THE MIDLAND WIND AND WATER MILLS GROUP

This Journal is published by the Midland Wind and Water Mills Group, which is concerned with the study of the history and technology of mills and, in principle, with their preservation and restoration. Its area is the region loosely defined as the Midlands, especially the central counties of Staffordshire, Shropshire, Worcestershire, and Warwickshire.

The group holds monthly meetings, with talks and discussions, during the winter, and arranges mill tours and open days during the spring and summer. Members periodically receive a Newsletter and the Journal.

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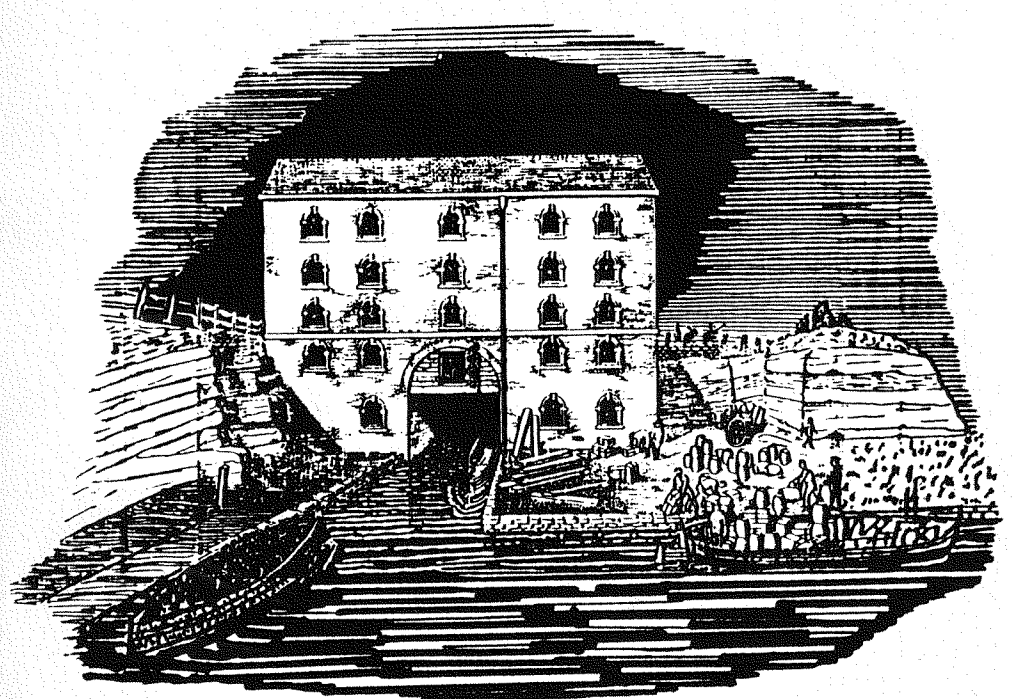
Wind and Water Mills

Number 12



The Midland Wind and Water Mills Group

Wind and Water Mills is the journal of the Midland Wind and Water Mills Group and is therefore naturally concerned with the mills of the Midlands, but it is not intended to be narrowly parochial. Interesting and important articles relating to mill matters in other parts of Britain and the world will be included whenever available. In general, articles by members will have priority for publication, but submissions by non-members will be willingly included.

Cover illustration. The original warehouse built by Henshall & Gilbert at Castlefield, Manchester about 1765. (see pages 33 to 48)

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WATERMILLS ON THE REPTON BROOK.

By Alan Gifford.

Few who know the area will disagree with the suggestion that the Repton Brook, which rises near Pistern Hill, to the east of Hartshorne, and which flows westwards towards Repton, probably remains one of the most attractive water courses in the district. In the past it had six watermills in its short length to add to its beauty! (see opposite)

The stream rises at almost 500 feet (SK 338203) and in six short miles drops to 140 feet at its junction with the Old Trent Water in Repton. It falls steeply for the first half mile, dropping to 400 feet, but then flows smoothly through a wooded valley before entering into the ancient village of Repton (SK 305274), which is situated about half way between Derby and Burton-on-Trent.

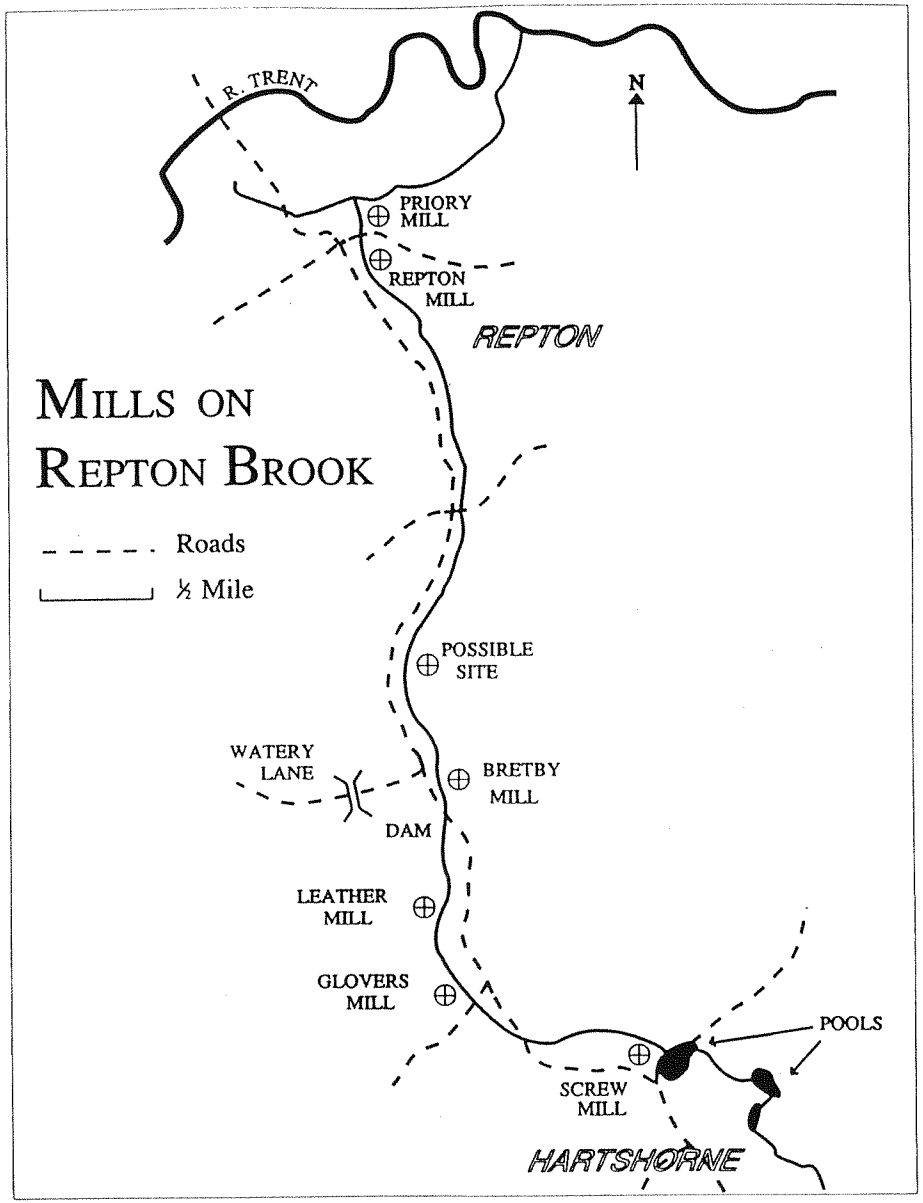
Hartshorne Screw Mill.

The first mill site downstream on the brook, to become known as the Screw Mill, is in the village of Hartshorne, some half mile from the source of the brook. There was possibly a corn mill on the site originally but by the 17th century this was converted into a furnace site which smelted iron in charcoal-fired furnaces and then worked it into wrought iron. Dame Dorothy Rokeby sold some of her holdings in December 1699 and the sale included:-

> "One other fourth part of the aforsaid yearly rent of £10 payable for the liberty of scouring the said watercourse the said John Jennings his furnace at Hartshorne." [1]

In Farey's opinion this furnace last worked in 1765.[2] The present Screw Mill building lies to the west of the Hartshorne to Ticknall road (SK 325213). Its large overshot wheel was fed through an iron pipe which ran under the road, bringing water from the mill pond immediately to the east of the road. There were two other smaller ponds higher up the stream but these were breached about 1937 and the mill pond itself was filled in, probably during the Second World War. The brick building, with a tiled roof, is about 60 feet long by 25 feet wide and was built below the level of the adjacent road. The actual date of construction is unclear, but in 1783 it was operated by Shorthose, Wood and Company, listed in Bailey's Directory as screw-makers.[3] They had puchased it as a disused corn mill when they moved there from Tatenhill Mill near Burton-on-Trent.[4] A Royal Exchange Insurance Document dated 1793 states:-

> "One building being a watermill including the going gears and machinery therein, brick and tiled, situated in Hartshorne.....£300



On utensils and trade therein.....£100' [5]

The premium for cover was £2-13s-0d and the valuation represents a considerable investment for the time.

The mill was initially used to make unpointed iron woodscrews, hence the name of the mill. These early parallel sided screws, inserted in pre-drilled holes, were used before the modern type of screw was invented about 1834 by John Sutton Nettlefold, a founder of the famous company Guest, Keen and Nettlefold in Birmingham. Stebbing Shaw in his *'History of Staffordshire'* states that the mill employed 59 people, of whom many were children and they :-

> "made on average 1200 gross of screws a week by means of 36 engines or lathes which were turned by one waterwheel, cutting at great velocity eight or nine a minute." [6]

Nearly forty years later, in 1830, the mill was still being used to make screws by Smith, Port, Wood & Company, but this company went bankrupt in 1844.[7] Later, in 1846, Bagshaw advised that :-

> "An extensive screw manufacturory which gave employment to many hands has been discontinued."[8]

The building was then used for corn milling, later as a saw mill, and finally as a malting, until about 1945 when a dispute over water rights stopped its supply and the mill subsequently became derelict. It has recently been totally refurbished (1987) and converted into a public house, known as 'The Old Mill Wheel'. During this work the 23 feet diameter by 4 feet wide iron wheel, weighing over 25 tons, was removed from its bearings and was completely restored by the owner John Holland (see Plate 1). It now turns slowly in its original location, powered by recirculated water. This wheel has cross tension bars and is mounted on an iron axle. It has a cast iron rim gear-ring and the buckets are wooden, as nearly reproducing its original condition as was reasonably possible. Some of the various wooden gears found on the site are included inside the building, but it was not possible to salvage the wooden sluice or rebuild it into the restored building. However, an original length of shafting, complete with three large flat faced pulleys, is preserved.

Glover's Mill.

About a mile downstream, but still in the parish of Hartshorne, was the corn mill known locally as Glover's Mill (SK 312218). On Burdett's map of 1791 this location is called Mill Green. The mill building was about 30 feet long by 15 feet wide and had a ground floor built of local stone whilst the upper two storeys were brick, surmounted by a tiled roof. Although the mill is now a ruin (see Plate 3), the Mill House close by is still occupied. The mill continued to be in use until just before the First World War and the names and associated dates for some of its millers were carved in the stonework, namely:-

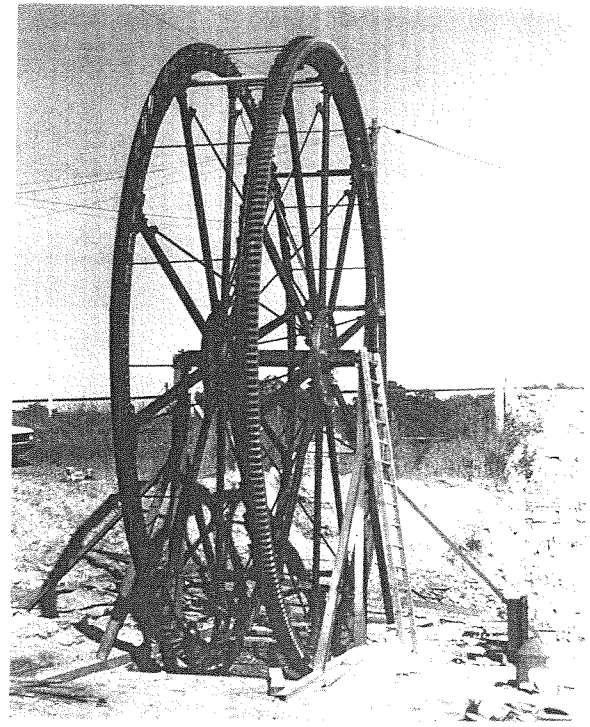


Plate 1. Hartshorne Screw Mill waterwheel during restoration in 1987.

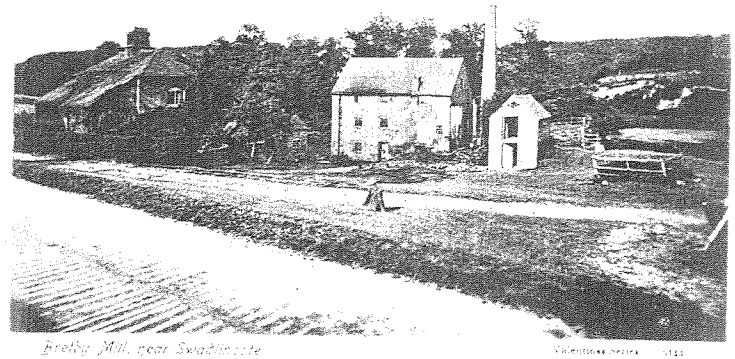


Plate 2. Bretby Mill about 1900, the engine house & chimney have not survived.

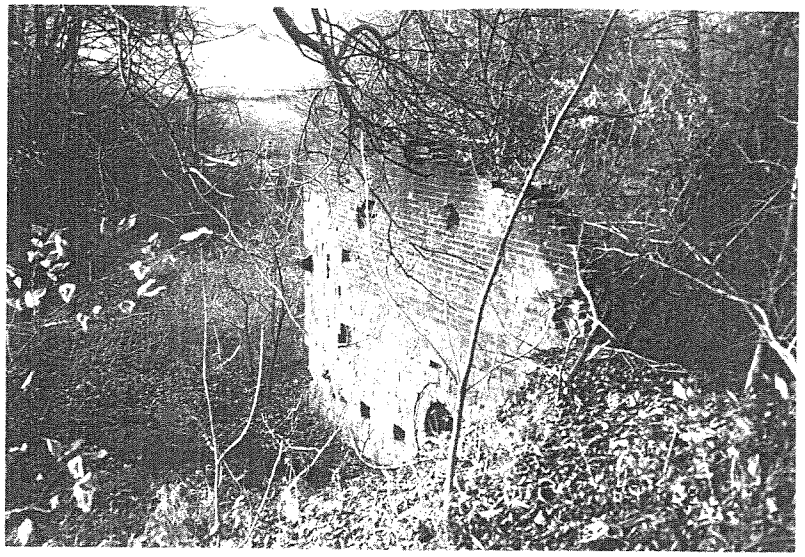


Plate 3. Current remains of Glover's Mill viewed from the mill dam, showing the circular stone hole for the waterwheel axle.

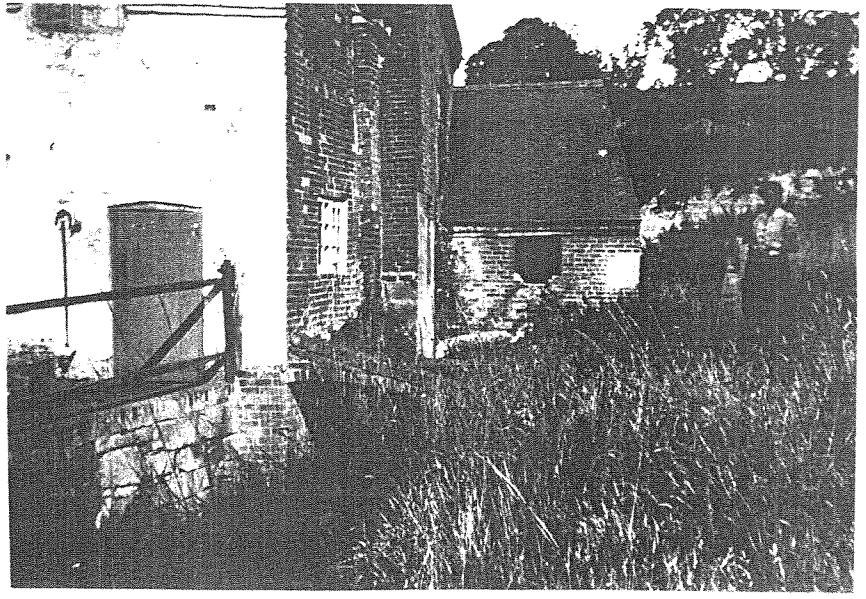


Plate 4. Repton Mill in 1923, showing the wheelhouse.

William West 1736
W Cook 1790
Joseph Jackson 1800
John Glover 1808

The Derbyshire Directory for 1857 notes that the miller was then Mary Glover, so it stayed in that family for many years. [9]

Part of the lower stone walls still survive, they retain the excellent quality stone circular opening, 34 inches in diameter, through which the wheel axle passed, and which carries a date of 1815. The wheel was overshot, and markings on the wall suggest it was about 19 feet in diameter with a wheel pit 7 feet wide - a large wheel for a small mill. The nearby mill pond is now largely overgrown but traces of a brick lined sluice to the wheel can be seen through the nettles; a site to be visited in the winter but which is accessible since it is on a public bridleway.

Bugley Hole Leather Mill.

The next site, some half a mile downstream, is immediately below the unusually named Hoofies Farm, at Bugley Hole, where a mill known as the Leather Mill was located (SK 310222). Some nearby cottages are still known as Leather Mill Cottages although all traces of the mill building and associated water works have long since disappeared. The site is marked on Burdett's map of 1791 with his characteristic star symbol but he does not name the mill. The mill produced "oiled and Shammey Leather"[10] and, since there were no tan pits close at hand, possibly drew its raw material from the tannery in nearby Repton. Lysons' *'Magna Britannia'* refers to its production of chamois leather[11] but the 1821 O.S. map marks a fulling mill on the site. No reference to the mill is included in an 1828 directory so it may have ceased operation by that date.

Bretby Mill.

A further half mile downstream Bretby Mill is still standing (SK 310232), although it is presently an empty brick shell with a tiled roof. The building is about 60 feet long by 30 feet wide and three storeys high, with a chimney on the side facing the road. There was a mill pond a short way upstream from the mill building. At the back of the mill is the lean-to brick wheelhouse which contained an overshot wheel, about 20 feet in diameter. The wheel, together with the machinery, was removed during the First World War.[12] This mill seems to have been the only one on the brook to have made use of steam power when water was scarce and a brick chimney and boiler house stood alongside (see Plate 2). This additional power system was installed in 1850 but was initially not successful, being replaced by a more powerful 12 H.P. engine in 1855.[13] The mill house stands close by and is dated 1814, but the mill itself may well be earlier.

Possible Site.

A steep valley, known as Watery Lane, joins the Hartshorne to Repton Road at this point and a few hundred yards up this valley are the remains of a large breached earth dam, with an old oak tree growing in the end of the dam wall. This dam must have, at one time, stretched right across the valley and was fed from another small stream. From this dam a long leat carried the water into the fields alongside the Repton Brook. There traces can still be seen, grassed over, running about 20 feet above the level of the stream. This leat continues for about 300 yards and terminates at a point where a mill building was possibly sited (SK 309236). This may have been a 16th century, or even earlier, mill site; but why go to such trouble to build the dam wall in the adjacent valley and the long leat? Maybe a dispute over water rights was the reason, but at the moment it presents something of a mystery.

Repton Mill.

About 2 miles further down the Repton Brook is the ancient village of Repton, famous for its association with the Vikings, being the capital of the Kingdom of Mercia, and also for its public school. The valley here opens out, becoming much wider and flatter. As a result the village mill (SK 309265) did not have a pond but was fed by a leat from about half a mile upstream, which was built in 1606 by Sir John Harper. It is not clear if this was the site of one of the two mills mentioned in the Domesday Survey of 1086, one of which was almost certainly Priory Mill, at Brook End, further downstream. The Repton corn mill ceased working in about 1936; it became a ruin which was eventually demolished in 1968, and is now the site of a number of houses. The brick mill building had a lean-to at the rear in which there was a large overshot wheel. This was still in place in 1942[14] (see Plate 4). It drove two pairs of stones by a conventional underdriven mechanism. The last tenant miller was Alfred Sanders who lived in a low, thatched, ochre washed, cottage nearby. Repton Mill, which belonged to the Lord of the Manor, was worked by the Sanders family for about 100 years.

Priory Mill.

The sixth and last mill on the Repton Brook was that belonging to the Priory which was founded in Repton about 1170 and dissolved in 1538. An indenture dated 1539, between Henry VIII and Thomas Thacker of Repton, which specified details of the property purchased by Thacker when the Priory was dissolved, includes "a water mill adjoining the monastery"[15] so it is therefore probable that the mill survived the Priory. It is not clear when it disappeared, but the line of its water course is still marked by a plaque on the arch of the School wall, at Brook End (SK 305272), which reads as follows:-

> "Under this arch once flowed the water to the Priory Mill. The arch was moved nine yards to the present position in March 1905"

It is some what surprising to have found at least six mills on such a short stream as the Repton Brook, some traceable back perhaps to Saxon times. However flour and feed were always staple foods and the mill on its stream was an essential factor to survival of the community in a rural area.

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Acknowledgement.

The thanks of the author and the editor are extended to Mr.S.E.Good for the preparation the map included in this article.

THE BISHOP OF LICHFIELD'S MILLS.

By Michael Cooksley.

The Bishop of Lichfield and Coventry had a number of estates throughout the Midlands. These included Prees in Shropshire; Wybunbury, Farndon, Tarvin, and Burton-in-Wirral in Cheshire; Sawley in Derbyshire; Chadshunt, Itchington and Tachbrook in Warwickshire and, in Staffordshire, the manors of Brewood, Cannock, Eccleshall, Haywood, Lichfield, Longdon, Rugeley and Whittington with smaller estates at Beaudesert and Blore-by-Eccleshall.

The accounts, where available, for 1350 to 1550 for these estates have been examined by Ian Rowney. In 1459 there were seventeen watermills, two windmills and four fulling mills as part of these estates. The watermills were at Wybunbury, Sawley(2), Prees(2), Brewood, Tarvin(2), Lichfield(3), Cannock, Eccleshall(4), and Haywood. There were windmills at Itchington and Burton-in-Wirral and fulling mills at Haywood, Eccleshall, Rugeley, and Prees. Another fulling mill was added at Sawley in the 1460s, and two horse mills, one each at Tachbrook and Itchington. After 1509 two windmills were erected at Longdon and another at Chadshunt. At Beaudesert the Fletcher family erected a private windmill in the 1520s, paying an annual rent of two shillings to the Bishop. The mills, besides symbolising the authority of the manor, since the tenants were required to use them for grinding corn and fulling cloth, were the Bishop's major industrial asset.

Excluding Wybunbury, where the mill income cannot be differentiated from the total manor, the mills' income was £89 in 1409 and rose to only £91 over the next 75 years. In 1472-3 general repairs to the estates totalled £73 of which £42 was taken up by mills, pools, dams and weirs. Estate buildings accounted for £27 (mainly building a tithe barn at Haywood), £3 on hedging and enclosures, and the remainder on miscellaneous items. The impression obtained from these accounts is that these were the minimum expenditure on repairs rather than any improvement to the estates. The amounts spent dropped further to £25 in 1525-6 and was even less in the 1540s when there was a threat of seizure by the crown. During this period the expenditure on enclosures increased and in the 1520s became greater than that on mills. In 1526-7 £36-5s-0d was spent on enclosures and parks (mostly at Haywood) and £12-3s-6d on mill costs.

The costs to the Bishop's estates of the mills were actually larger because the tenants of the mills could deduct from their rents the costs of any repairs, including replacement millstones. There were, furthermore, allowances for times when, due to damage and repairs in progress, the mill could not be worked. In 1448 the tenant of the malt mill in Lichfield was allowed 7s-8d per week for five weeks. A three month shut down of the fulling mill at Haywood resulted in the return of a quarter of the annual rent. In February 1465 there was damage from ice and flooding at Cannock resulting in repairs costing £4-13s-5d which

exceeded the rent by over a pound. In 1475-6 there was a major overhaul of the mills at Eccleshall. This cost £67-1s-7d which was nearly five times the annual rent. New dams of turf and wood were made, the machinery overhauled and the buildings improved. Since such a large undertaking was needed it could be surmised that the decline in income from £18-13s-4d in 1447-8 to £14 in 1475 was the result of the poor state of the mills. However it would appear that the problem was deeper than this since the mills continued to decline and in 1521-2 were worth only £9-6s-8d.

The overall impression of milling on the Bishop's estates is one of decline over the period of this study. It shows, perhaps, the decline in the power of the Lord of the Manor with the establishment of private mills.

After Henry VIII had broken with Rome many of the estates were lost to the Bishop by various devices. William Paget acquired several of these including Cannock, Longdon, and Rugeley. Many of the Warwickshire estates were sold off to the Duke of Somerset. Tachbrook and Chadshunt were lost to Queen Elizabeth I in 1559. So within a short period many of the estates and their mills were lost to the Bishop.

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THE ABANDONED WINDMILLS OF LANZAROTE.

By Salvador Hernandez.

Translated by Andres Coombes.

Lanzarote is one of the Canary Islands which lie between 70 and 250 miles off the coast of Africa some 700 miles south of the Straits of Gibraltar. The islands were known to the Romans about 40 B.C., however they were rediscovered by sailors from Spain at the beginning of the 15th century and have been recognised as Spanish since 1479. They are now one of the autonomous communities of Spain.

In spite of their southern latitude, the Canary Islands enjoy a maritime climate but with only a very moderate rainfall. The islands themselves are volcanic in origin and achieve considerable heights, above 8500 feet in one case, with very steep sloping hillsides. This means that watermills were not a suitable proposition as there is not the consistency of water supply available. This is due to the low rainfall which quickly runs off, and the fact that what rain there is, is much more importantly used as drinking water.

However, the islands are situated within the path of the north-east trade winds, which blow strongly all summer, and are only occasionally interrupted in winter by winds from the west to south-east. Consequently, over the years, the use of windmills has been the only practical way, apart from the use of muscle, to provide mechanical power.

In the past Lanzarote used to have many windmills. However with the advent of electricity, and the change from an agrarian to a tourist based economy, many of these windmills have now disappeared. As Plates 1 - 4 show, there were two distinct types of windmill; the simple tower mill, and the type where the sails are mounted on an open framed structure on top of a square building holding the milling equipment. A recent survey of the island shows that there are only sixteen windmills remaining, of which most are in various states of decrepitude.

Mala.

The total loss of the windmill at Mala, one of its most historical monuments, has drawn attention to the serious neglect of Lanzarote's windmills, which if not soon checked, will certainly result in their almost complete disappearance in the near future.

It would appear that the lack of cooperation between the authorities and private individuals has been the cause of the destruction of La Molina del Jable

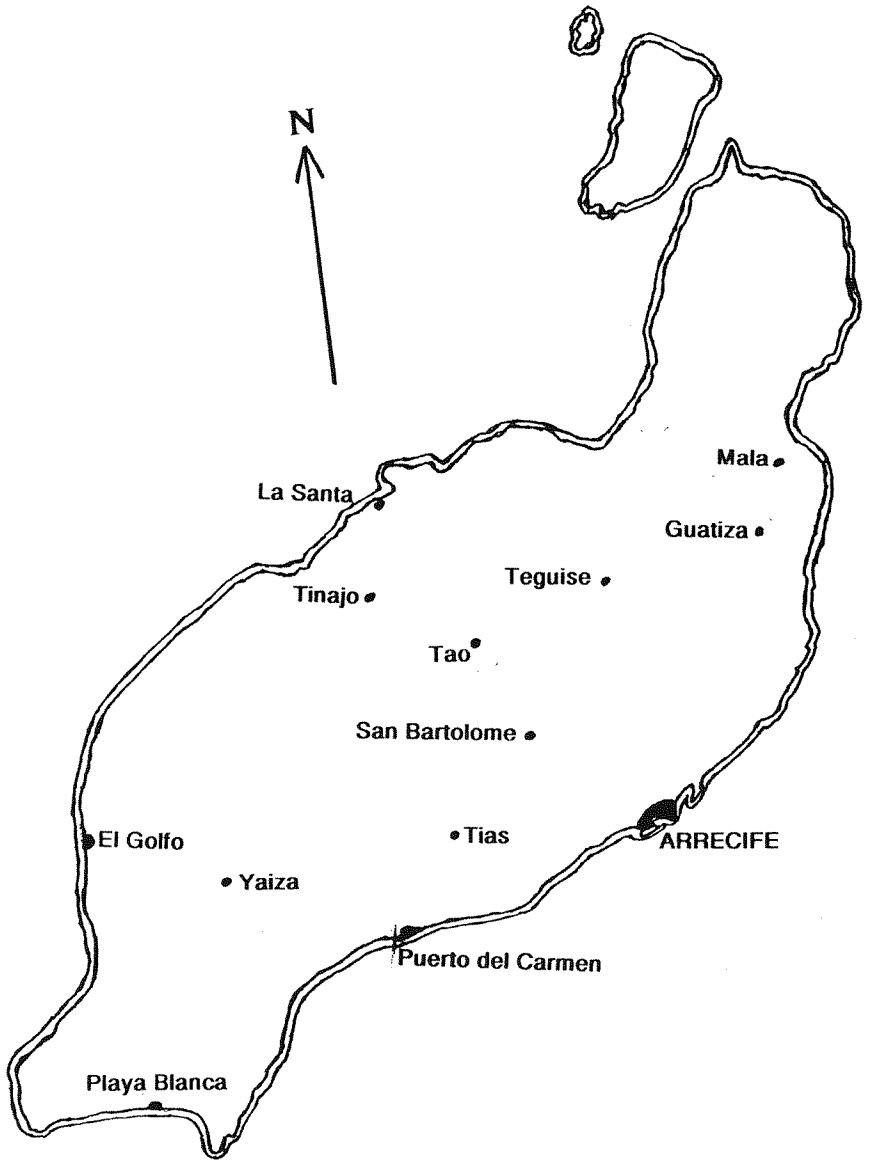

Figure 1. Map of Lanzarote.

in Mala which for many years has been a feature of the history of the village. Despite continuous warnings by *'Lancelot'*, a local journal for tourist information, the constant extraction of sand from round the base of the windmill (which cannot have benefited the perpetrators by more than a few miserable pesetas) has caused the progressive collapse of the structure.

Although the Council in Haria and the Gabildo Insular try to deny their responsibilities, claiming they have made every effort to preserve the windmill, the fact remains that it has been totally destroyed. Apparently the Council made an attempt to acquire the property but were not prepared to pay the price of half a million pesetas (approximately £2500) asked by the owner who promptly sold the sand and destroyed one of the oldest monuments in the village.

Arrecife.

In the area known as La Pedrera in Arrecife, 'El Molino de Verona', featured in Angel Guerra's book 'La Lapa', stands neglected and forlorn, disfiguring the approaches to the capital. According to Jose Maria Espino, the Mayor of Arrecife, it is intended to transfer the windmill to another site and build a small plaza around it. If and when this project is realised it will certainly enhance the northern approach to the town. Within the municipality there is another windmill near the Colegio Las Dominicas which is owned by Senor Juan Grimon. Restoration will be difficult, as only the base of the tower remains, but it does boast some very old stone walls which are in good condition.

Guatiza.

In the area round Guatiza there are no less than five windmills. Two of these are in the village itself. The one at the northern end surrounded by cactus fields, although in need of a coat of paint, is in exellent condition but of the other only the structure remains. The other three are in the surrounding hills, one of which until recently was used for the milling of straw. According to Dimas Martin, the Mayor of Teguise, two of the latter mills are the property of the Council, although nothing appears to have been done to preserve them. The third is privately owned and would not be too difficult to restore.

Teguise.

In the town of Teguise itself there exists a single windmill which is in a shocking state. It is owned by the first Corporation Insular, to whom repeated requests have been made to have it transfered to the local council, so that it could be restored at some future date. Meanwhile, of course, the process of deterioration continues.

The municipality of Haria, in which Teguise is situated, owns one other windmill in the Atalaya mountains which is beyond all hope of restoration as only a few stones remain.

Tias.

The municipality of Tias possesses two windmills. The one in Macher has had its sails disconnected and has been converted to electric power, but profits have dwindled to the point were it is no longer a viable proposition and it has ceased operating. The other one, situated in the village, has had its sails and working parts removed and is being used as a storeroom. Florencio Suarez, the Mayor of Tias, maintains that the windmill in Macher is in good condition and requires no restoration, whilst the one in Tias, despite also being privately owned (as though this were some hinderance to its conservation), has been well preserved in so far as the structure is concerned.

San Bartolomé.

The municipality of San Bartolomé possesses three windmills which the Mayor's Lieutenant says "we will not allow to be destroyed, nor on the other hand, can we undertake to preserve them." A statement which would not seem to augur well for their survival. The first of these windmills is in Guime where, many years ago, it was brought stone by stone from Munique, but it is now in ruins. The second, popularly known as the 'Don Juan Gil', is in the town of San Bartolomé and is still in use, although the power from the wind driven sails has been replaced by an electric motor. The third, known as the 'Don Juan Armas', is also in the town, but has not been used for many years and is badly in need of restoration.

Tinajo.

In Tinajo only two windmills remain, 'El Molino de Pio' and that owned by Domingo Abreut at the entrance to the village, which according to the Mayor's Lieutenant has been declared an historical monument by the Council. The Gabildo Insular has stated that they have attempted to purchase the latter mill but have not been able to agree a price, so that restoration has proved impossible. The inability of the local Councils to find the money to acquire these windmills for restoration seems to be a recurring theme.

Yaiza.

Finally we come to Yaiza where the mayor Honorio Garcia Bravo would appear to be the one most conscious of the need to preserve the island's windmills. For some time he has been trying to acquire the one situated at the entrance to the village in order to carry out a complete restoration and replacement of the sails, but it would seem that this has proved difficult as it is owned by a foreigner. The mayor has also stated that he is anxious to restore the one in Playa Blanca. To this end negotiations have been going on with a construction company who are prepared to undertake the necessary work providing they are allowed to display a small publicity placard on the site. It is fifteen years since the windmill was in use and presumably conditions imposed

by the company are proving a stumbling block to its restoration. There is a third windmill in the town of Yaiza, the 'Gritano', which it is hoped to restore despite it being in very poor condition.

It is understandable that, prior to the boom which struck the island several years ago, the funds available to the Councils were needed for more important schemes. However one cannot help feeling that some of the money now pouring into the island should be earmarked for the restoration of Lanzarote's windmills before it is too late to save what little remains of these landmarks of the island's history.

Editor's Note.

The Editor would like to thank the publishers of *'Lancelot'*, the magazine for tourists to the island of Lanzarote, and also to Max Sinclair, miller at the Danzey Green Windmill, in the Avoncroft Museum of Buildings, who brought this article to the editor's notice.

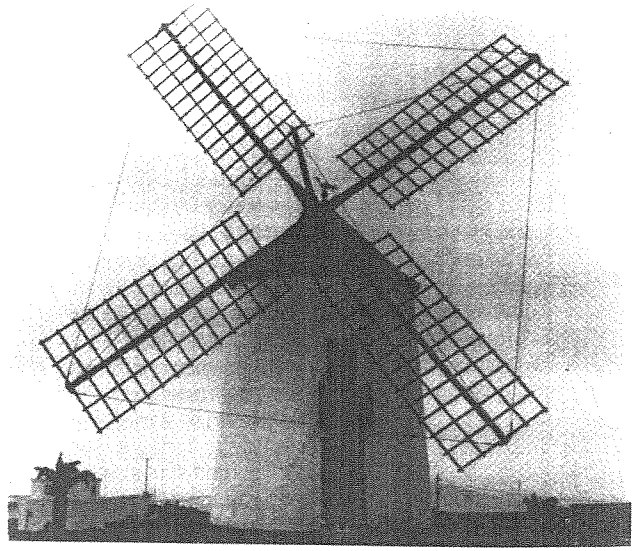

Plate 1. The restored windmill at Tao.

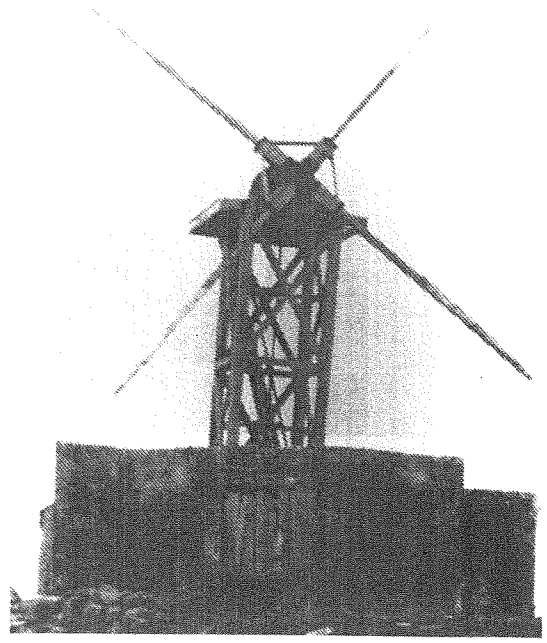

Plate 2. The 'Don Jaun Armas' windmill at San Bartolomé.

Plate 3. 'El Molino de Verona' at Arrecife.

Plate 4. The remains of the windmill at Tias.

SHIFFORD'S GRANGE FARM MILL, THE DISCOVERY OF A PREVIOUSLY UNRECORDED INSTALLATION.

By Barry Job and George Riley.

Shifford's Grange is sited just off the A53 road on the outskirts of Market Drayton, Shropshire, although the grange itself is on the Staffordshire side of the county boundary, SJ 697353, (see Figure 1). It belonged to the Abbey of Combermere in Cheshire from the 12th Century to the Reformation[1] and it is reasonable to assume that it was once farmed by the monks from the Abbey.

The mill does not feature in any of the standard reference works for mills in Staffordshire and therefore it can be said that its existence was relatively unknown. However, during research for the book on the watermills in the Borough of Newcastle, Staffordshire,[2] at the Keele University library, a reference was found which stated that, in 1814 water was brought from Daisy Lake to the grange by an artificial channel, thereby "affording water power and means of irrigation"[3]. Water power surely meant a waterwheel, and on a subsequent visit to the grange, the lady of the house pointed out a small brick building on the side of the main farm building. On opening the door, the remains of a pitchback wheel were seen below.

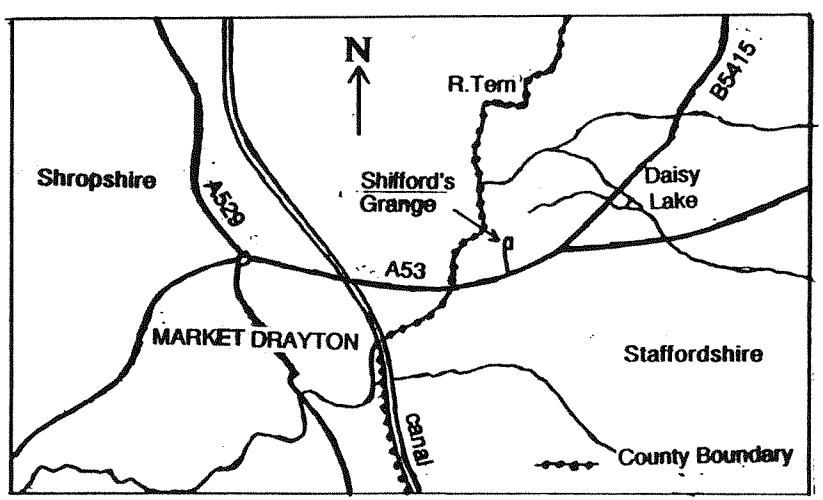

Figure 1. Location Map.

Daisy Lake was then visited, for this had been the water source mentioned in the original reference. The lake was fed from the Hempmill Brook, a tributary of the River Tern, and evidence of a weir and a deep channel was found. A culvert under the B5415 road had carried the headrace into a field opposite. It was then noticed that the 1968 Ordnance Survey map[4] clearly showed a "drain" from this point to the grange across the fields, nearly a mile away. The remains of the headrace ran across several fields, following the hedge boundaries, but had been ploughed in places. It is estimated that it had originally been about five feet wide and six feet deep and its construction in 1814 must have been a considerable task without mechanical aids. At the grange the channel led to a sunken area which had been the site of the pool, now dry. It is estimated that the pool area had covered about 1250 square yards (see Figure 2). A decayed overflow sluice and the remains of a ditch going down to the River Tern could also be seen.

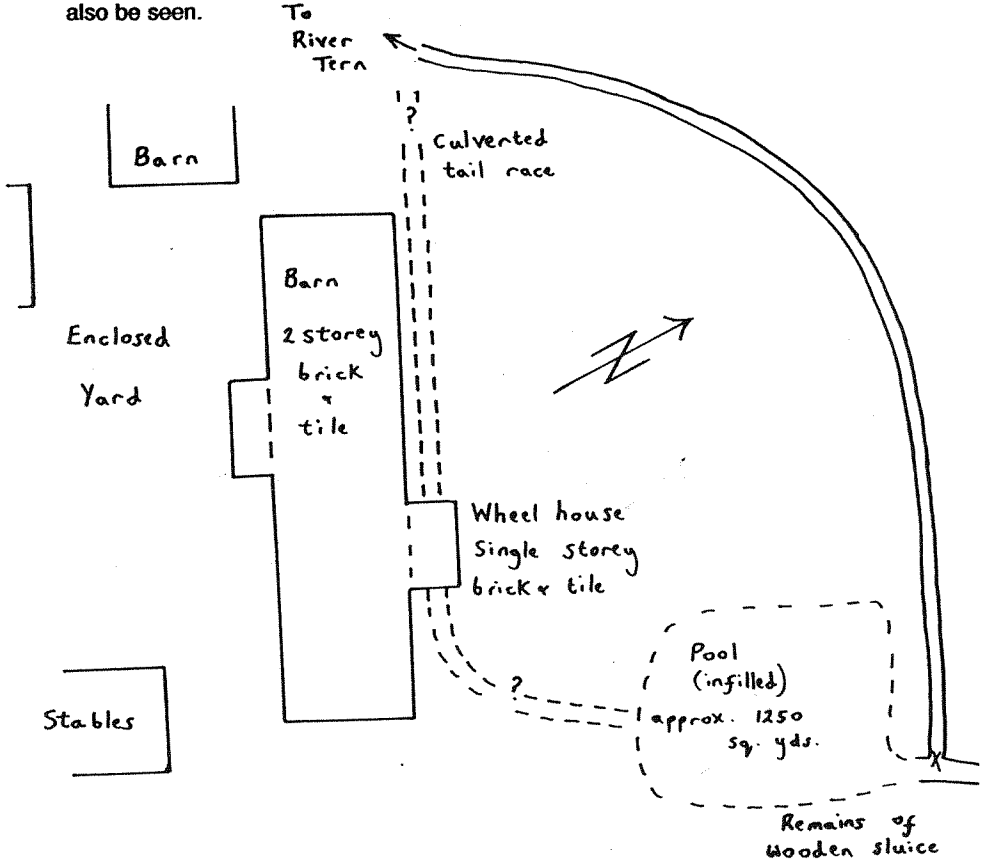

Figure 2. Generalised Layout of Shifford's Grange.

From the pool, the water had been channelled to the building housing the wheel, and had been controlled by a hand operated sluice on the headbox. The installation had been well thought out, and, dating back to 1814, must have been an early installation for a private purpose. The mention of "miller" in a London Gazette notice of 1837 would suggest that at a later stage it was doing work for outside customers. It has not been possible to ascertain when the mill ceased working, but it is believed that it finished at the end of the first World War.

Recently, it was a great shock to learn from the owner that the roof and part of the wheel building had been damaged by a storm, following which he had demolished the rest of the building and "filled in the wheel"! Fortunately we had previously been able to measure methodically and photograph the entire installation for posterity.

Technical Description.

The pitchback wheel was found to be 12 feet in diameter and 3 feet 6 inches wide (see Figure 3.) It was constructed in two halves, the rim and six spokes were of iron, as was the shaft. The wheel pit was completely below ground, and was partly filled with debris, but when examined a maker's name could not be found on the wheel. A rim gear on the inside of the wheel drove an iron bevel gear on a vertical shaft which was carried in bearings bolted directly to the barn wall. Towards the top of the shaft there was a second bevel gear driving a third on the end of a length of horizontal lineshafting sitting in bearings now carried on angle brackets. This lineshafting carried a single flat belt pulley, and there were sloping slots in the barn wall to take the belt up to the first floor. Interestingly, the belt must have slipped on this pulley as it was wrapped with rope as a means of increasing the friction.

A novel method was used to disengage the drive. On the angle bracket directly behind the line shaft bevel gear, the bearing sat on a plate hinged close by the wall (see Figure 4). This plate dropped over a substantial, slotted peg and was secured by a tapered wedge through the slot. A second wedge (also shown on Figure 4) did not appear to perform any useful function. Thus with the wedge removed from the peg, a pivoted lever could be depressed. The hinged plate, complete with bearing, bevel gear, and lineshaft, could be lifted up, via a lifting ring and hook, to take the gear teeth out of mesh. There would appear to be an engineering problem in that the lifting lever and the plate were hinged at opposite ends of the angle bracket. Thus their arcs of movement were opposite and the amount of movement would hence be restricted, although there was obviously sufficient for the mechanism to work, the oval link being practically worn through with use. Also there did not appear to be any method of holding the lever in the depressed position. If the wedge was re-inserted, would this keep the teeth sufficiently out of mesh? This did not seem likely. Or did the second wedge originally perform some function in this respect?

On the first floor of the barn another lineshaft sat in bearings and brackets bolted to the wall (see Figure 5). This carried fast and loose pulleys, which drove a belt. This belt then passed down through the floor, where it drove a belt pulley,

and hence a pair of bevel gears, to the underdriven pair of French burr stones (see Figure 6). Tentering was achieved by turning a nut on a threaded rod where it passed through a wooden beam. This raised or lowered a pivotted cast iron beam carrying the vertical shaft and runner stone, as well as one of the bevel gears. Thus tentering would alter the mesh of these gears, although this was not critical. The bevel gear could be jacked out of mesh by turning two ring screws which passed through a fixed collar into the gear (see Figure 7).

On the other end of the lineshaft was a fixed belt pulley which drove a pulper which carried the maker's plate - James Clay Ltd. of Wellington. This machine was sited directly in front of, and practically blocking, an internal doorway so was obviously a later addition. It incorporated its own elevator bringing the root crop from the lower end of an inclined tubular iron cage housed in the southern extension to the barn (see Figure 2) and driven by the elevator. Presumably the crop was collected in the yard and thrown into the rotating cage. This knocked off the soil as it travelled down to the elevator. Here it was carried up, so as to fall into the pulper. The pulped crop then fell down a chute back to the ground floor, from where it could be shovelled away. There is evidence that at one period this interesting machine had been converted to be driven by an electric motor.

Although the brickwork of the wheelhouse had not been tied in to the brickwork of the barn, which suggested a later addition, the substantial stonework of the wheelpit indicated a construction contemporary with the barn. Originally the wheel would have driven the single pair of stones, with the pulper being added later. Before its recent demise the machinery was relatively complete, although the drive belts, one pulley, the runner stone, and all of the stone furniture were missing. The gear teeth were very worn and the wooden buckets and sole plates had rotted away. The water supply was completely absent, but if water could have been brought to the wheel it was conceivable that the machinery could have been made to turn without too much effort. Sadly that is not now the case. The wheelpit is completely filled in with the debris from the wheelhouse, with undoubted damage to the wheel (which is, of course, no longer visible). Also the headbox is not visible (presumably it is also in the wheelpit) and most of the drive mechanism shown in Figure 3 is damaged. Thus it is now extremely unlikely that the machinery will ever be made to turn again.

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1. "The Collection for a History of Staffordshire." p.12. Staffordshire Record Office. 1945 & 1946.

2. Riley, G. "The Watermills of the Borough of Newcastle." Borough of Newcastle-under-Lyme and The Centre for Local History, University of Keele. 1991.

3. "The Collection for a History of Staffordshire." p.259. Staffordshire Record Office. 1945 & 1946.

4. Ordnance Survey, Sheets SJ63NE & SJ73NW, 1968.

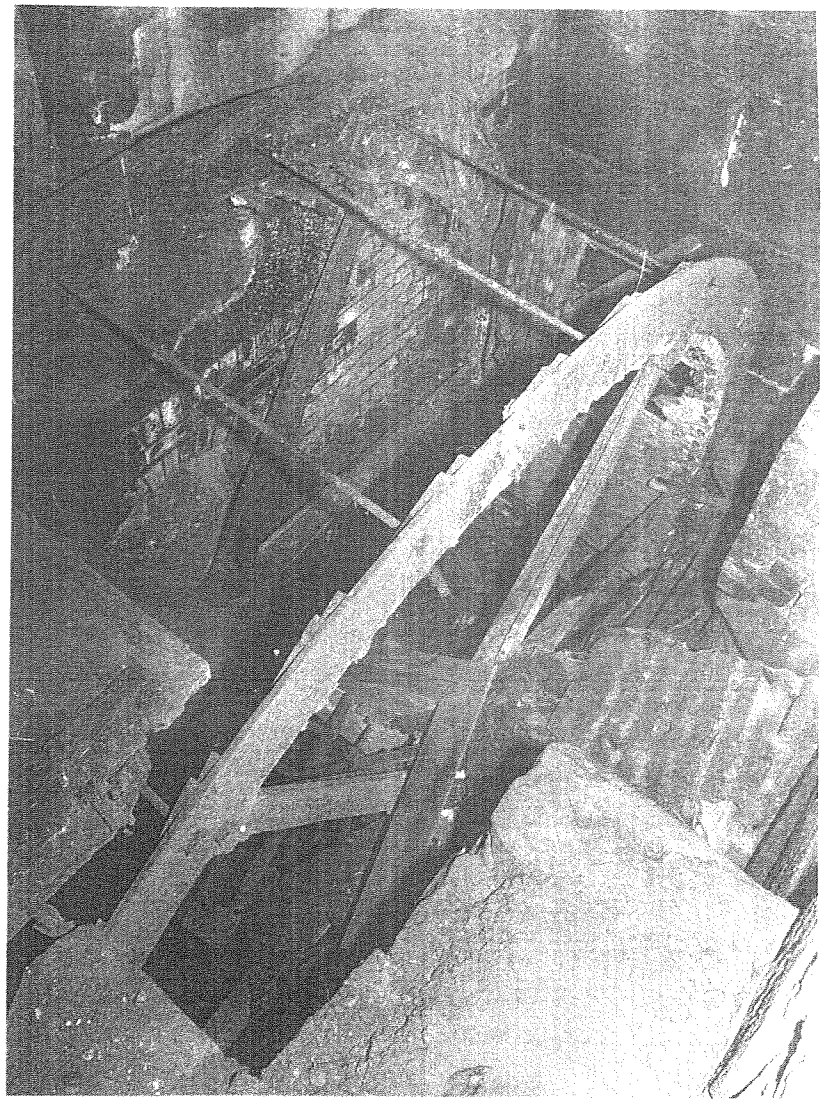

Plate 1. The Remains of the Pitchback Waterwheel.

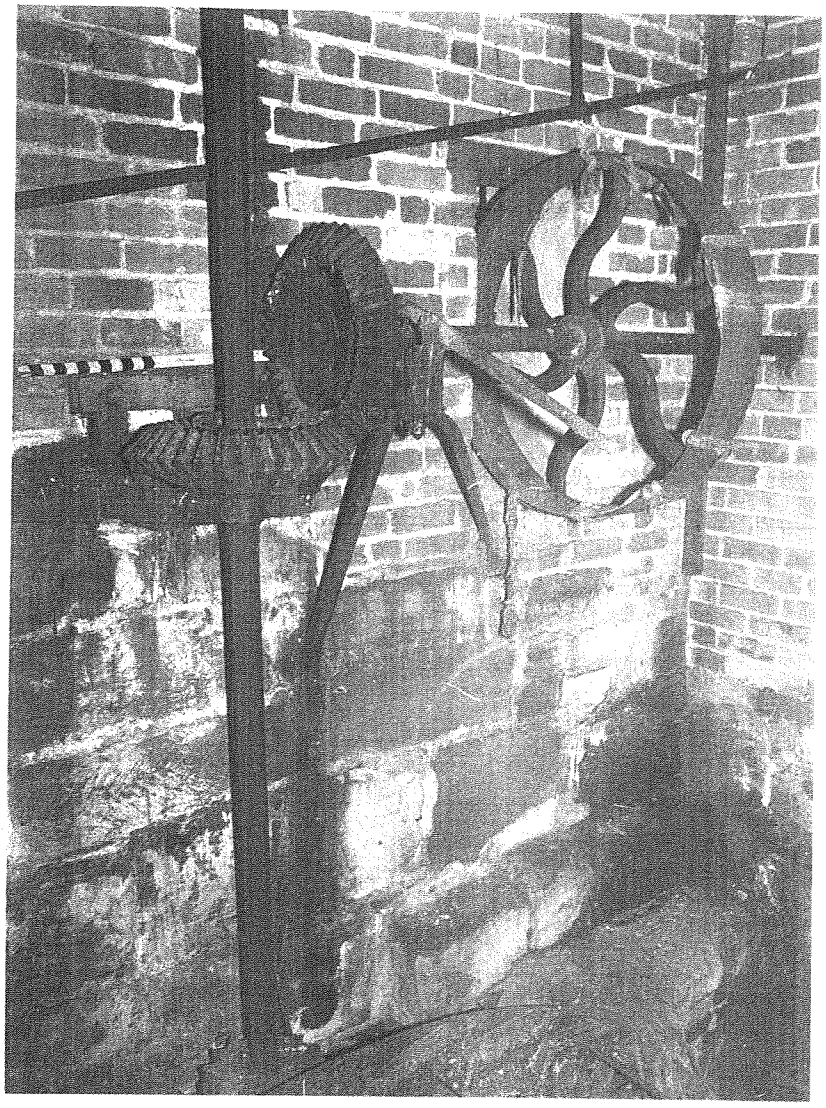

Plate 2. The Method of Disengaging the Drive Mechanism.

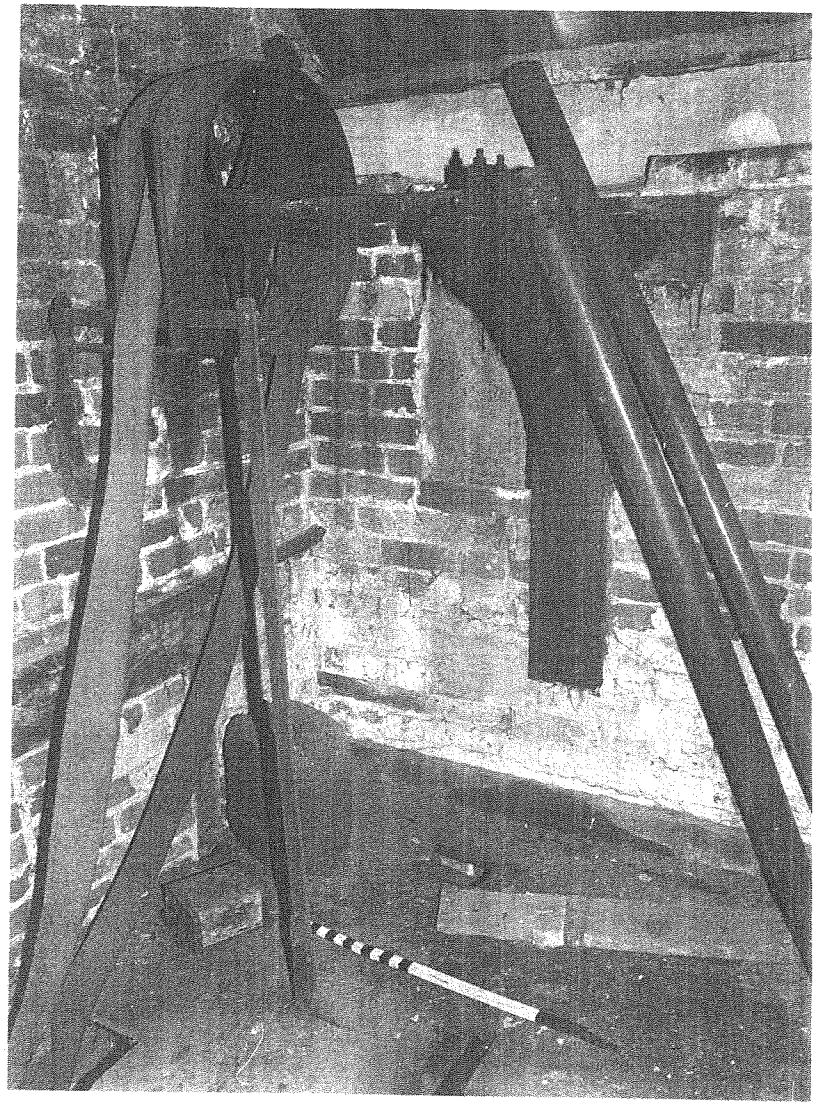

Plate 3. Belt Pulley on the First Floor.

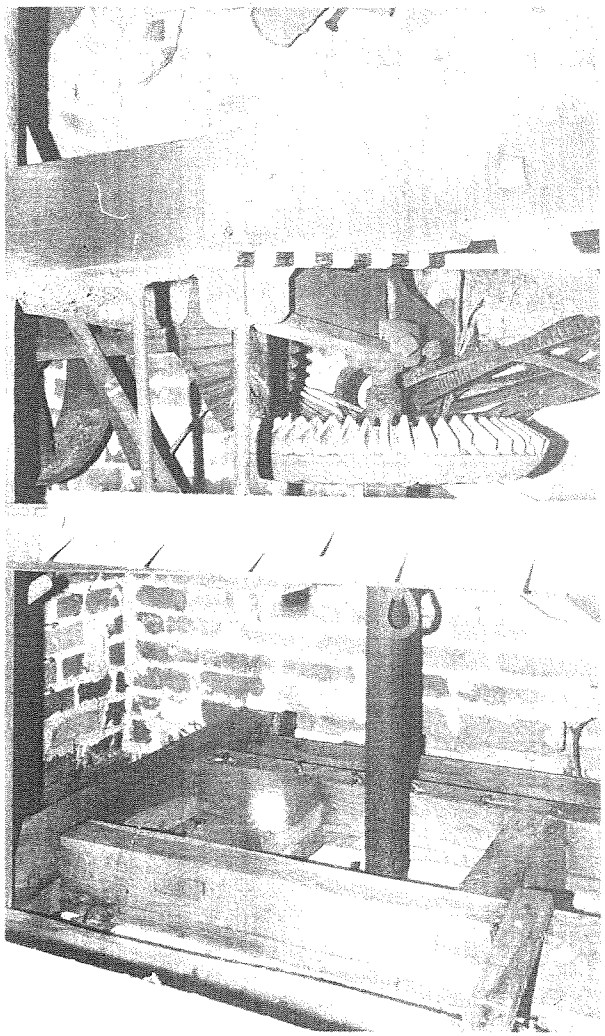

Plate 4. The Drive to the Millstones.

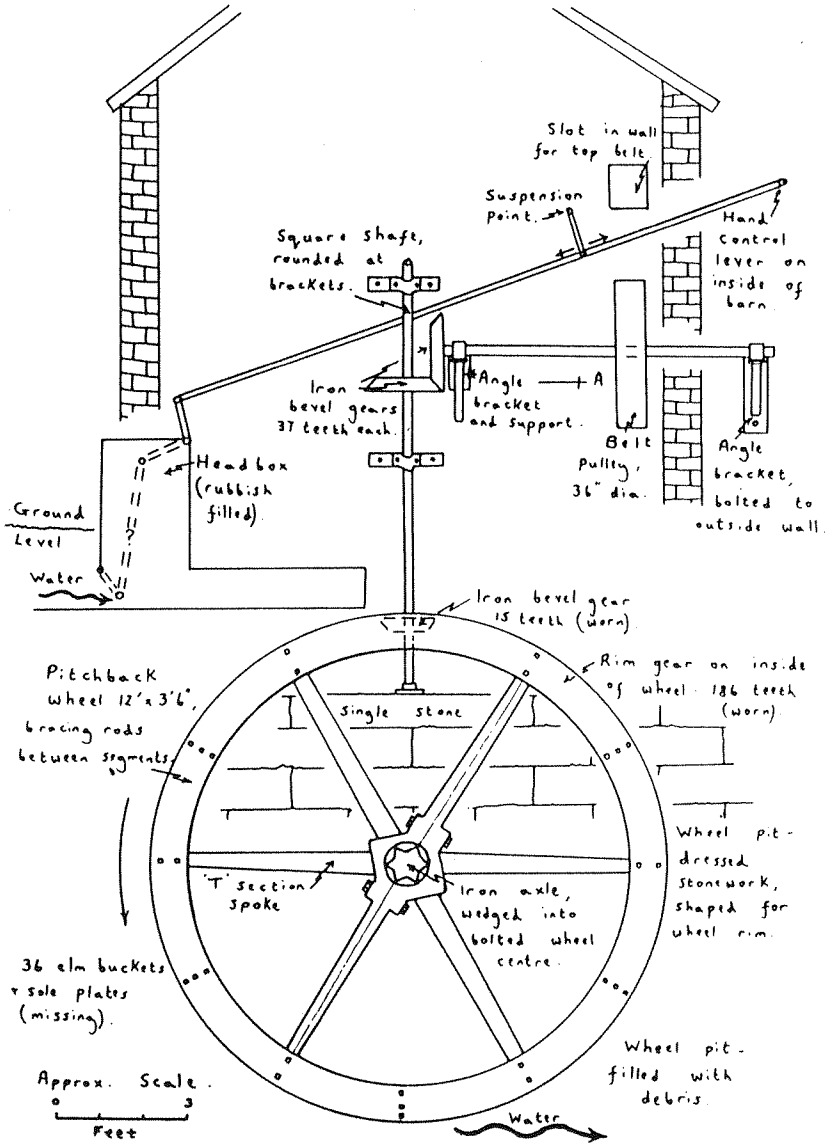

Figure 3. Wheel and Drive Mechanism, Elevation.

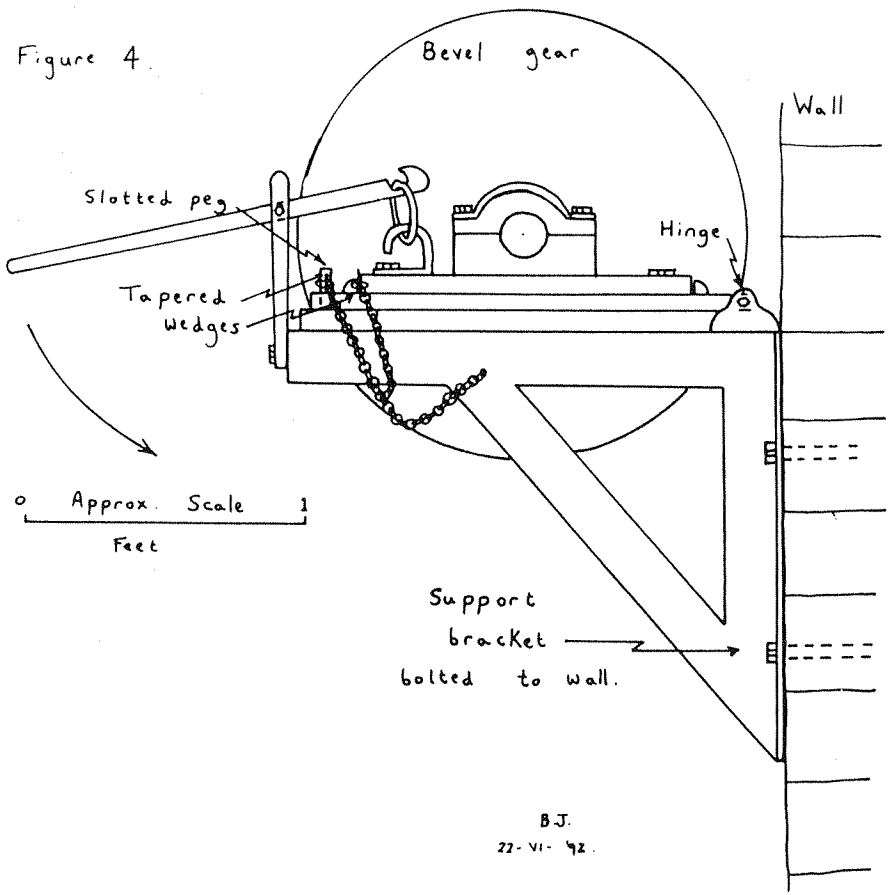

Figure 4. Method of Disengaging the Bevel Gear Drive, (Elevation on A).

The asssembly is situated directly behind the bevel gear. The left hand wedge is removed (the right hand wedge does not appear to perform any important function) depressing the lever then lifts the hinged bearing plate with the bearing, shaft, and bevel gear. The oval lifting ring is very badly worn.

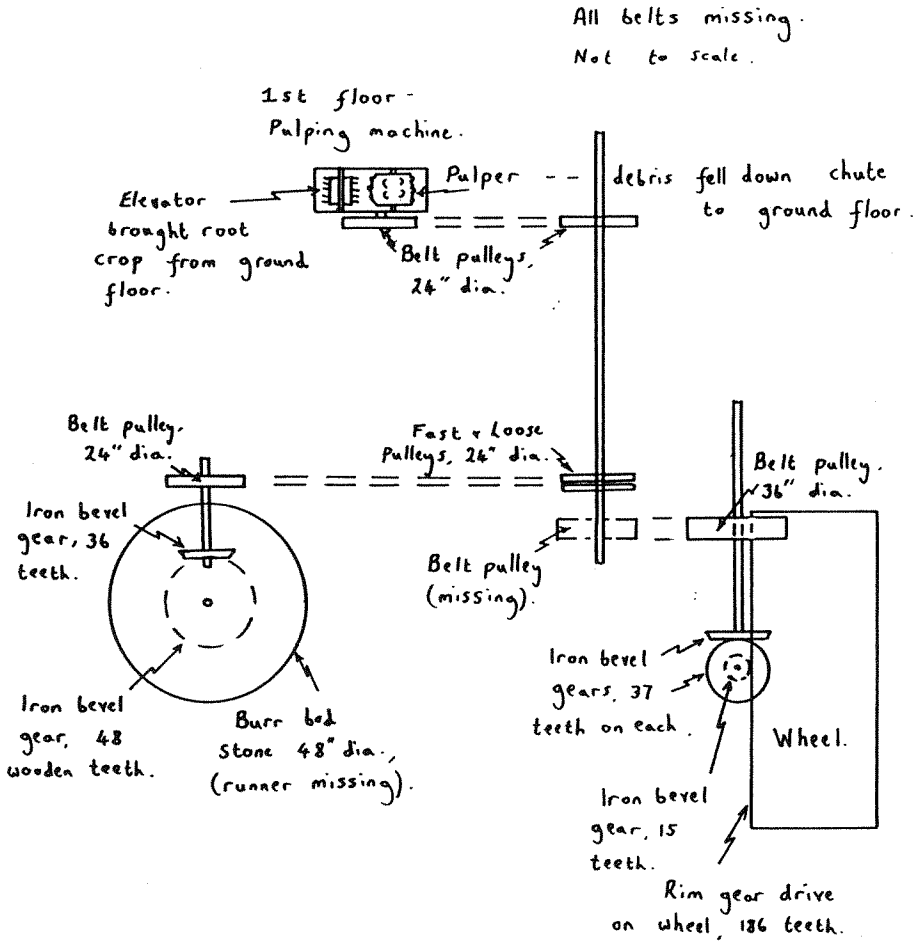

Figure 5. Drive Layout Plan.

The wheel drove a vertical shaft through bevel gears to a horizontal shaft and a 36 inch belt pulley (wrapped with old rope to prevent the belt slippage). The belt passed through slots in the wall to the layshaft on the first floor. The belts then passed to the pulping machine and down below the floor to the underdriven stones. If the missing belt pulley had a 24 inch diameter then the gearing to the stones would have been 1:14.

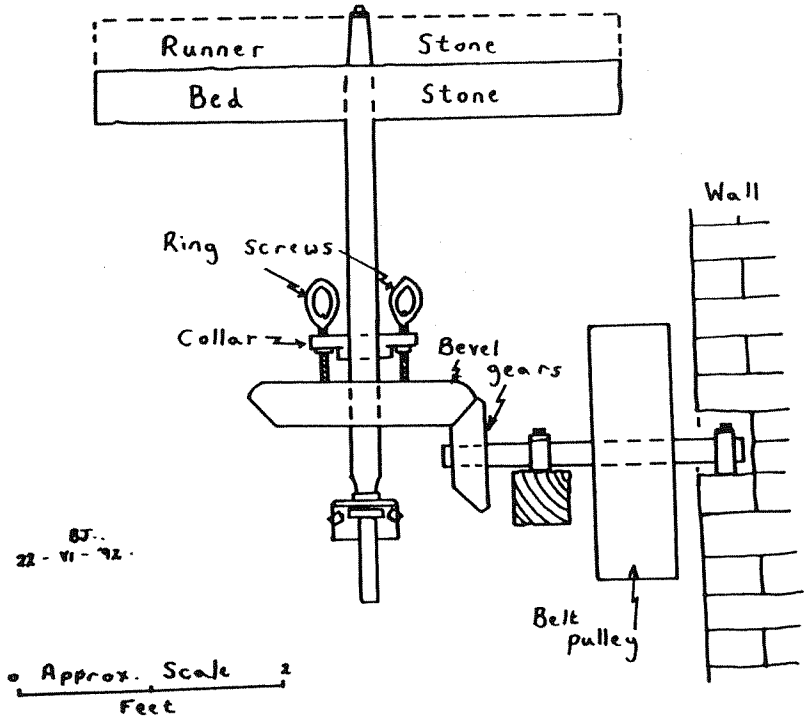

Figure 6. Drive to the Runner Stone (missing).

The drive could be disengaged by turning the two ring screws and lifting the top bevel out of gear. Tentering would slightly alter the mesh of the bevel gears.

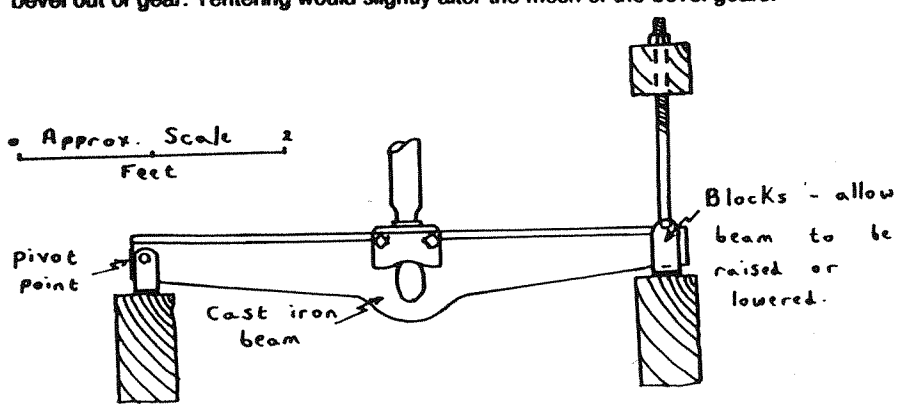

Figure 7. Side view of the Tentering.

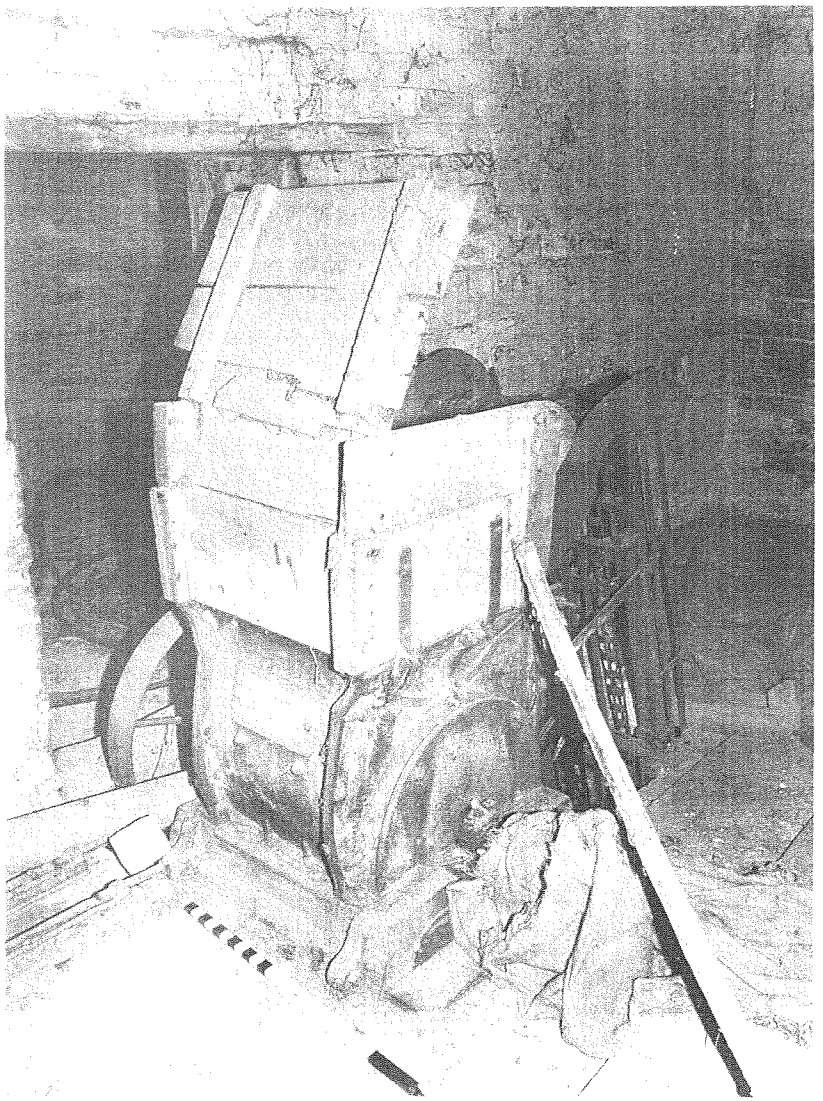

Plate 5. The Pulping Machine.

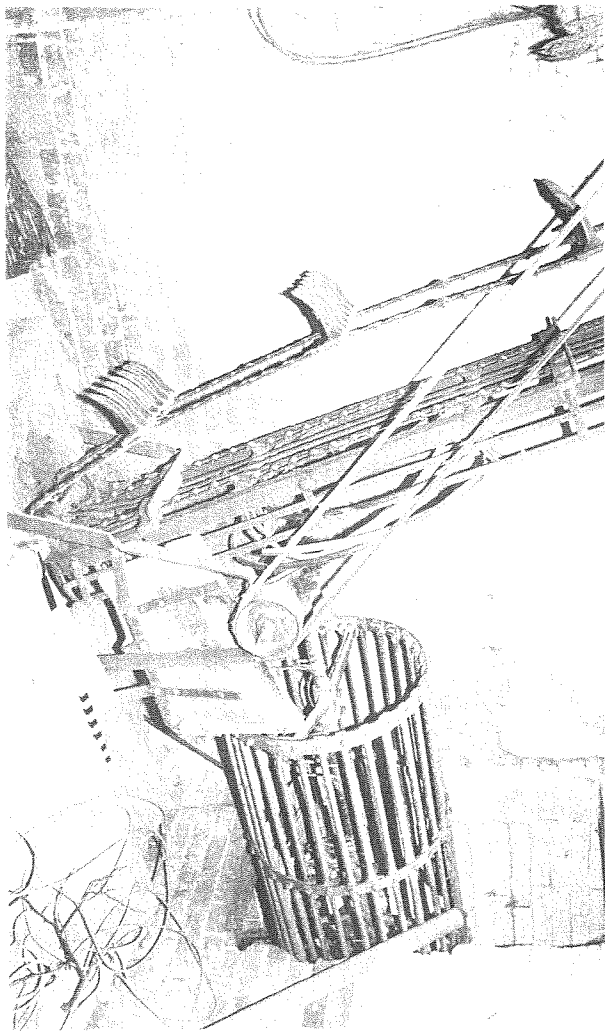

Plate 6. The Rotating Iron Cage and its Elevator

THE WATER POWERED HOISTS AT CASTLEFIELD.

by Cyril T.G.Boucher

In 1760 the Duke of Bridgewater was granted an act of parliament enabling him to build a canal from his estate at Worsley, 7 miles from Manchester, to Castlefield in the city. The main purpose of this canal was to carry coal from the Duke's mines at Worsley to the potential market of the growing metropolis of Manchester, cheaply but profitably. The resulting Bridgewater Canal was due to the combination of the skills of the Duke, his agent John Gilbert, and James Brindley, a well known millwright at that time. The canal was a wholly artificial waterway of about 9 miles in length and therefore had to have a constant supply of water to compensate for losses. This was achieved at Worsley by connecting it into the coal mines themselves, acting as a drain and also providing an underground navigation to take the coal direct from the working faces. Eventually these underground canals were 46 miles in length, on two levels, connected by an inclined plane.

At the Manchester end of the canal, at Castlefield, the River Medlock formerly flowed by the foot of a sandstone cliff and entered the River Irwell. Where the Medlock passed under the Chester Road, Brindley constructed a weir and a tunnel (see Figure 1C) which carried the waters of the river at a depth of about 12 feet below the ground across to an outlet some 400 yards away. Having thus diverted the river he brought the canal along, above the tunnel, to meet the Medlock at its upper level at the weir. Everything thus far described is still existing and can be seen by anyone who cares to look over the eastern parapet of the road bridge and see the weir and tunnel, or over the other parapet and see the canal coming up to it.

This is a very complex way of achieving the simple objective of supplying water for a canal from a river, obviously the arrangement described was designed at its outset to provide a potential source of energy (i.e. a head of water) to drive machinery, as well as filling the canal. The first use of this energy was to power a hoist (see Figure 1A).

In 1763, as part of the terminal facilities of the Bridgewater Canal at Castlefield, Brindley designed a navigable branch that entered the cliff face as a large tunnel, approximately twice the length of that now existing. Half way along the tunnel was a vertical shaft that ascended to the surface, about thirty feet above the water below. The lower end of this shaft can still be clearly seen. Beyond the end of the large tunnel, continued another much smaller tunnel capable of taking the small mine boats - known as 'starvationers' because they were very thin and it was possible to see their ribs! - which came from the underground canal at Worsley. They were 47 feet long by 4.5 feet wide and

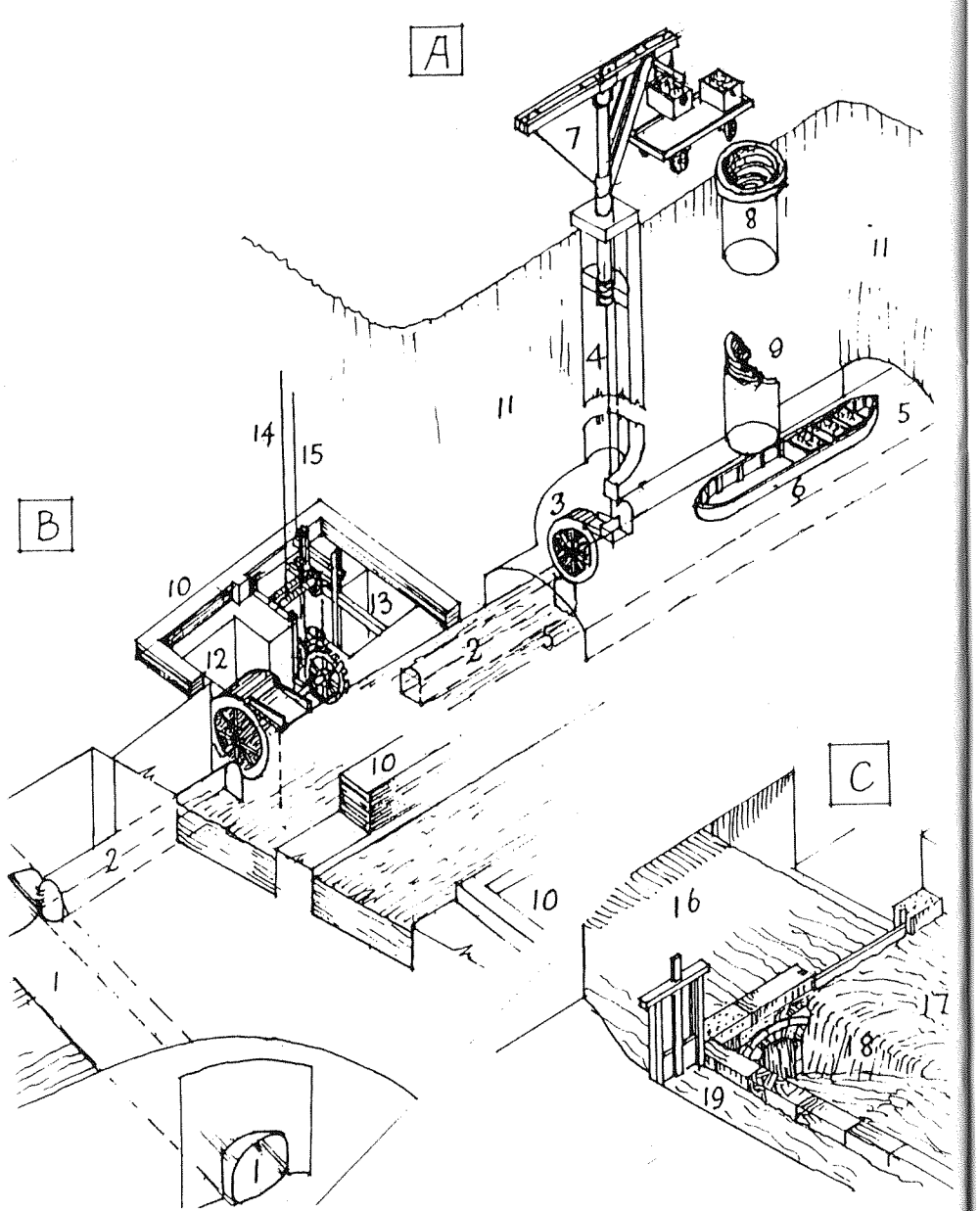

Figure 1. The Waterpowered Hoists at Castlefield.

The Water Powered Hoists at Castlefield.

Sectioned Isometric View.

Key to Numbers

Figure 1A. James Brindley's Coal Hoist of 1761.

1. Tunnel carrying River Medlock under the canal.
2. Branch tunnel taking waste water from the water-wheels.
3. Waterwheel and slack chain winding barrel with the penstock to admit water from the canal.
4. Rope shaft with winding rope & control rope.
5. Canal branch entering cliff face as a tunnel.
6. Mine boat or 'starvationer' loaded with boxes of coal.
7. Swivelling crane loading a box of coal on to a road vehicle.
8. Winding shaft up which the boxes were drawn out of a starvationer.
9. Portion of the winding shaft still existing as shown, alongside the towpath of the Rochdale Canal.

Figure 1B. The Grocers Warehouse of c.1765.

10. Outline of the walls of the warehouse.
11. Cliff face cut away to show the machinery to A & B.
12. Waterwheel of 12 feet diameter with flume & penstock. The wheel is housed in a pit, and water descends into branch tunnel 2.
13. Adjoining pit holding hoisting gear as shown. There was originally a second winding barrel serving the second loading hole.
14. The hoist chain relayed over the vessel being unloaded.
15. Control cord which operates the slack chain drive.

Figure 1C. The Entrance to the Underground Tunnel.

16. Chester Road-Deansgate bridge and the start of the canal.
17. River Medlock above ground.
18. Wier where River Medlock overflows into tunnel.
19. Penstock and feeder to canal.

carried 12 iron boxes each with a capacity of 8 cwt. This small tunnel extended to the yard of the Grocers Company near Bridgewater Street, (see Figure 1) and there was doubtless an access shaft there. In the large tunnel, on the left hand side at water level, a small arch leads into an underground chamber wherein was housed a waterwheel which powered a crane on the surface, over the vertical shaft previously mentioned. The examination of remains in 1960 determined that the wheel was about 10.5 feet in diameter by 4 feet 4 inch wide.

A second parallel shaft was provided for the winding rope which was thus kept clear of damage by the ascending or descending load or its carrier. This crane was used to lift the twelve iron boxes out of the starvationers, one at a time. The water to power the wheel was drawn from the canal at a sluice gate placed in the small arch. Of course water can only have power as it descends from one level to another, and so here the water drove the wheel and descended some ten feet into an underground exit which connected to the tunnel carrying the River Medlock below the level of the canal. This scheme is fairly clearly shown by the accompanying illustration, (see Figure 1A), though no guarantee can be given as to details and actual dimensions. On the 1st August 1765, the *Manchester Mercury* reported:-

> "There is a large tunnel in Castlefield under the hill in which will be a bucket wheel to draw up the coals brought in boxes fixed in the boats and when discharged, will be landed where the way to Manchester is so level that a good horse may easily draw one ton to any part of that town".

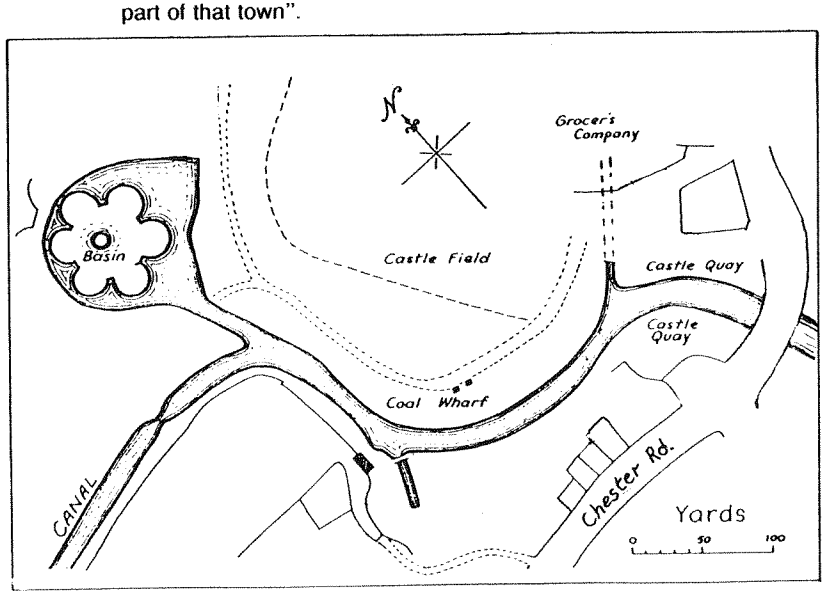

Figure 2. Plan of Castlefield Basin, 1765. (Reproduced by kind permission from *'The Canals of North-West England'* by Gordon Biddle & Charles Hadfield.)

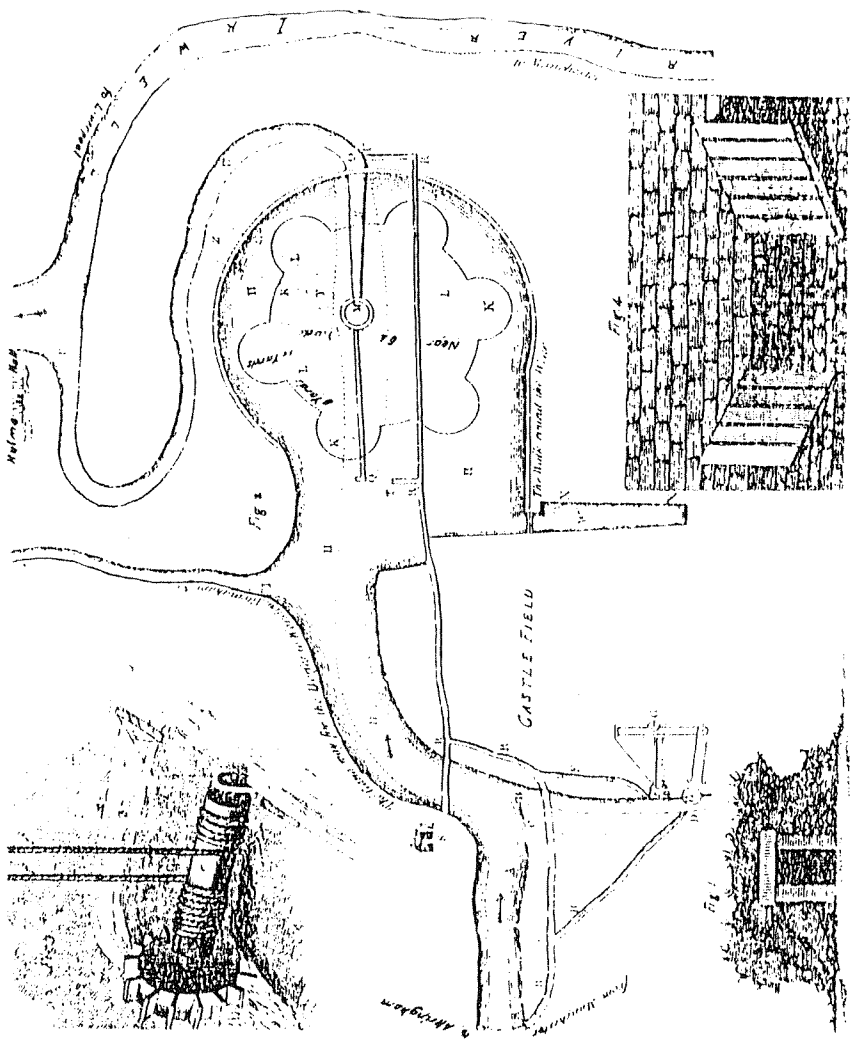

Figure 3. Details of Castlefield Basin from A.Young's *'A Six Months' Tour through the North of England,'* 1770, showing the Waterwheel and Crane.

Arthur Young, in his contemporary publication, describes how two men and a boy were employed in the unloading and that the unloading of the cargo of about five tons could be discharged in twenty to forty-five minutes, according to the height of the water in the channel. When the water was high the working of the waterwheel was impeded.

To minimise fluctuations in the level of water the Bridgewater Canal had a big foliate weir, (see Figures 2 & 3). The purpose of the six foliations was to provide a large perimeter to the weir, in a confined space, over which flood water could pour without raising the level of the canal. In this case the total length of the weir was 360 yards. The water runs into the basin shown and then out at the bottom into the adjacent river at a lower level. The foregoing work is refered to in Brindley's diaries for 1763 which accurately fixes the date of construction.

At the time of the opening of the Rochdale canal in 1804, all this apparatus went out of use. The Rochdale Canal - at that time traversing Gaythorn Tunnel (see Figure 4) - cut right through Brindley's tunnel where the vertical shaft goes up. Standing on the old coal wharf in Deansgate, now so pleasantly converted into a small park, picnic area and mooring for cruisers, the intersection can clearly be seen. Gaythorn tunnel was opened up very many years ago, but the cut still runs through the solid rock. At the point where it cuts through Brindley's tunnel, the towpath wall changes to brickwork, while alongside the towpath, somewhat surprisingly, part of the vertical coal winding shaft rises up, clearly to be seen. Quite recently, a party employed in cleaning up the Rochdale Canal towing path, but lacking proper supervision, cleared away the considerable remains of the old winding shaft (number 9 on Figure 1) which had stood there for about 225 years. It is hoped that the authorities will reinstate and suitably label this significant object. The second or rope shaft cannot be seen but it still comes up to the underside of the pavement in Castle Street which runs between the Rochdale Canal and the Bridgewater Canal at this point.

Returning to the Bridgewater Canal, soon after 1765, Henshall & Gilbert built a warehouse in front of the cliff face and included in it one shipping hole, which lines up with Brindley's tunnel. A second shippng hole was inserted later, as can be seen from the remains of a window which it cut through. Hugh Henshall was Brindley's brother-in-law and partner in his engineering practice. After Brindley's death in 1772, Henshall continued as engineer of the Bridgewater, the Grand Trunk or Trent & Mersey, and the Chesterfield Canals, while he subsequently became General Manager of the Grand Trunk Canal. It is believed that the Gilbert in the partnership was Thomas, agent to Earl Gower, one of the principal promoters of the Grand Trunk and not his brother John, agent to the Duke of Bridgewater. Before the coming of the railways, canal companies were strictly prohibited from acting as common carriers. To evade this restriction the Grand Trunk set up a carrying company which they financed but which traded under the names of Henshall & Gilbert who were their servants. When in 1777 Gilbert dropped out of the partnership, it became Henshall & Company. In due course, with business changes, the warehouse passed around 1811 to the Manchester

Grocers Company and was known thereafter as the Grocers Warehouse.

To power the hoists in the new warehouse, machinery was designed and installed as illustrated, (see Figures 1B). Inside the building, on the left of the left hand shipping hole are two large pits. The nearer pit houses a powerful overshot waterwheel of composite construction, twelve foot diameter and six foot wide. The further pit holds the hoist machinery. A pit wheel on the waterwheel axle engages with a cogwheel on a layshaft, at the other end of which is a V-pulley. Up above at ground level is a second V-pulley mounted on a winding barrel capable of being raised. The two V-pulleys are connected with a chain band. When the upper shaft is raised, the chain tightens and the winding barrel commences to rotate, thus winding up goods from the boats to the various levels of the warehouse. The winding barrels were duplicated, the left hand barrel winding from the left hand shipping hole, and the right hand barrel from the right hand hole. All this machinery had no connection with the older coal lift inside the cliff as described earlier, but the two systems may have worked simultaneously for some years. From the presence of all iron gear wheels, as distinct from wooden, and iron mortice wheels, it is possible that some of the warehouse machinery may have been renewed, perhaps about 1850, but the design goes back to the original installation.

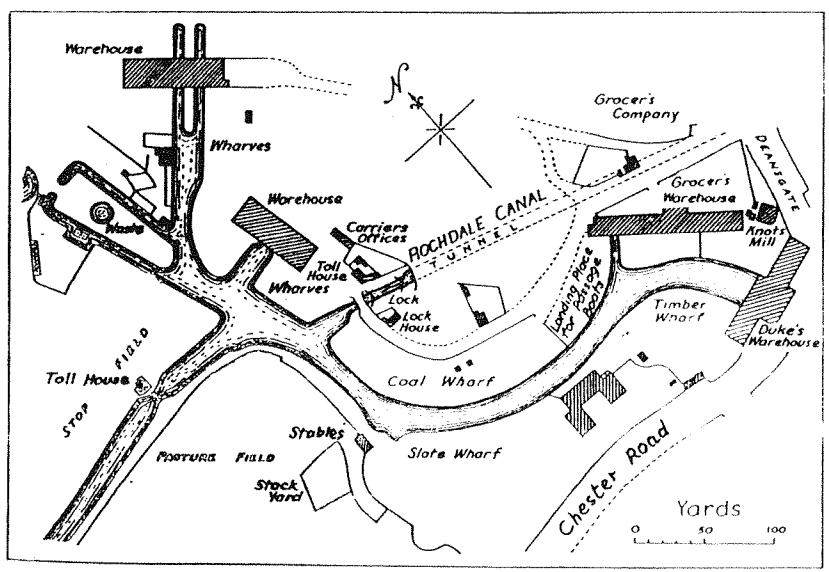

Figure 4. Plan of Castlefield Basin, 1825. (Reproduced by kind permission from *'The Canals of North-West England'*, by Gordon Biddle & Charles Hadfield.

It is very possible that this new warehouse and its machinery were designed by Hugh Henshall under the influence of James Brindley. The machinery includes many details used in Brindley's designs, particularly in his watermill at Leek, the machinery of which was restored under the author's supervision some years ago. As regards the architecture, the windows with their stone surrounds are almost identical with those of the Leek mill. Within a few years the warehouse was extended by linear additions along the wharf, but the original section is clearly marked by the extent of the stone string course.

The long extensions refered to reached right to Deansgate, but these were cut through in 1841 when Bridgewater Viaduct was built to make a straight and wide main road connection between Deansgate and Chester Road, while a further section was sold and replaced in 1853 by the large church with the lofty and handsome tower, now used as an estate agents.

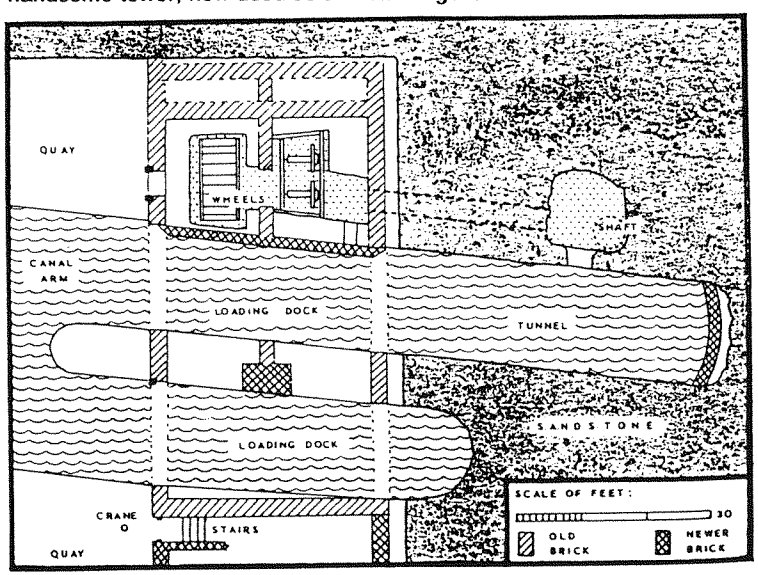

Figure 5. Plan of the Ground Floor of the Grocers Warehouse in 1960.

The Grocers Warehouse became disused and semi-derelict and was demolished in 1960 (see Plate 1). Before it was destroyed the machinery was photographed in part for, or by, Mr. Alfred Hayman, the manager of the Bridgewater Department of the Manchester Ship Canal Company. He very kindly gave a set of these photographs to the author who was also familiar with the building. Although the machinery was already disarranged and thus presented a very cryptic appearance, the photographs were of great assistance in deciding how to construct a replica of the original. When the building was knocked down, the rubble fell and filled the two pits, breaking up much of the machinery in its fall. When the pits were re-excavated, it was possible to recover and carefully

measure the broken parts and even to recover some undamaged. Consequently the machinery as restored represents a close approximation to the original. The drawings in Figures 6 to 9 are the working drawings provided by the author acting as consultant engineer to the restoration.

The original parts re-used included the waterwheel axle, and the gudgeons and bearings of the three wooden shafts. Some of the original gearwheels and V-pulleys, too damaged to re-use, have been cleaned and painted and are mounted around the building as exhibits.

As with the many schemes for the restoration of old machinery, the engineer concerned often comes up against unforeseen difficulties. One such occurred here. When the restoration was first proposed the Bridgewater Canal authority claimed that they could not spare any canal water to drive the waterwheel. Consequently the original restoration plan involved using water from the Rochdale Canal, which is about 7 feet above the Bridgewater at this point. However the exit tunnel or tailrace was blocked up with silt and rubbish, as might be expected, and the water in the wheel pit stood at about the axle level of the waterwheel. When the tunnel was cleaned out, however, the water again rose to the same level. In these circumstances an electric pump was installed in the unseen triangle between the warehouse and the cliff face, and now the water running on to the wheel from the Bridgewater Canal drives the wheel as it always did, and as all can see, but is recirculated from the sump back to the Bridgewater Canal by the unseen pump.

One opinion is that this rise in water level was due to the silting up and blockages of the Medlock down stream, but the author's personal opinion, however, is that when the Manchester Ship Canal was built, Mode Weel Lock nearby in Salford, was built somewhat higher than the old Mersey and Irwell Mode Wheel Lock, thus raising the water in the tunnel by that amount. This is because the Manchester Ship Canal above Mode Wheel Lock is at the same level as the Rivers Irwell and Medlock. This can probably be linked with the fact that the waterwheel went out of use about the time of the opening of the Manchester Ship Canal in 1894, as it could no longer be used. After that the area was covered with a plank floor which gave further warehouse accommodation and the machinery was forgotten until 1960, a period of 66 years, so that it is altogether more than 94 years since it was last seen working.

As the Bridgewater Canal was one of the first canals to be built, it is very probable that the original canal-fed waterpowered hoist designed by James Brindley was the first of its kind. However it did not remain unique for very long. The Gilbert brothers certainly constructed similar hoists at Hugh's Bridge on the Donnington Wood Canal, in Shropshire, in 1766 for the Earl Gower. In the Manchester area one was reported working in an underground chamber at Dale Street on the Rochdale Canal about 1860. Also a similar installation has been recently restored at Portland Basin, Dukinfield, on the Ashton Canal.

Over the last few years much research has taken place as to the respective contributions of the three main personalities involved in the building of the

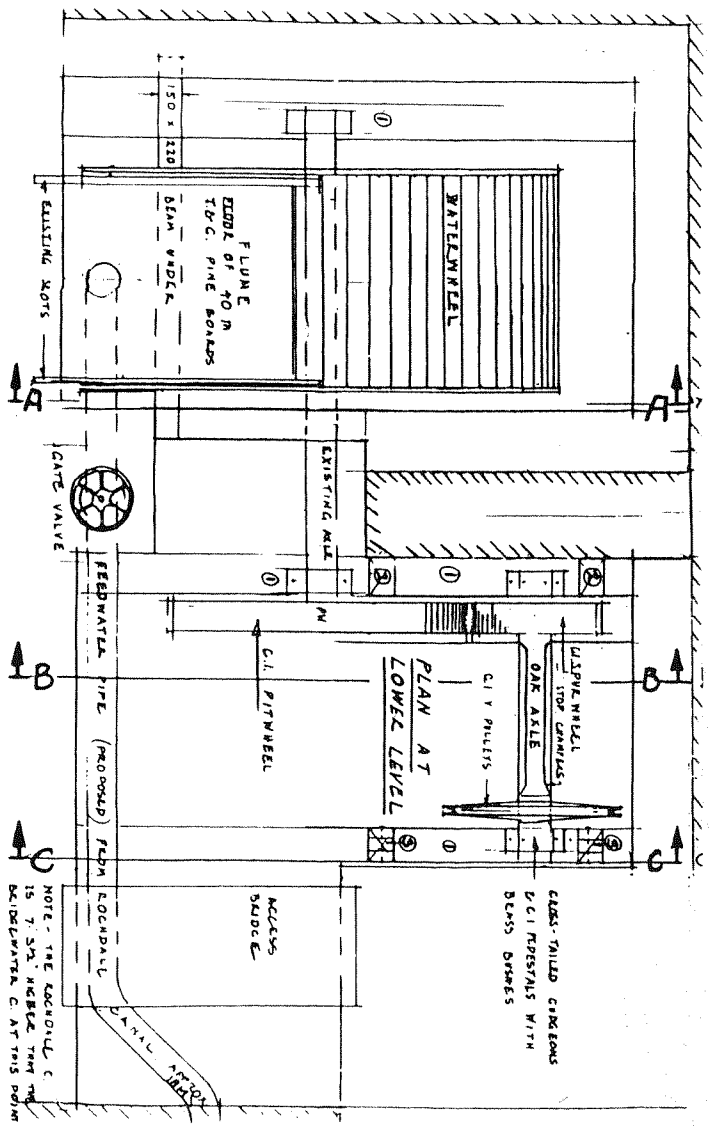

Figure 6. Plan of the Grocers Warehouse Waterwheel & Hoist Mechanism, showing the positions of sections A-A, B-B, & C-C (See Figures 7 to 9).

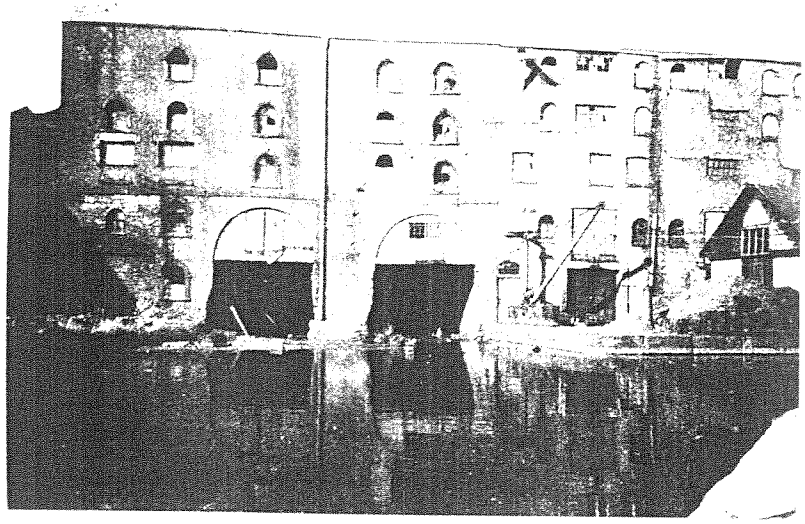

Plate 1. The Grocers Warehouse in 1960.

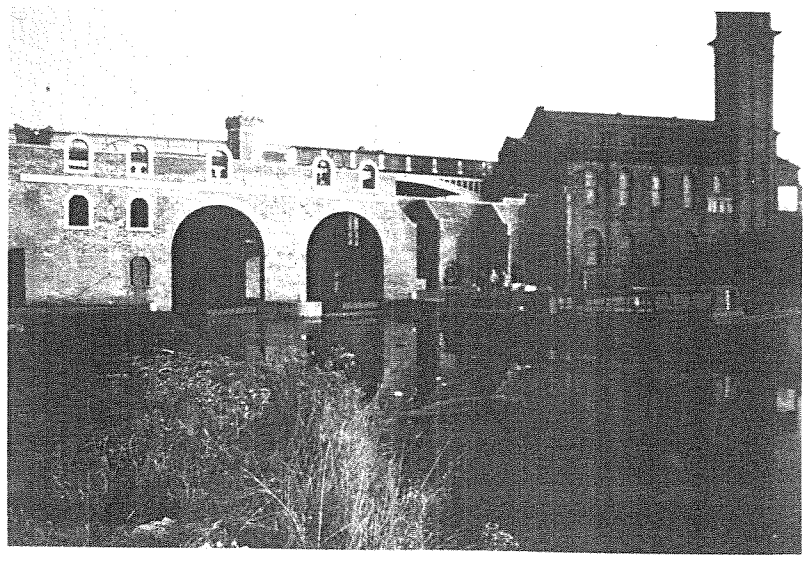

Plate 2. View of the restored Grocers Warehouse from the front,1988

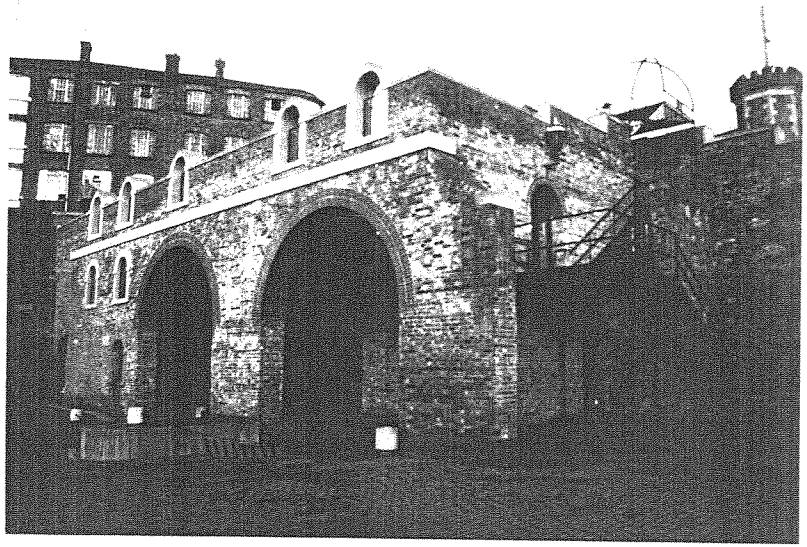

Plate 3. Side view of the Grocers Warehouse, showing viewing platform.

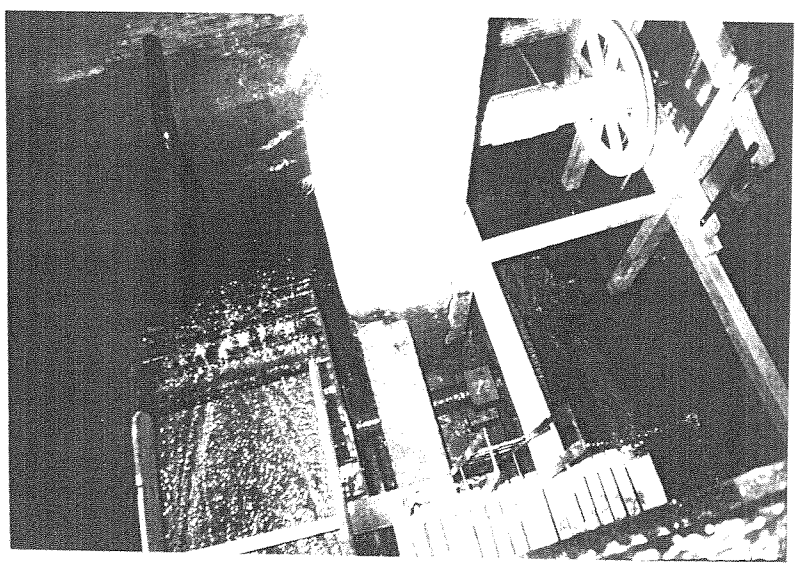

Plate 4. View of the restored Waterwheel & Hoist from above.

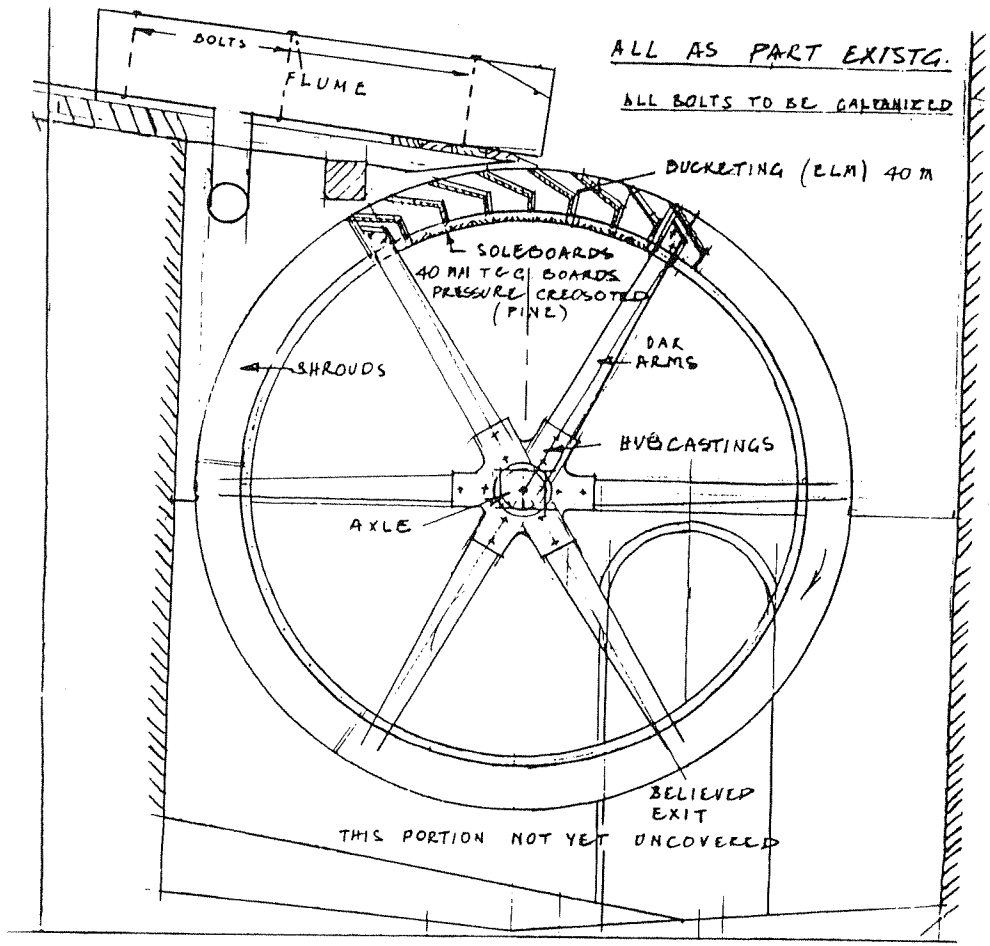

Figure 7. Section A - A. The Waterwheel and Penstock.

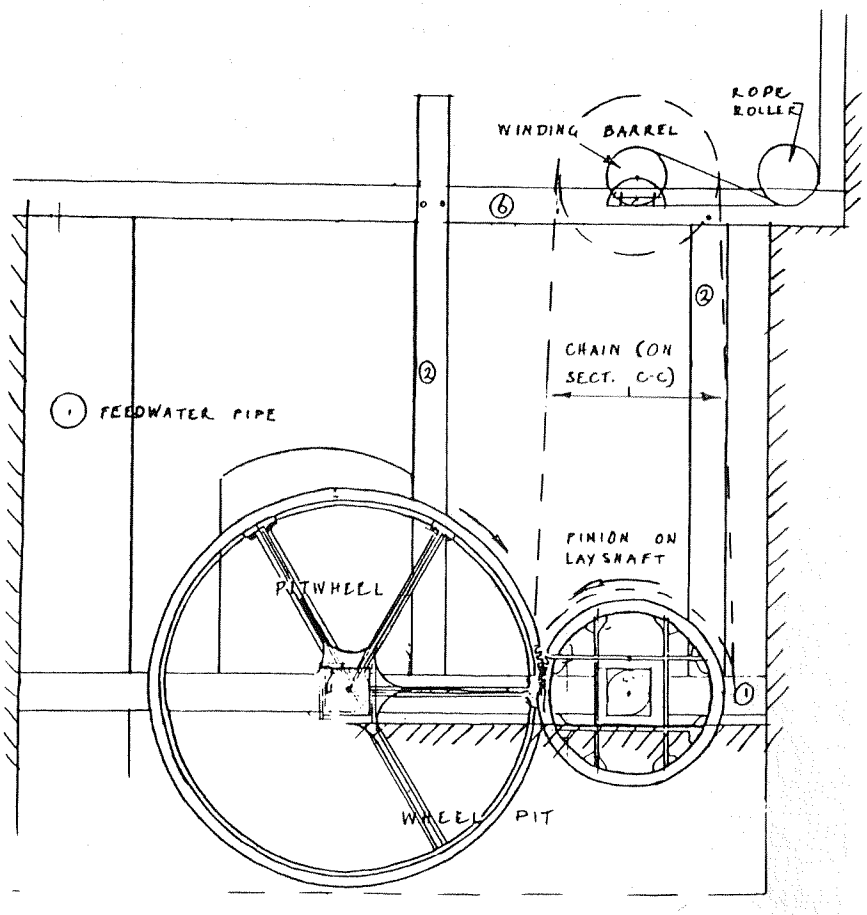

Figure 8. Section B - B. The Pitwheel and Layshaft Pinion.

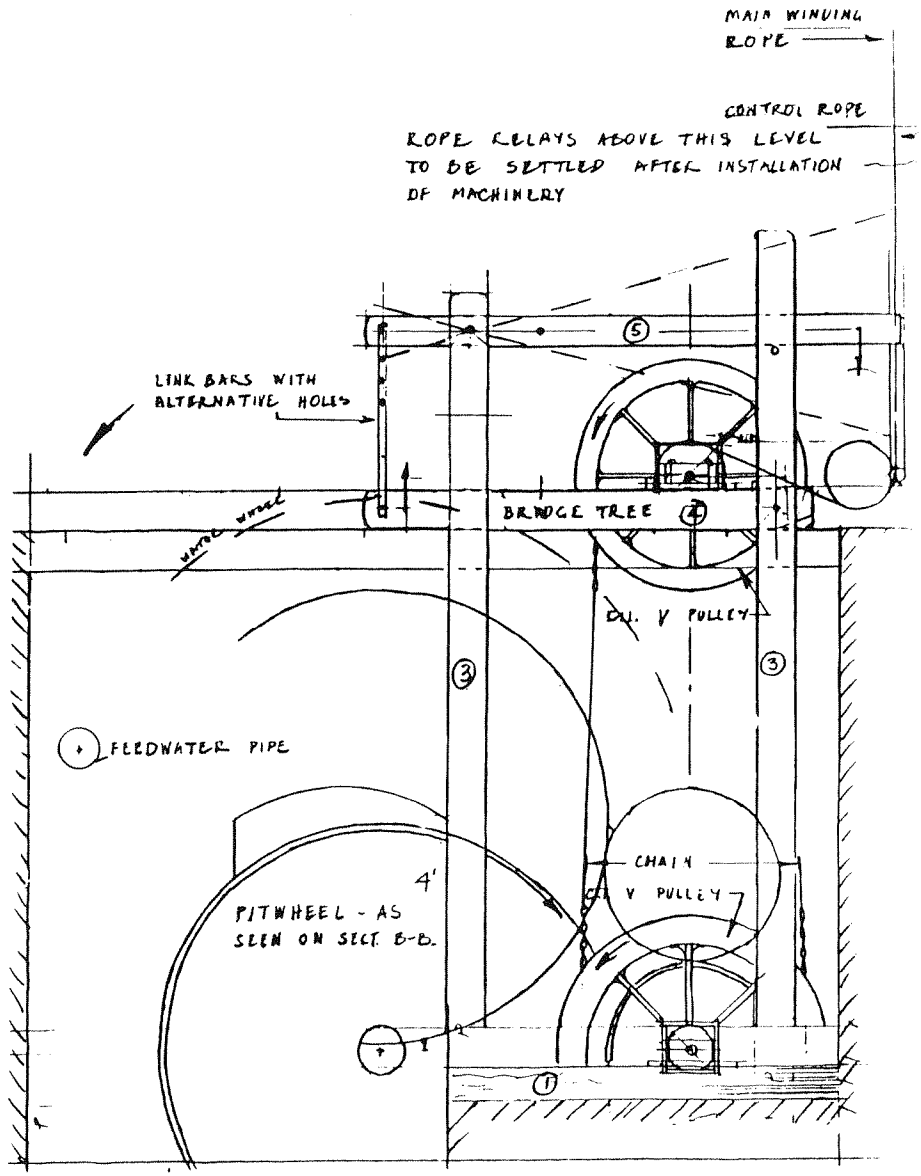

Figure 9. Section C - C. The Bridgetree and Hoist Pulleys.

Bridgewater Canal. However the design and implementation of the Castlefield water control arrangements and the hoist, powered by a waterwheel and operating identically to a miller's hoist, was undoubtedly the work of James Brindley. The documentary evidence and similarities to other Brindley installations is overwhelming. The ingenuity of the scheme is obvious to all, bearing in mind that it was all executed over two hundred years ago, so there can be no hesitation in applying the title 'Engineer' to Brindley in its true connotation as defining one who uses his ingenuity.

As for the restoration of the Grocers Warehouse hoist, the whole project was brought to a successful conclusion and re-opened by Councillor Arnold Spencer on Friday 8th April 1988 (see Plates 2 & 3). The work was designed by the City Architect's Department. The building was erected by Goodyers Ltd. The author was enlisted as consultant for the waterwheel and machinery, while the contract for that work was let to Dorothea Restorations of Whaley Bridge, Derbyshire. The project was funded entirely by the Government under the Manpower Services Commission so, as Manchester Corporation were only agents, no charge fell on the rate payers of the city.

When the water was turned on and the wheel went merrily round, working the hoist as it did, sending forth its cheerful water music, all the onlookers were most gratified, not least the present author.

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