these there was no risk of trouble in service because they were bound with the tyre. George and Sydney Baker and their wives went to see this Press in 1937 and bought it. I saw it's mate working when I visited Pittsburgh in 1947 and saw how easily 10,000 Tons could forge a wheel blank. The top entablature of these presses and the base each weighed 105 Tons. The columns weighed 25 tons each and were 24 inches diameter by 30 feet long. With the lifting cylinders and their rams the total weight was 500 tons. I never learned how much was paid for it. It came over by Cargo boat and it was found that only one port in the British Isles had a crane capable of lifting over 100 Tons and that was at Hull. These castings were so wide that it had to come by rail on a Sunday with one way traffic on the railway. When it arrived we had to set about unloading it with jacks and winches as quickly as possible because of high demurrage on the special wagons used. It was conveyed to it's site about 200 yards away on axle blooms as rollers on rails resting on wooden sleepers and pulled by winches.

This operation went extremely smoothly due to the long experience of those involved in moving heavy weights. On the site had been erected 4 steel lattice columns about 50 feet high. These were joined at the top by girders which had a bogey on rails on them. The columns were distanced apart over twice the width of the top entablature and base, each heavy casting in turn was put alongside its final position. Huge concrete foundations had been prepared for the Press. The base was first lifted using 4 Pulley blocks suspended from the bogey above and attached to the 4 corners of the casting. The four ropes from the pulley blocks were connected to four hand operated winches. It was lifted off the ground, the bogey, with it's suspended load, was traversed along till it was over the final resting place of the casting which was then lowered down to rest on four column nuts beneath. Then the 4 columns were each lifted in turn carrying one
base nut and dropped through the holes in the base and screwed into the bottom nuts. Then in turn the crosshead, ram, cylinder and top entablature were lifted and lowered over the columns with the intermediate nuts (each weighing 2 tons) being screwed on at the appropriate places and finally the top nuts. This whole job was a real 'Tour de Force'.

When George Baker was told by the Americans that it regularly broke one or other of its 24 inch diameter columns he decided to reduce the stress on these by working it as a 6000 ton press. This erection was completed when the war started and a massive accumulator was constructed with a new piston and cylinder - The dead weight itself being provided by the old 1,800 Ton Firth Press Base, crosshead and top entablature spaced apart by its columns and nuts and the spaces between filled in with pig iron. Yet another example of George Baker's resource and ingenuity.

Completion of the working of this as a Wheel Press stopped with the War so the high pressure pumps and accumulator had to wait till after the war. However the press cylinder was coupled to our works 750 pound per square inch hydraulic supply with controlling valve gear which gave us a Press capable of a 1,300 ton squeeze. With this we forged some 9.2 inch howitzer shells. But the demand eased for these heavy shells. However another use was found for it.

Hadfield's had produced a special armour plate for Tank Turrets. These were rolled as slabs and required bending to shape. Six of these welded together made a turret. This press bent many of these plates for Hadfields.

About 1947 this press was ready to forge wheels. In using it we soon found we had another unexpected problem. The ram head was a separate casting form the ram itself. It was cast iron and had a simple groove around it's periphery which was wide enough to hold 6 rounds of chevron packing but with no means of tightening up when the chevrons wore. See Stage 1 below. The ram head weighed about 8 tons. So we made an adjustable gland with a ring capable of tightening the packing as shown in Stage 2 above. While this was a great improvement the packing still did not last very long and its renewal was very expensive. The ram head and the ram itself were removed and the cylinder bore examined and it was found to be rough and showed serrations caused by some years of work in the U.S.A. before we bought it. I suspect that they sold us the worst worn one of the pair. Our resourceful youg Chief Engineer L. Raynor, decided to undertake the very formidable task of grinding the bore 'in situ' of
this huge 6 foot diameter bore cylinder which weighed 40 tons and had a twelve inch wall thickness. He devised and arranged a machine whereby a grinding wheel could be moved in three dimensions, so that the wheel could be fed into the cylinder, rotated round it and moved vertically up and down. A very creditable achievement which solved our leaking packing problems.

The press had sufficient power to forge a wheel blank complete with flange at one squeeze and did not need a second to form the flange using an inserted ring as needed on the less powerful 4,000 ton press but it could not punch the hole in the blank so an old shell forge press was erected to do this. But this raised another problem - handling all these operations quickly. In this year, 1947, I had visited Blaenavon Steelworks, South Wales where they had a new wheel mill with a splendid plant but, for reasons explained in another paper, could not work it successfully. I predicted bankruptcy in two years and this happened. So I visited Blaenavon again and bought their almost new manipulator very cheaply to use alongside the existing one to serve the three presses. L Raynor adapted this to our use with the presses.

However, the extra output this manipulator achieved raised another problem at the other end of the wheel making process. We needed another manipulator at the wheel end. The one machine there was acquired from Henry Bessemer in 1929 on the takeover together with two ingot slicers and their tyre finishing mill with its 600 H.P. D.C. motor already mentioned. This manipulator was extremely versatile in its motions and I put it down in 1932 where it did away with the hand bogey handling of wheels. It was made by Wellman Smith Owen.

So the American Press with this limitation at the mill end really only gave us an output increase of about 30% reaching an output of 240 fifteen ton wagon wheels a shift, and it is doubtful if it ever justified its purchase and the heavy cost of transportation and installation. We never got down to the purchase of the extra manipulator required, due to what would have been a very costly machine, before the works closed in 1964.

On re-reading this paper I have thought that perhaps I have laid too much emphasis on the number of breakdowns we had but these illustrate the resource and initiative required to effect their urgent repair. There is a cogent reason for these. Although much of the plant was bought cheaply secondhand the original purchase cost when new must have been high. This applies to all heavy steelworks plant and undoubtedly in order to make it economic our hydraulic plant was heavily stressed and this was the true cause of its failures. It is to be hoped that in the atomic energy plants, such as the pressurised water reactors stresses are kept down and high tensile steels used, including stainless, to prevent corrosion fatigue.

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