1st. Break Roll

The 1st. Bk roll is where the wheat enters the milling process. The wheat enters the feed hopper and then passes to the feed roll which spreads the wheat across the fluted rolls. Rotating at different speeds, these tear the grain open. From here it falls into a hopper beneath the rolls and then into the elevator boot which takes it up three floors, to the plansifters.

Wheat is fed into the feed hopper by means of the three wooden spouts coming from the clean wheat bins. Each spout has a slide to adjust the flow into the hopper to spread evenly across the width of the hopper. When leaving the feed hopper, the width of the gap through which the wheat passes can be adjusted by the small levers at the side.The wheat then passes onto the feed roll which is about 3 inches (75 mm) diameter and fluted at around 4 flutes per inch (25 mm), running about 150 rpm. This drops the wheat at a regular rate into the nip between the two rolls. Each of these rolls is 40 inches (1.07 m) long and 10 inches (254 mm) diameter. These rolls are fluted at 12 flutes per inch, cut in a diagonal pattern and rotate at different speeds. The flutes are so arranged that they cannot interlock, rather they meet like the blades on a pair of scissors. The upper roll is the fastest at around 350 rpm and the lower runs about 140 rpm, a speed differential of 2.5:1. The two rolls rotate such that both are travelling down into the nip and because of the speed differential, a grain of wheat is sheared, rather than flattened, between them.

At the sides of the machine are two handwheels; these are used to adjust the lower roll position. By altering them individually, the lower roll can be set parallel to the upper one and then by adjusting both by the same amount, the clearance between the rolls can be altered. At the bottom of each adjuster is a large spring which allows the rolls to separate if any obstruction passes between the them, The springs are set at a sufficiently high pressure that they do not separate when a heavy feed is applied. The small handwheels are to lock the adjustment when it is satisfactory.

There is a lever on the left side of the roll which is used to move the lower roll apart from the upper roll when the feed has stopped. This produces a clearance of about 1/8 inch (3 mm) between the two rolls. At the same time it removes the drive from the feed roll by releasing a dog clutch.

The stock, having passed through the rolls, falls into the hopper and then down a spout in the cellar into the elevator boot, from where it is collected in the elevator buckets and carried to the top of the mill.

Bagging Machine

This is the machine used to weigh 1½ kg of flour into bags. 3 sacks of flour are placed in the hopper and the flour is then dispensed into bags in 1½ kg lots. A single 1½ kg may be produced by pressing the foot pedal or the machine can be switched to continuous in order to dispense a series of 1½ kgs to fill a larger bag.

The machine was brought to Caudwell's Mill from Elsecar Mill, in South Yorkshire, when it closed down.

Barley Roll

This is used to flatten and open the grains of barley for animal feed (provender).

Driven by a 5 H.P. (3.7 kW) electric motor running at 950 rpm, the two 5 inch (127 mm) wide rolls rotate in opposite directions. The rolls are of 24 inches (610 mm) and 10 inches (254 mm) diameter and produce a linear speed differential which opens the grain.

Barley is stored in the hopper above the roll and the finished product is collected in sacks at the mouth of a spout on the floor below.

This was donated to the Trust by Nottingham University.

Belts

Belts in the mill are often leather as this gripped the driving pulley well. There is such a belt on display adjacent to the plansifters. The original stitched join where the belt has been chamfered (thinned) is visible. Modern joins are not as neat as this but can be done very much quicker by just hammering a metal jointer into the belt.

The direction of the drive can be reversed by using a crossed belt.

Bevel Gear

These are used to alter the drive from the "Little Giant" turbine through 90° from a vertical shaft to a horizontal one. The horizontal gear has metal teeth, the vertical has wooden teeth. This ensures that if the drive jams because of a problem in the mill, only the wooden teeth that the miller can replace easily break. If metal ones break then a complete gear is required. The wood to metal contact also runs quieter than metal to metal. A similar gear with 60 wooden teeth rests against the wall to the right.
Often on pairs of gears like these there is an extra tooth (called a hunting tooth) on one gear. This prevents the same two teeth constantly meeting and this spreads the wear on the teeth.

Break & Reduction rolls
The other sets of rolls in the mill are either break or reduction rolls. Break rolls (identifiable by numbers on the roll i.e. 1st Bk.) have flutes on their surface, ranging from the 12 flutes per inch for the 1st Bk. down to 30 flutes per inch for the 4th Bk. The reduction rolls (identifiable by letters i.e. C) have a smooth surface.
Reduction rolls run with an upper roll speed of around 215 rpm and a speed differential of 1.25:1, producing a lower roll speed of 170 rpm.

C Roll
This roll was installed in the mill in 1914 by the German firm of Amme, Giesecke & Konegen. It is a reduction roll and so has two smooth rolls. The far side is no longer used.
The reason Amme, Giesecke & Konegen were selected for this re-modelling of the mill is not known, although Edward Caudwell's brother Charles, at Congleton Mill, had bought 3 plansifters from them about a year previously. The team of German fitters completed the work and some (if not all) were interned at Knocksherry on the Isle of Man until late 1919. When back in Germany, they wrote to Edward Caudwell asking for the return of their toolboxes and hoping that the machinery they had installed was still working well. [It is still doing so.] The total cost of the work, installing a roller mill, 4 plansifters, the Francis turbine and all ancillary equipment was £1522.12.6 and the final part of the bill was not paid until 1924.

Centrifugal
There were a pair of these installed in 1947 by Mr Arthur Fox but they had been out of use for more than 20 years when the mill closed in 1978. They consist of a rotating polygonal cylinder which has a set of beaters rotating inside. The cylinder rotates at about 20 rpm and the beaters at 200 rpm. A single size of wire or silk is fitted to the cylinder, thus to make many separations a number of machines would be used.
Various types of centrifugal were available to millers, depending where in the mill flow they were required. A mill flow sheet of 1950 by E R & F Turner shows a pair of centrifugals dressing the stock from the K and L rolls, although by 1956 Henry Simon was only showing one centrifugal on L roll.
The stock is fed into the cylinder from one end and is helped to travel the length of the cylinder by some of the beaters being twisted into a spiral. Fine stock falls through the mesh and the coarser stock overtails. The "throughs" fall into the bottom of the machine where a worm takes them to the outlet spout.

"Clean" Wheat Bins
These wooden bins store wheat that is ready for milling after being cleaned and conditioned. There are ten bins, each holding 2.5 tonnes of wheat. The bins are filled on the attic floor and empty into measurers on the ground floor.
The bins are made of best red wood battens each 3 * 2 inches (75 * 50 mm) cross section and may have been built around 1907, by Joseph Thornton of Retford, when the "dirty" wheat bins at the south end of the mill were built. Each bin is approximately 32 inches (812 mm) square internally and 14 feet 6 inches (4.42 m) deep. Wheat from the cleaning & conditioning plant is stored in these bins, ready for milling.
The 10 bins are split into 6 mill bins and 4 day bins. Mill bins hold wheat for a short period to allow the conditioning to be completed. Conditioning is the drying or damping of the bran to

achieve 16% moisture content, which produces bran that separates cleanly from the endosperm (flour) on the rolls. Stock from the mill bins is transferred, via measurers which allow final blending, to the day bins where it is fed to the 1st break rolls for milling.

"Clean" Wheat Measurers

The speed of rotation of these can be controlled by the lever on the side. This allows different types of wheat to be blended from the mill bins before being milled.

Each measurer contains a rotor having four vanes which sweep inside the casing. Adjustment of the lever at the side of the machine alters the number of teeth moved on each rotation of the shaft. It is possible to alter the range of delivery from 0 to 80 bushels per hour which is approximately 0 to 2 tonnes per hour. The miller can alter the delivery of the measurers to achieve the correct blend of wheat (called grist) for the type of flour being milled.

The four measurers (one is missing at the moment) feed into a worm below them which in turn discharges into the boot of an elevator. The elevator discharges into the day bins.

Conditioner
In order to mill wheat efficiently, it needs a moisture content of between 14 to 16%. The conditioner is used to dry the wheat and comprises a series of radiators through which the wheat falls. Heat was produced by the boiler and the speed of the wheat through the conditioner controls the dryness. If damper wheat is needed, then a small amount of water can be sprinkled onto the wheat. A Cornish boiler is in the boiler room at the rear of the Mill but is no longer in a working condition. Steam from the boiler was passed through a calorifier to heat water for the radiators. The wheat would have been checked for moisture content and then passed through the conditioner to achieve the correct level. If the wheat is too dry, water was sprayed on to it as it passed along a small worm above the conditioner. The wheat could then pass through the conditioner without heat.
From the conditioner, the wheat is placed in the conditioning bins (6 bins holding 2.5 tonnes each) and kept for up to 24 hours to allow the moisture level in the bran to stabilise.
It has been found that to mill wheat, extracting the endosperm (flour) cleanly and efficiently, it is best to have the bran at a moisture level of 14-16%. This has the effect of having the bran hard enough to be broken, but tough enough to remain in large pieces and thus be easy to remove in the following processes.

Cyclone
There are 4 cyclones in the mill, taking dusty air from machines and separating the dust from the air. The dust laden air enters the cyclone tangentially at the top and spins inside the case, forming a vortex (like a whirlpool). The heavier stock moves to the centre and falls to the base where it is bagged, whilst the air leaves at the top. The exhaust air, in some cases, still contains dust particles and is passed through cloth bags before leaving the mill. The dust, in some cases, would have been used in the provender mill.

Detacher
These are installed in the flow of flour between the reduction rolls and the plansifters. Their function is to break up flakes of endosperm without disintegrating the bran & germ particles. A worm with a continuous blade forces the stock against a delivery cone. The cone is spring loaded and the pressure can be regulated.
In the milling of fine & coarse middlings (stock produced from the middle sieves) the pressure exerted by the reduction rolls can be sufficient to produce flakes of stock. These small flakes are much larger than the stock and so are unable to pass through the meshes of the plansifters and would overtail. The flakes can be broken down by detachers and thus pass as middlings to the plansifters. There has been controversy among millers as to the value of detachers, some saying they enable finer silks to be used, whilst others have the opinion that detachers produce additional bran powder and break up flakes of bran & germ.
These detachers were installed by Amme, Giesecke & Konegen of Brunswick, Germany in 1914, when the mill was remodelled. There are two dual detachers and one single machine, and when installed. a single detacher cost £15.

"Dirty" Wheat Bins
These wooden bins store wheat that has been delivered to the mill from the farm. There are thirteen bins, 11 each holding 13 tonnes and 2 each holding 6.5 tonnes of wheat. The bins are filled on the attic floor and empty into measurers on the ground floor.
The bins are made of best red wood battens 3 * 2 inches (75 * 50 mm) cross section and were built by Joseph Thornton of Retford, Nottinghamshire in 1907. The timber cost £66.14.00 and the metalwork £121.10.10. Each large bin is approximately 4 feet (1.22 m) by 3 feet 6 inches (1.07 m) internal cross section and 22 feet (6.7 m) deep. The two smaller bins are 2 feet by 3 feet 6 inches and also 22 feet deep. The bins can be used to store wheat that has just been delivered or some of them can hold wheat that has been partly cleaned. Different types of wheat can also be stored in separate bins. This allows the miller flexibility in the type of flour he is going to produce. The wheat is taken from the bins into measurers and then into worms which feed the elevators.

"Dirty" Wheat Measurers

The speed of rotation of these can be controlled by the lever on the side. This allows different types of wheat to be blended from the "dirty" wheat bins, which are above the measurers, before being milled. Facilities are also provided to by-pass the measurers if wheat is going for cleaning and there is no requirement for measuring the quantities.
Each measurer contains a rotor having four or more vanes which sweep inside the casing. Adjustment of the lever at the side of the machine alters the number of teeth moved on each rotation of the shaft. It is possible to alter the range of delivery from 0 to 80 bushels per hour which is approximately 0 to 2 tonnes per hour. The miller can alter the delivery of the measurers to achieve the correct blend of wheat (called grist) for the type of flour being milled.
The two rows of measurers feed into worms below them which in turn discharge into either the cleaning equipment worm or the elevator. The elevator discharges into the mill bins.

Display Roller Mill
This is a typical roller mill similar to the 12 inside the Mill. It was thought that to have been made by Briddon & Fowler, but there is some belief that it may be an early Henry Simon mill.
The roll cover has been removed to allow to internal parts of the machine to be seen.
Stock enters the hopper at the top, passes to the feed roll which spreads it across the two smooth rolls (unfortunately rusty in this machine). These break the large flour particles into smaller ones. From here it falls into a hopper beneath the rolls and then into an elevator which takes it to the top of the mill, then to the plansifters.
Wheat is fed into the feed hopper by means of the wooden spouts coming from the wheat bins. Each spout has a slide to adjust the flow into the hopper to spread evenly across the width of the hopper. When leaving the feed hopper, the width of the gap through which the wheat passes can be adjusted by the small levers at the side.The wheat then passes onto the feed roll which is about 3 inches (75 mm) diameter and fluted at around 4 flutes per inch (25 mm), running about 150 rpm. This drops the wheat at a regular rate into the nip between the two rolls. Each of these rolls is 24 inches (0.61 m) long and 10 inches (254 mm) diameter. The upper roll is the fastest at around 215 rpm and the lower runs about 170 rpm, a speed differential of 1.25:1. The two rolls rotate such that both are travelling down into the nip and because of the speed differential, the flour is sheared, rather than flattened, between them.
The stock, having passed through the rolls, falls into the hopper and then into the elevator boot, from where it is collected in the elevator buckets and carried to the top of the mill.
This roller mill was donated to the Trust by a mill in Wantage where it was no longer needed.

Dust Extractor
This machine was installed in the mill in 1914 by the German firm of Amme, Giesecke & Konegen. It's purpose is to remove dust from the plansifters and other machines. Spouting connects each machine to a large metal trunking which enters the collecting chest at the rear of the machine.
The dust extractor comprises a collecting chest at the base with four separate dust chambers. Each chamber has 8 cloth sleeves fixed to the top of the chest at the base and to an iron frame at the top, the top being closed. Air is extracted from the outside of the sleeves by the large fan to the right of the machine, and is then blown out of the cowl on the roof. As the air passes through the sleeve, the dust is collected on the inside of the sleeve. If this was allowed to continue indefinitely, the sleeves would soon become choked and the machine would cease to function. In order to prevent this, on top of the machine is a shaft with a set of cams. As the shaft rotates, the suction to each chamber is shut off periodically and the flow of air through that chamber's sleeves is reversed. At the same time the iron frame is lifted about 2 inches (50 mm) by a cam and then allowed to drop, thus shaking the sleeves and allowing the dust to drop into the chest. In the base of each section of the chest is a chain driven brush which sweeps the dust to the front of the machine, where it falls into a worm which carries it out of the machine for disposal. In order not to spoil the vacuum inside the machine, a rotary valve is placed in the outlet spout (just under the ceiling of the plansifter floor) which maintains a nearly air-tight seal but allowing the passage of the collected dust.

Elevators

These are used to carry stock vertically in the mill. They are made from a canvas belt fitted with metal buckets, about three every yard (metre). The belts are driven by shafts at the top of the mill. The elevator belt is about 5 inches (127 mm) wide and fitted with metal buckets. The profile and depth of the buckets varies, and the number per yard (metre), depending on the type of stock to be carried. Around 60 buckets are on one belt, although the number varies with the amount of stock to be carried. Some of the elevators have two separate belts in one divided casing, each carrying a different stock.

The stock is fed into the base of the elevator (called the boot) from where it is collected by the buckets and carried to the top of the elevator.

The speed of the elevator belt is critical as the stock has to be thrown out of the bucket cleanly into the outlet spout of the elevator. If the belt is too slow, the stock just falls back down the elevator casing, whilst if it is too fast the stock bounces back from the wall of the elevator and again falls down the casing.

Elevator Tops
The tops of the elevators are on both sides of the mill on the attic floor. In the wooden top, a pulley carries the elevator belt. This pulley drives the belt and in turn, is driven by the shaft which may drive one or two elevators. As the belt carrying the buckets passes over the pulley, the stock is thrown out and enters the spout to be taken to the next process by gravity.
The speed of the belt travelling round the pulley is quite critical, too slow and the stock does not reach the spout, falling down the elevator casing; too fast and the stock is thrown against the front of the elevator and again falls down the inside of the casing. When this happens, stock collects in the elevator boot and eventually chokes the elevator, usually causing the drive belt to fall off it's pulley. A severe blockage may break the elevator belt and the two sides of the belt fall down both sides of the elevator casing, resulting in a considerable delay in resuming production. In some cases there are multiple spouts leaving the same elevator, with slide valves to select the appropriate one. This allows the miller some flexibility in selecting the type of flour produced.

Flour Hopper
Flour produced in the Mill enters this hopper from the flour worm on the floor above. A 70 lb (32 kg) sack is fitted to the outlet spout and is filled in about 2½ to 3 minutes. Originally there was a steelyard connected to a sliding collar on the outlet spout which weighed the sack as it filled. This was removed some time ago.

“Francis” Turbine
This turbine was installed to drive the flour mill in 1914 by Amme, Giesecke & Konegen of Brunswick, Germany at a cost of £310. It develops 76 H.P. (56.7 kW) at a shaft speed of 125 rpm. Control vanes on either side of the turbine allow the power to be reduced if required. The water flow through both ends of the turbine, passes the rotors driving them round, and emerges through a tube into the tail race.
This turbine is the second installed to drive the flour mill. Originally the mill had 8 pairs of millstones driven by a water wheel in this chamber. The water wheel was 13 feet (3.96 m) diameter and 11 feet 3 inches (3.43 m) wide. and probably had a shaft speed of about 10 rpm.
This was replaced in 1887 by a 40 inch (1 m) diameter “Trent” turbine supplied by C. L. Hett of Brigg, Yorkshire which had a shaft speed of 85 rpm, and thus was more suited to the speeds needed by the roller mills which had been installed in 1885.
By 1914, more equipment had been installed in the mill and more power was needed. After a series of quotes from various firms, Amme, Giesecke & Konegen, who were partly remodelling the flour mill were selected to supply the new turbine.

“Francis” Turbine Sluice Gates
These were probably installed in 1906 by Joseph Thornton of Retford, Nottinghamshire. Only one gate is currently used as it supplies sufficient water to drive the turbine. Approximately 35 turns of the handwheel are required to raise the gate sufficiently to run the mill when milling flour.

Gardener “Rapid” Mixer
This has a pair of rotating stirrers (metal spirals) internally and was used for mixing a proportion of sharps and middlings with white flour to produce wholemeal flour. The machine had been out of use for a number of years prior to the Mill's closure in 1978, according to Mr. Arthur Fox who was the rollerman at the time.

Hammer Mill - “Miracle” Mill No.2
Hammer mills are used to pulverise stock into powder. The one in Caudwell’s mill was used to pulverise barley for animal feed (provender). Hammer mills have a high throughput, but require a lot of power to drive them and are very noisy. This was apparently purchased before 1927 as Caudwell's were buying spares in 1927. The price quoted in 1927 for this machine was £200.
The hammer mill comprises a set of 24 swinging hammers (maces) suspended from the rotating shaft. They rotate at 3000 rpm in a perforated casing, which can be exchanged in order to vary the hole sizes, which, in turn, varies the fineness of the stock leaving the mill. When milling barley this

had an output of between 380 and 3600 lbs per hour (172 to 1620 kg per hour), depending on the fineness, and required between 25 & 30 H.P. (18.6 to 22.4 kW). These were cheap to buy but expensive in the amount of power required to drive them. The stock enters the mill down a wooden spout, passes through the hammer mill and is then blown by the fan up the metal tube to the top of the mill. Here it enters a cyclone in the schoolroom which extracts the stock, whilst allowing the air to escape. Following this the milled stock can either be bagged and sold, or mixed to make provender.

Intake Hopper
Placed outside the mill, wheat is emptied into here, either direct from the farm or from the ports. It is then raised to the rubble reel by the elevator for screening.

Imperial Weights
The weights used in the Mill were known as "Imperial". They are those used in England before the introduction of the metric system in 1971.
The weight range that might have been met in the Mill is outlined below:

Imperial	Imperial usage-pounds	exact kilograms	equivalent kilograms	notes
1 Ton	2240	1016	1000	
280 lbs	280	127.0		Sack until ~1914
140 lbs	140	63.50		Sack until ~1940
1 cwt	112	50.8	50	hundredweight
70 lbs	70	31.75	32	Sack until ~1971
½ cwt	56	25.4	25	
1 qtr	28	12.7	12.5	quarter cwt
1 stone	14	6.35	6.5	
½ stone	7	3.18	3	
3 lbs	3	1.36	1.5	household bag
16oz	1	0.454	0.5	ounces - small bag

Caudwell's roller mill is known as a 5 Sack mill. This indicated it could produce 5 Sacks, each of 280 lbs, in 1 hour i.e. 1400 lbs or 635 kg per hour of flour.
Mills were sized in this manner, at least until the late 1960s.

Intake Spouts
Wheat is now brought to the mill in lorries and is blown up to the attic floor by compressed air. It is then distributed into the 10 bins under the floor in the centre of the mill using the spouts above them. Each spout has a slide valve so that the feed into any bin can be controlled. The bins holds 2.5 tonnes of wheat each.
When the mill was in full operation these bins had a slightly different function. The first six bins were "conditioning" bins and wheat that had passed from the "dirty" wheat bins, through the cleaning plant, and then through the conditioner was stored in these for a period around 1- 2 days. After this it was moved into the remaining four "day" bins, and could be blended using the measurers on the ground floor at the same time.
When in operation the mill produced about 5 tonnes of flour each eight hour shift so the four day bins would only have held two days production. It would have been one of the workmen's job to see that wheat was transferred from bin to bin so as not to hold up the production of flour.

Line Shaft
The shaft in the cellar transmits the drive from the Francis turbine to the machines. A belt on the south wall takes the drive to the 1st floor. The different diameter of pulleys are used to produce different speeds, whilst the different widths are to transmit different powers. The shaft rotates at 125 revolutions per minute.

The overall length of the shaft in the cellar is about 35 feet (10.6 m) and is split into 2 sections, one of 4 inches (101 mm) diameter and the other, nearer the turbine, of 6 inches (152 mm) diameter. There are 26 pulleys on the shaft, ranging in size from 6 inches to 54 inches diameter and from 2 inches to 11 inches in width. Some of the pulleys do not have belts fitted as the machine they drove is no longer in use. 7 bearings are used to support the shaft along its length.
A large pulley 40 inches diameter and 11 inches wide takes the drive from an electric motor used if the water level is too low to drive the mill. Between the turbine and the shaft is a clutch which allows the motor to drive the shaft without having to drive the turbine.
NOTE:
The tachometer on the roller floor indicates an operating speed of 85 r.p.m., although the turbine and hence the line shaft rotate at 125 r.p.m.. This is because the tachometer was fitted for an earlier turbine which ran at 85 r.p.m. The pulley diameter has been altered on the tachometer to indicate the original speed.

"Little Giant" Turbine

The "Little Giant" turbine was installed in the Mill in 1898, replacing a 11 feet (3.35 m) wide 10 feet 6 inches (3.2 m) diameter water wheel. The rotor is 33 inches (0.84 m) diameter and on the 10 foot (3.1 m) head here would develop 56 H.P. (42 kW) at a shaft speed of 92 rpm. This turbine now drives an electricity generator producing 12 kW used in the Mill for lighting.

The lower bearing at the base of the shaft is a piece of lignum vitae wood in the shape of a half sphere and the bottom of the shaft is formed into a cup to rest on it. There are three pieces of lignum vitae at the upper section of shaft which keep the shaft centred. Water enters past the control sluice and then emerges from the shell shaped outlets at the top & bottom of the rotor. Depending on the head available, the power developed varies from 9.2 H.P. at 3 feet to 830 H.P. at 60 feet.

A smaller "Little Giant" turbine standing outside the mill was given to the Trust by York Castle Museum. It's rotor is 16 inches (0.41 m) diameter and on the 10 foot (3.1 m) head here, would develop 9 H.P. (6.7 kW) at a shaft speed of 190 rpm. Depending on the head available, the power developed in this smaller turbine varies from 3.2 H.P. at 5 feet to 130 H.P. at 60 feet.

At the present time, the supplier or maker of either of the "Little Giant" turbines is not known. These turbines were first built in 1876 by J. C. Wilson & Co. of Ontario, Canada, and imported to Britain by S. Howes of London. In 1904 Wilson's were advertising that they had sold more than 1900 "Little Giant" turbines and were offering a range from 14 inch diameter (2.6 to 108 H.P.) to 36 inches diameter (12.5 to 1120 H.P.).

NOTE: a very similar turbine was made by Armfield.

Millstones

These were found buried in the millyard. The left one is a Peak stone (gritstone) probably used for provender milling; the one to the right is a French Burr (pieces of quartz) used for flour milling. Two-thirds of the Peak stone has been dressed (furrows cut in surface) whilst the remaining third is left as it has worn down.

During renovations to the mill and outbuildings, some trenches were dug in the yard and these two stones were discovered. John Caudwell, when he built the mill in 1874, had 8 pairs of stones installed and it is possible these were some of them. Unfortunately there is no record of the types of stone used, or even how many of each type, but it is almost certain that most of them were French Burr for flour milling and a few Peak stones for provender milling. Eventually the stones would wear to a level where they could no longer be dressed and they would be replaced. These may have been rejected as worn out or they may have been thrown out when, in 1874, the roller mills were installed.

The Peak stone has been partially dressed by Sid Hipkiss in 1986 to show the depth of the furrows compared with the lands (the flat surface).

The French Burr is made from pieces of quartz assembled to form a circular stone and then iron rings are fitted around the circumference to hold the whole assembly together. Inset into the upper section of the stone are small pockets which are filled with weights (often lead) to balance the stone.

With both types of stone, when set for milling, the gap between the runner (moving) and the bedstone (fixed) is not much thicker than a piece of paper and yet the runner, probably weighing ½ to ¾ of a tonne, rotates at 100 to 120 rpm and does not touch the bedstone.

In operation the wheat would have been fed into the centre (eye) of the runner and passing across the face of the stone would have been sheared between the vertical faces of the furrows and then ground between the flat surfaces of the lands. It would finally have reached the outer edge of the stones from where it would have fallen to the floor surrounding the stones and been collected for sieving.

Plansifters

These are used to sieve the stock produced by the rolls. Each section has 12 separate sieve trays and produces up to 6 separations from the stock. The swinging is produced by a crank in the drive shaft. The whole weight of the machine is supported on 24 canes.

Amme, Giesecke & Konegen installed 4 plansifters in 1914, although one has been replaced by a machine from E R & F Turner of Ipswich. It is possible that 2 plansifters were in the mill by 1905, but the supplier is not known.
Plansifters were the machines that revolutionized roller milling. They enabled the stock to be sieved into fine gradations which can then be fed back to individual rolls for further treatment.
The 12 sieve trays have a coarse sieve at the top and the sieves get finer as they approach the bottom of the unit. The coarsest sieves are a wire mesh with holes about $\frac{5}{64}$ inch (2 mm) square and the finest are nylon (formerly silk) that can hardly be seen through i.e. 0·0044 inches (0·14 mm) diameter with 140 threads per inch. Under each sieve is a brush running on an oval track. This brushes the underside of the sieve and causes the stock to be brushed through the sieve. If the stock is fine enough it will fall through the sieves and pass into the flour worm ready to be bagged, otherwise it overtails (passes over the sieve) and goes back to a roll.
The drive shaft, which has a 2 inch (50 mm) offset as it enters the plansifter, has spherical bearings at the top & bottom allowing it to swing as the plansifter runs up to operating speed; when up to speed there is a counterweight which balances the offset shaft so that the machine runs in a 4 inch (100 mm) circle. This shakes the stock along the trays and causes the brushes to move along the track. The whole weight of the machine (about 2 tonnes) is suspended on the 24 rattan canes, in 4 groups of 6, which allow it to swing freely.
In order to get stock in and out of the plansifter, cloth tubes (called socks) connect the fixed inlet & outlets to the plansifter.

Plansifter Screens
Two plansifter screens are displayed, one having a wire mesh and the other a “silk” mesh. The mesh is called a cover. Wire mesh is typically used for the upper trays (sieves) where the stock is coarse and the “silk” for the lower trays having the finer stock. Originally “silk” was silk but in most cases now a nylon (or similar) thread is used.

Provender bins
A set of wooden bins used to hold grain to be made into animal feed (provender). These are not currently in use.
These 6 bins are made of best red wood battens each 3 x 2 inches (75 x 50 mm) cross section and may have been built around 1907, by Joseph Thornton of Retford, when the “dirty” wheat bins at the south end of the mill were built. The bins are 20 feet (6.1 m) deep and hold approximately 7.5 tonnes each.
Stock from each bin can be fed individually or simultaneously through measurers. The use of the measurers allowing various types of grain to be blended for particular types of animal feed.

Provender Feed Worm
This worm, about 12 inches (300 mm) diameter, was used to take provender into the mill. Originally it went below the mill wall so that stock, barley, oats, wheat etc. could be poured into it from the delivery vehicle. As it rotates the blades drive the stock along into the base (boot) of an elevator. This lifts the stock to the attic where it is placed into the provender bins behind the elevator.

Purifiers
Purifiers are used to extract the finest bran particles from the endosperm (flour). The flour is fed onto a sloping sieve which shakes; air is drawn through the sieve, lifting the fine bran and depositing it onto the trays. From here it is brushed off and returned to the mill. The flour falls through the sieve, is collected, and taken to the next process. There were originally 4 machines, each having two sections.
These purifiers were made by Henry Simon Ltd. and were probably installed in the 1930's as there is a Henry Simon drawing dated 9/12/1930 proposing to introduce new purifiers. The four purifiers were introduced because Edward Caudwell wanted to extract the maximum amount of flour from the wheat (and also produce a very white flour). Later the need was not so great and so

two purifiers were removed sometime after 1956, thus lowering the amount of power required to drive the mill.

Querns

Querns are hand operated methods of grinding wheat (or other grains) into flour.
The saddle quern was found near Bakewell and probably dates between 100 B.C. and 40 AD although the type date from about 3,500 B.C. in Egypt. Moving the cylindrical stone along the curved surface of the “saddle” crushes the grain to release the flour. This could be used for any type of grain (or seeds) to produce a powder for cooking or other purposes.
The rotary quern is a type used from 1000 B.C. to the modern day. This particular quern was bought new in 1995 from India. Grain is fed into the hole (eye) in the centre of the upper stone and as the upper stone rotates the grain is milled into flour. The flour emerges at the sides of the quern and is collected from the board for use. Both upper & lower stones are grooved in patterns similar to the large millstones seen outside the mill.

Rattan Canes
The plansifters, each weighing about 48 cwt. (2400 kg) are supported on 24 rattan canes. These allow the body of the machine to swing freely but be totally supported by the canes.
In 22 years the Trust has only replaced 2 canes, in 1995, at a cost of £12 each.
One of the broken canes is on display near the plansifters.

Rubble Reel
Wheat, delivered from a farm, is passed through a rubble reel that extracts stones, similar sized objects and sticks or straw from the wheat.
The grain comes from the intake hopper into the upper (right) end of the inclined drum. There are two sections of screen in the drum, the first (upper) having $\frac{5}{64}$ in (2 mm) diameter holes which retain the wheat but allows dust and fine particles to pass through for disposal. The second section (lower) has $\frac{17}{32}$ in (13.5 mm) diameter holes which allows the wheat to pass through, to be taken into the mill, but retain the coarse refuse. Sticks, small stones, wheat stalks and similar sized objects pass over the drum (overtail) falling out of the end and are collected for disposal.

Sack Hoist
There are two sack hoists in the mill, but the one in the provender end is not in use. The one in the north end of the flour mill one is used regularly to raise flour to the first & second floors. A rope, which passes through all the mill floors, is attached to a lever, which is pivoted near its lower end. At the base of the lever is a pulley which, when the rope is pulled, moves into contact with the drive belt. This tightens the belt and thus applies drive to the sack hoist drum. As the drum rotates it winds up the chain, lifting the sack as required.
When installed this sack hoist would be lifting 280 lb (127 kg) sacks, at present it is only required to lift 70 lb (32 kg) at a time. When using the hoist, it was possible to have the wooden flaps shut so that as the sack went through them, there was a bang and so the position of the sack was known. The rope passes through each floor of the mill and so the hoist can be operated at any level.
For a short period of time the rope can be slightly slackened, allowing the drive belt to slip, thus slowing the sack and allowing it to be pulled into the mill and onto the floor.
Current safety practices require two people to operate this hoist and each has to be able to see the other. The person at the bottom is in control and indicates the required action by hand signals.

Scales
Two types of scales may be found in the mill; balance, where the mass on one side is the same as the object being weighed and lever, where a small mass is multiplied by levers to be the equivalent to a much larger mass.
Balance scales have two platforms connected by a rod or set of rods. The rod is pivoted in the centre and a known mass placed on one platform. The object being weighed is placed on the other platform. When both masses are equal, the rod is horizontal and both platforms are level. Often a pointer is connected to the centre of the rod allowing the balance position to be observed easily.
Scales of this type are often used in the house and a variant is the “fan” scale that is seen in shops.
Lever scales use a series of levers to multiply a small weight. They often have the facility to move a small mass along a beam thus making them more versatile than most balance scales because a large range of masses is not required. Additional masses can be added to the end of the beam to alter the range of the scales. These are derivations of the “Steelyard” that has been in use since Roman times.

Scratch rolls
There are two rolls which do not follow the letter rule, X & Y both have flutes, X having 38 per inch & Y having 36 per inch. These are called scratch rolls and are intended to “scratch” the last particles of endosperm (flour) from the bran.

Shoe Feeder

This is used for feeding flour and powders and for mixing in previously collected stock. If a choke occurs in the mill, the stock is collected and fed slowly back at a pre-determined rate into the 1st Break Elevator as the base of the shoe feeder oscillates back and forth.
The base of the shoe feeder is suspended on flexible steel strips and is oscillated by means of the eccentric cam below the base. This cam is driven by the shaft and pulley. At the front of the shoe feeder is a slider which can be adjusted up & down to alter the amount of stock fed on each stroke of the base.

Vertical Stone Mill
A pair of vertical Carborundum "stones", one fixed and one driven, are used to mill the grain into flour. The gap between the stones is adjusted (tentering) by means of one handwheel and the other used to lock the adjustment. The drive was taken from one of the line shafts.
This stone mill was actually used to break up the "sharps" when Caudwell's produced white flour. The mill was sold about 1950 to Mr West in Leeds who donated it to the Trust in 1995. It has been installed in its original place in the mill. Sharps are a mixture of flour, soft fibrous stock and bran shreds. When reduced in size their high protein content makes ideal provender, for example for use as pig food.
Briddon & Fowler Ltd. of Stockport advertised this machine in their 1914 catalogue. The text says the machine has the capacity of a pair of millstone 5 feet (1.52 m) diameter.
The stock was fed into the centre (the eye) of the driven stone and passed to the outside edge, being milled by the "lands" formed between the grooves in the stone. Having passed between the stones, the stock then left the machine at the bottom, falling down a spout to be bagged on the floor below.
The stones are made from an mixture of emery particles and strong cement on a cast iron backing plate. The fixed stone can be moved closer to the moving stone by the handwheel until the stock passing through the stones is the correct fineness.
In other machines of this type, the rotating stone is spring-loaded, allowing it to move apart if a large particle of foreign matter enters the machine. This, less popular model, is not spring loaded thus increasing the risk of damage to the stones.
A belt drive was taken from the line shaft and the driven stones rotated at 450 rpm.

Worm
Worms are actually Archimedean screws and are used to move stock horizontally across the mill. As the blades rotate they push the stock along.
This is believed to have been invented by Archimedes in Greece before 212 B.C.. Originally it was used to raise water but here it moves flour horizontally across the mill. By altering the type and inclination of the blades it is possible to vary the quantity of stock moved per rotation of the shaft. Using a continuous blade, stock could be moved vertically. If the blades on sections of the shaft are inclined in opposite directions it is possible to move stock in two directions simultaneously even though the shaft rotates continuously in one direction.

