

Wind and Water Mills

Number 21

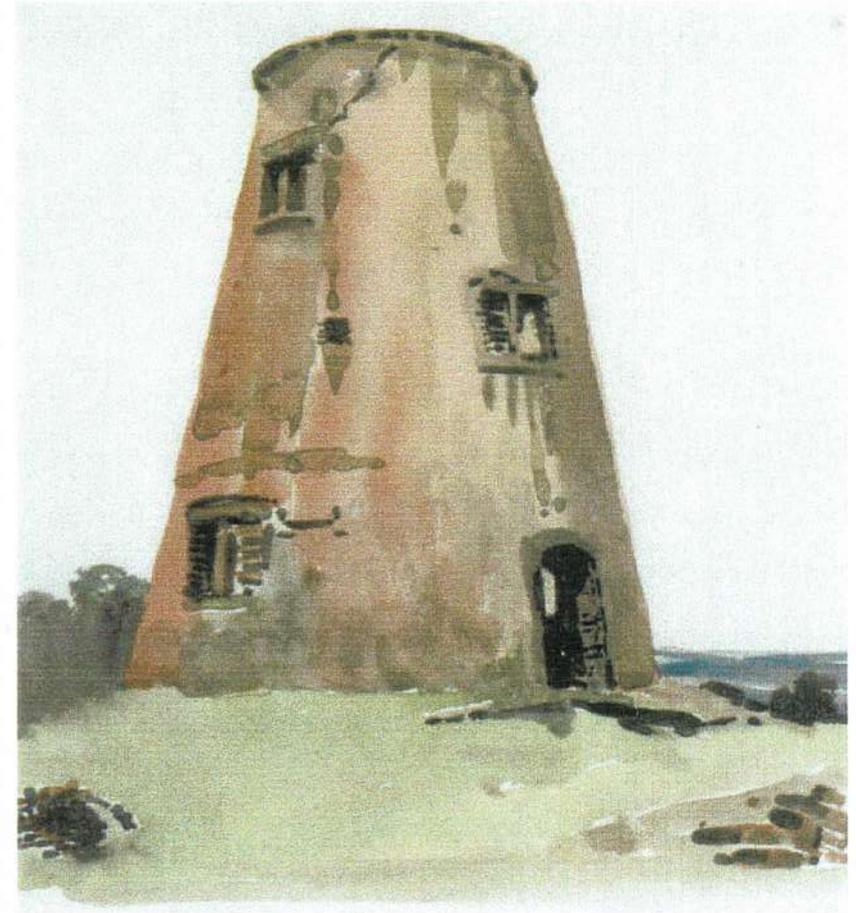
THE MIDLAND WIND AND WATER MILLS GROUP

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 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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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. Croxton Windmill, Staffordshire, painted by Karl Wood in 1938, reproduced by kind permission of the Usher Gallery, Lincoln.

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ISSN 0260-504X

Publisher: The Midland Wind and Water Mills Group, 2002.

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Congleton,
Cheshire, CW12 3BH

Wind and Water Mills

**The Occasional Journal of the
Midland Wind and Water Mills Group**

Number 21

2002

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CROXTON WINDMILL STAFFORDSHIRE

By Barry Job & Tony Bonson

Introduction

Staffordshire is not a county that is famous for its windmills. The county is made up mainly by the Trent valley together with all its associated tributary streams and rivers. All these watercourses have been extensively used in times past to generate power so there has not been any overriding need to utilise wind power in the county. However, in spite of this abundance of water power, a survey of wind power in the county published in 1985 had details of 133 windmills that had once existed in Staffordshire, with 24 still having remains to be seen.¹ Unfortunately none of these remaining windmills have any machinery, ten of them have been converted into living accommodation with the remaining fourteen standing derelict.

One of these derelict windmills is the remains of a tower mill at Croxton, which is a Grade 2 listed building. Croxton is a small hamlet lying about ten miles north west of the county town of Stafford (see Figure 1 below). To the west of the village the land gradually rises to a low ridge about 170 metres above sea level. The remains of the mill stand on the south slope of this high ground not far from its summit (SJ 782319). Currently there is a proposal to convert this derelict tower into habitable accommodation which has prompted this survey and historical investigation.

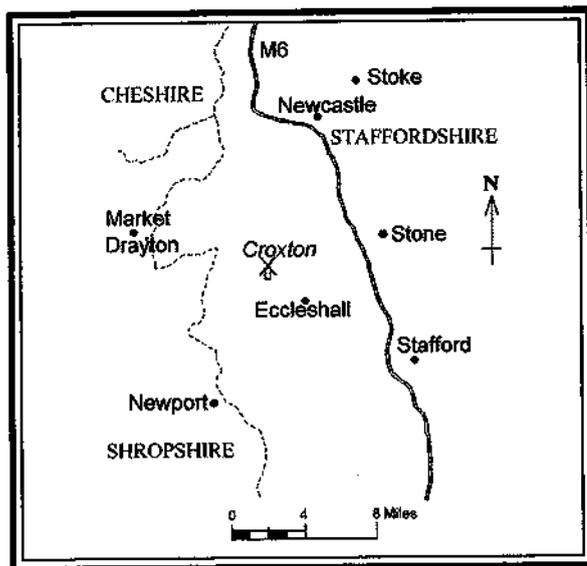


Figure 1.
Map showing
the location of
Croxton
windmill.

History of the Mill

The village of Croxton is an ancient one. Of the various suggestions for the origin of the name Croxton, the most appealing is "the place of the stone cross". There was said to be a chapel built on the site of the original cross, this was replaced by St. Paul's Church in 1855, eighteen years after Croxton became a separate parish.

The following entry is recorded as part of the Bishop of Chester's Eccleshall Estate, in the Domesday Survey of 1086:

"In Croxton (*Crocheftone*) land for 3 ploughs. The Bishop has two villagers and eight smallholders with two ploughs. It belongs to Eccleshall. Value 20s."²

Many windmills are built on old sites, but this is not the case at Croxton. The site of the windmill seems to have been agricultural land until the last quarter of the 18th century. The only proviso is the statement by the Reverend Weston E. Vernon Yonge that "it was probably one of the chain of bonfires which were the 'fiery heralds' of the coming of the Armada in 1588".³ This is noted in the Listing of the windmill. However, it is more likely that the actual beacon site (assuming the statement is correct) would be on the highest point to the north. The parcel of land, about a quarter of an acre in size, was divided from the rest of the Croxton Upper Town Field after the constituent parts of the field were sold in 1774 by Godfrey Bosville of Gunthwaite Hall, Yorkshire, to Samuel Barlow of Gratewood Lodge.⁴ Three years later, in 1777, Samuel Barlow built Croxton windmill, reputedly for a workman of his, who was to occupy and use the mill on the condition of grinding free all corn grown on Gratewood Lodge Farm.⁵ It is said that this condition was observed for a century.

In the late 18th century the village of Croxton was quite small, a fact that has not changed to this day, and would have been able to satisfy all its milling requirements at the local water mills, the nearest of which is at High Offley not far to the south. The local farmers, etc. would have long standing arrangements for the grinding of their grain on a toll basis. These arrangements would have developed from the old manorial system whereby the farmers had to have their grain processed at a particular mill with the miller receiving payment by keeping a percentage of the grain processed. Therefore the provision of a windmill at Croxton would not have been for use by the local population but was probably built in response to the increasing demand for flour from the growing populations in the Staffordshire towns brought about by the expansion caused by the onset of the industrial revolution. The miller at Croxton windmill would most certainly have operated on a merchant basis, buying grain from a variety of suppliers and selling the output of the mill to bakers, etc. in the nearby towns.

In 1795, on the death of Samuel Barlow, the windmill passed to his brother Abraham Barlow of Acton, near Stafford.⁶ In 1832 it was up for sale in the Staffordshire Advertiser, as follows:-

TO BE SOLD OR LET WINDMILL HOUSE AND LAND.

A substantial windmill containing four pair of stones, with a dwelling house, stable and garden and a close of land contiguous thereto, containing in the whole with the site of the buildings 6A OR 35P or thereabouts, situate at Croxton in the parish of Eccleshall in the County of Stafford. The mill is situate on an eminence, unobstructed by any other land in any other quarter, is capable of doing much business, very substantially built and in good repair. Early possession may be had on the whole premises.⁷

The details of this advertisement give some indication of the nature of the machinery in the mill. Having four pairs of millstones confirms that the application of the wind power must have been via a great spur wheel driving through four stone nuts to the millstones. This gearing arrangement was introduced sometime in the middle of the 18th century and would have been the latest technology when the mill was built in 1777. The fact that there were four sets of millstones confirms that the mill was not just intended to satisfy local requirements. The throughput of four sets of millstones would have been far in excess of that required locally and could only have been intended to serve the nearby growing industrial towns such as Stafford, Stone, and the Potteries.

The windmill was purchased by Andrew Cornes, a farmer and miller of Croxton, in 1833,⁸ but he died on 13th November, 1836 and, under the terms of his complicated will, half of the mill was left to his son, Thomas Cornes, with the proviso that this share would eventually devolve to Thomas's eldest son, and half to his daughter but with his widow enjoying the income as long as she remained a widow. Unfortunately both his widow and his daughter died in 1838 and so the whole of the windmill then became the property of Thomas Cornes. Having taken possession of the whole of the mill, rather than working as the miller, Thomas Cornes attempted to turn his inheritance into an income producing asset. Thus he advertised the mill to let in 1840:

CAPITAL WINDMILL, HOUSE, GARDEN and LAND to let.

All that capital windmill in complete repair, together with a Dwelling House, garden and about six acres of good land, situate and being at Croxton, three miles from Eccleshall and a short distance from the turnpike road leading from the latter place to Market Drayton and Woore.

Immediate possession may be had. Apply to Mrs. Silvester, Croxton. Personal application will be preferred, if by letter, to be pre-paid.⁹

This advertisement appears to have been successful because by 1841 Windmill House was occupied by Henry Mainwaring, a miller, and his wife Ann, both of whom were 25 years of age. Living near the mill was Abraham Lowe, 45, agricultural labourer and his wife, also called Ann, 45, plus their children, Hannah, 15, Adam, 8, Moses, 7, and Ruth 8. Nearby there was the Plant family, all of independent means, Dorothy, 62, Ann, 30, May, 26, and Harriet, 25.¹⁰

About this time the mill reputedly lost its cap in a violent storm, blowing it into an adjoining field.¹¹ This would not have amused the mill owner, Thomas Cornes, as he would probably have been liable for the repairs. After the mill was repaired it was advertised to let again in March, 1844.

TO MILLERS

To Be Let and entered upon immediately.

All that substantial windmill situate at Croxton in the Parish of Eccleshall. For particulars apply T. Corns [*sic*], Croxton.¹²

Possibly Thomas Cornes was not impressed with Henry Mainwaring's competence and thought a new miller was required. However it does not appear that he was successful in finding another miller because later that year, in November, Thomas Cornes decided to liquidate his asset and the mill was offered for auction:

CROXTON WINDMILL, HOUSES AND LAND

In the parish of Eccleshall.

TO BE SOLD BY AUCTION

By Mr. Ash

At the Royal Oak Inn, Eccleshall... on Friday, 22nd November.

Lot 1. All that substantially erected and powerful WINDMILL in perfect repair containing four pairs of stones, two dressing machines with every convenience necessary for carrying on an extensive business, situate on the summit of the high land, near the village of Croxton aforesaid, together with a newly-erected brick and tile MESSUAGE or DWELLING HOUSE with garden and appurtenances thereto belonging situate opposite to the said mill now in the occupation of Thomas Poole.

Lot 2. All that two MESSUAGES or DWELLING HOUSES... situate in Croxton... Now in the occupation of Dorothy Plant and Abraham Lowe.

Lot 3. All that parcel of excellent old turf land called 'The Shipman's Breech' now in the occupation of Thomas Corne [*sic*].

Lots 1 and 2 are freehold, Lot 3 is copyhold.

Mr. Thomas Corne, the proprietor, will show the respective Lots...¹³

This attempt to sell the mill was no more successful than the previous attempts to attract a new miller. In 1851 the miller was still Henry Mainwaring, living at the mill house with his wife. Abraham Lowe and his wife were also still living nearby.¹⁴ At some time in the 1850s the Mainwarings left the mill and a new miller was found to operate the mill. At some time prior to 1861 the miller at Croxton was recorded as William Petchell.¹⁵ However by 1861 Joseph Shelley, aged 35 and described as a miller, was living at Windmill Bank with his wife Eliza and his mother. He was assisted in the mill by Jeffrey Lowe who was either the son or grandson of Abraham Lowe who was still living nearby.¹⁶

Thomas Cornes was still attempting to sell the windmill and in May 1869 there was an indication in the Staffordshire Advertiser that the mill would once again be offered for auction:

PRELIMINARY NOTICE

CROXTON WINDMILL near ECCLESHALL

With several pieces of FREEHOLD and COPYHOLD LAND

Containing about 30 acres the Property of the late Mr. Andrew Cornes will shortly be offered for auction.¹⁷

However, when the auction was held in June the nine lots offered did not include the windmill.¹⁸ Consequently Thomas Cornes was still the owner. By 1871 there was yet another miller in residence at Windmill Bank, namely John Whittaker, aged 43, with his wife Ann, 36, and his daughters Eliza, 17, and Mary Ann, 10.¹⁹

In the early 1870s Thomas Cornes must have been desperate to realise the capital locked up in Croxton windmill because he had decided to emigrate to the United States. This did not prove possible and the Cornes family emigrated still owning the mill. In 1876 when Thomas and his eldest son were in Coal Valley, Rock Island, Illinois they gave Humphrey James of Stockton, Shropshire the power to dispose of the mill for them.²⁰ Whether they had settled in Coal Valley or were just passing through that area on their way westward has not been established.

Two years later, in 1878, Humphrey James sold the freehold of the mill with three cottages to James Hurd, a farmer of Croxton for £800, the windmill being valued at half this amount. In order to complete the purchase of the windmill, Hurd had borrowed £650 from Maria Leech, a spinster of Castle Villas, Stafford, which he was unable to repay. Consequently, in 1883, the mill was sold to Walter Williams, an ironmaster and gentleman of Sugnall House, just south of Croxton, for £115.²¹ It went out of use about this time and this may be indicated by the reduced value.

However, the mill nearly had an earlier demise. to celebrate Queen Victoria's Jubilee in 1887 a chain of bonfires were lit throughout the land. Croxton was chosen as the site for a bonfire on the highest part of Abraham Plant's fields opposite the mill, and also to signal to bonfires at Ashley Heath and Mow Cop, the cue being taken from a beacon on the Malvern Hills. At Croxton two rockets were set off from the top of the mill when the Worcestershire bonfire was spotted and Mrs. Plant, of Sugnall, pulled a cord which turned over a barrel of tar on the top of the bonfire and set it ablaze. Unfortunately a spark from one of the rockets set the old mill woodwork alight and it was only extinguished with some difficulty.²²

In the last two decades of the 19th century the milling industry was subject to massive change with the introduction of roller milling taking place in large industrial mills often located at the ports processing imported grain. These changes spelled the end of the small country mills with some switching to provender milling but many just going completely out of business such as happened at Croxton. About 1890 the sails were cut off by James Benbow of Croxton. He was reputedly a craftsman joiner and a local character who liked a drink. After each sail was cut off he would descend for a pint of beer and in the middle of the road in front of the gathered crowds he would drink the health of the old Mill.²³ The mill gear was also removed, reputedly to convert it to a residence,²⁴ but this was never done.

Walter Williams died on 5th May, 1890 and in 1893 the Trustees of Walter Williams's will auctioned the mill. The sale catalogue entry is reproduced in Figures 2 & 3.

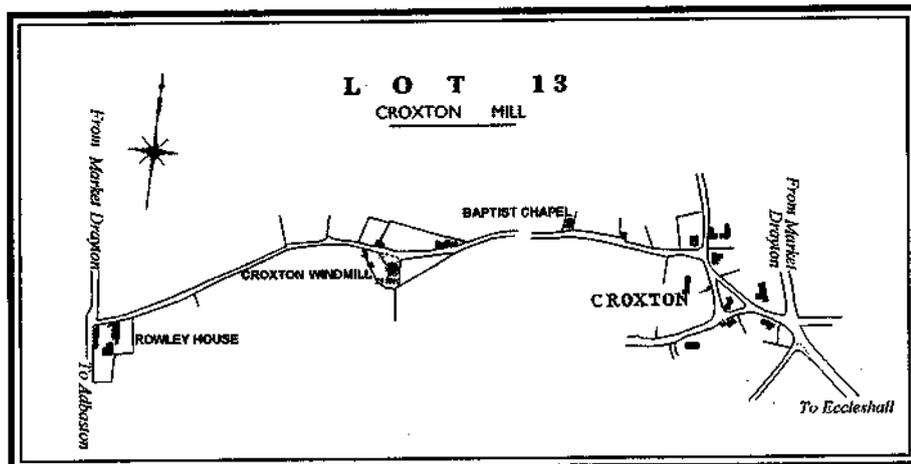


Figure 2. Map showing Croxton Windmill in the 1893 sale catalogue.

LOT 13.
Coloured Green on Plan.
A SMALL PIECE
OF
FREEHOLD PROPERTY,
Numbered Part 1630 on Plan,
ON WHICH FORMERLY STOOD
CROXTON WINDMILL,
Situatd within a short distance of Croxton Village, and but a little over half a mile from the North-West corner of Lot 2.
It stands on the South side of the road leading from Croxton Village to the main Albaston Road, and comprise in all about
A Quarter of an Acre.
The Walls of the Mill, a circular red brick Building, still stand, and might again be utilised for a similar purpose, or they could readily be converted to any other use.
There is space on the road frontage for carts to draw in for loading, and on the other sides the Building is surrounded by a
PIECE OF GARDEN GROUND.
This latter is let to Mr. GEORGE TITLEY, on an Annual Tenancy from Lady-day at a Rental of 10s a Year, but the Building, &c., is in hand.
This and Land Tax, see General Remarks at the commencement of these Particulars. I R

Figure 3. The 1893 sale catalogue entry for Croxton windmill.

Charles Lowe of Summerfield House, Reddish, Lancashire, a chemical manufacturer, purchased most of Walter Williams's estate in 1894. He also bought the windmill but this was conveyed in a separate conveyance from the other lots.

Dated 17th January 1894

The Trustees of the Will of the late Walter Williams Esq. Deceased

To Charles Lowe Esq. conveyance of a piece of land on which formerly stood Croxton Windmill... for the price or sum of thirty pounds... All that freehold windmill with the land adjoining and belonging thereto... containing by estimation one rood and six perches formerly in the occupation of James Hurd and now of George Titley...²⁵

The mill became filled with rubbish in the 1930s but on the outbreak of the Second World War it was decided to use it as a Home Guard Post to watch for enemy aircraft. The rubbish was cleared out and a platform installed at the top by Mr. Meadows and Mr. Bolton, the local joiner. It was reached by two ladders tied together, but this was declared to be unsafe so a midway platform was constructed.²⁶ The mill continued to be derelict for the rest of the twentieth century, but about 1990 it was conveyed by the Trustees of the late C. E. Lowe to Timothy Greville Jacques, becoming part of the Sugnall Estate.²⁷

Survey of Croxton Windmill Tower

Surveying the remains of Croxton Windmill provided a number of problems. The survey took place in the summer of 2001 when the mound at the base of the tower was covered in dense vegetation. This vegetation prevented any attempt at making measurements of the mound and hence all the details of this feature on the drawings have been taken from plans drawn up in 1996 by Anthony Blacklay & Associates which were kindly supplied by Balfour Burd & Benson.

Although access was possible to the basement area and the ground floor level, safety considerations meant that access to the upper floors was ruled out. In order to make measurements at the higher levels of the mill a regular sample of brickwork consisting of a width of ten stretchers (2.46 metres) and a height of ten courses (0.78 metre) was measured to give an average value for the width of a brick stretcher and a course of brickwork. Features in the upper stories were then measured in terms of the number of brick stretchers (for width) and the number of brick courses (for height) by observation and then converted into standard metric dimensions.

The Tower

Croxton windmill consists of the derelict brick built tower of the former windmill. It is built of locally made bricks and reaches a height of about 12 metres above the adjacent roadway. It has a batter or taper towards its top of approximately 8° to the vertical, such that the diameter of the top of the mill is 5.75 metres (outside measurement) compared to the 8.5 metres (outside measurement) at the height of the surrounding mound which is designated as the ground floor level. The building shows evidence of having had four storeys including the basement. The tower walls at ground floor level consists of a double layer of bricks separated by an air gap somewhat like a modern cavity wall. This air gap tapers as the wall gets higher but the height at which this gap disappears is not known. The brick tower is surmounted by a row of engineering brick tiles at the level that once provided the curb on which the cap rested. The ground around the mill has been built up to provide a platform at the level of the top of the basement which was used to provide access to the sails. The brickwork is constructed of one row of headers every three rows of stretchers, i.e. it has been built using English Garden Wall bond. (See Plates 1 - 3)

The Doorway Apertures

There are three entrances to the tower, one of which is located at basement level, with the other two at ground floor level. The basement entrance passes through the surrounding built up mound on the northern side of the mill. On either side of this entrance passage there are two recessed shelves at the approach to the actual door built into the mound. The purpose of these shelves is not known. The door used to be mounted on hinged posts, of which one is still present, and the remaining part of the latch shows that this door used to open inwards. The arch of this doorway is made from seventeen brick headers (see Plate 4).

The other two entrances on the ground floor are opposite to each other in the middle of the east and west sides of the mill. Both these two doorways had arches made up of thirteen brick headers and their cills consisted of hard wearing granite slabs. The doors that were once fitted on these two entrances also used to open inward. Although all three doorways are the same height the basement entrance is 1.25 metres wide as opposed to the 0.9 metres width of the ground floor entrances. (see Plate 1)

The Window Apertures

There are two apertures in the east and west walls of the basement directly under the two doorways on the ground floor. These apertures had sandstone lintels and cills and each aperture was divided into two by a vertical chamfered sandstone mullion in the middle of the aperture. The internal reveals of these apertures are of brick and are splayed towards the interior. The main construction of these apertures are now in a state of collapse and some of the major sandstone blocks, such as the central pillar of the eastern aperture and both the cills, are missing. From the position of these apertures with respect to the external mound it is not entirely clear if they were originally meant to be windows, however they have the same general appearance of the other windows (see Plate 5).

There are two window apertures on the ground floor located in the middle of the north and south faces of the windmill. Externally these two window apertures have sandstone lintels which have a slight curve to their upper face together with sandstone cills (see Plate 6). They also have vertical chamfered mullions that divide the aperture in two lights. The external aperture reveals are squared and made of brick. Internally these two ground floor window apertures had wooden lintels but that belonging to the southern aperture is missing. The internal wooden lintel still to be found on the northern aperture has been cut to a curved shape at its eastern end (see Plate 7 and Figure 5). Both apertures are without their internal cills and their brick reveals are slightly splayed towards the inside of the apertures. Each of the lights in these two ground floor window apertures originally had four horizontal iron bars but in the northern aperture only two remain in the easterly light, whereas the westerly light has been infilled with bricks at some time. In the south window aperture none of the iron bars has survived and again the westerly light has been infilled with bricks.

On the first floor there are two window apertures, one each in the middle of the east and west faces of the windmill directly above the two entrances on the ground floor. From the exterior the form of the lintels, cills and mullions of these first floor window apertures is the same as the window apertures on the ground floor. Internally the first floor window apertures are also the same as those on the ground floor but all the internal lintels and cills are no longer in position. The eastern window aperture has four iron bars in its northerly light but none in its southerly light. As for the window aperture in the west face of the mill, it has no iron bars in its northerly light and the southerly light has been infilled with bricks. There are also two small openings in the walls of the first floor in the north-west and south-east sides which are about 0.3 metres square. Internally these two openings had wooden lintels and cills.

The second floor has two window apertures in the same position as those on the ground floor, that is in the north and south faces of the windmill. These second floor window apertures have the same form as those on the ground and first floors except that their internal reveals are not splayed at all. The northern aperture has four iron bars in its westerly light but only the bottom three remain in the easterly light, whereas in the southern window aperture both lights have been infilled with brick.

The Floors

The position of the various floors in the mill can easily be seen as there are some visible remains of most of them. There is one of the main wooden beams that used to support the ground floor still *in situ* running north to south on the western side of the mill.

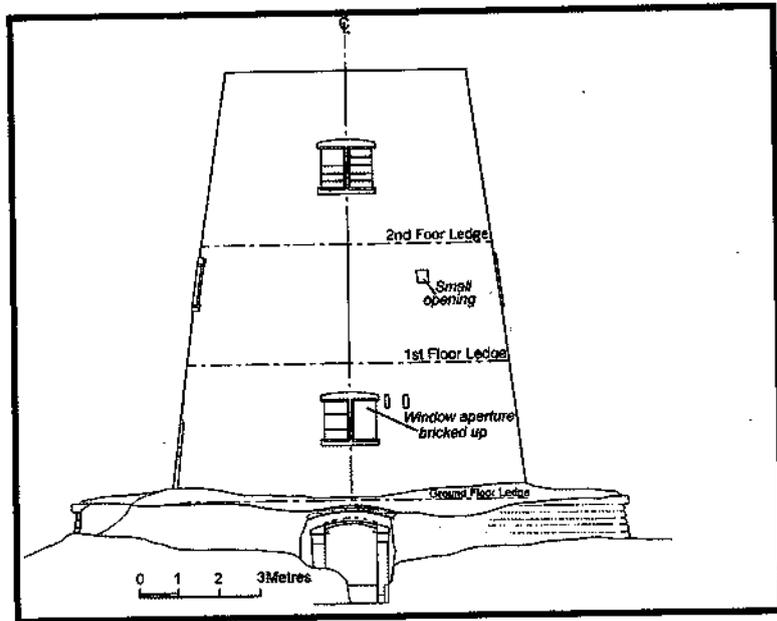


Figure 4. Northern elevation, external.

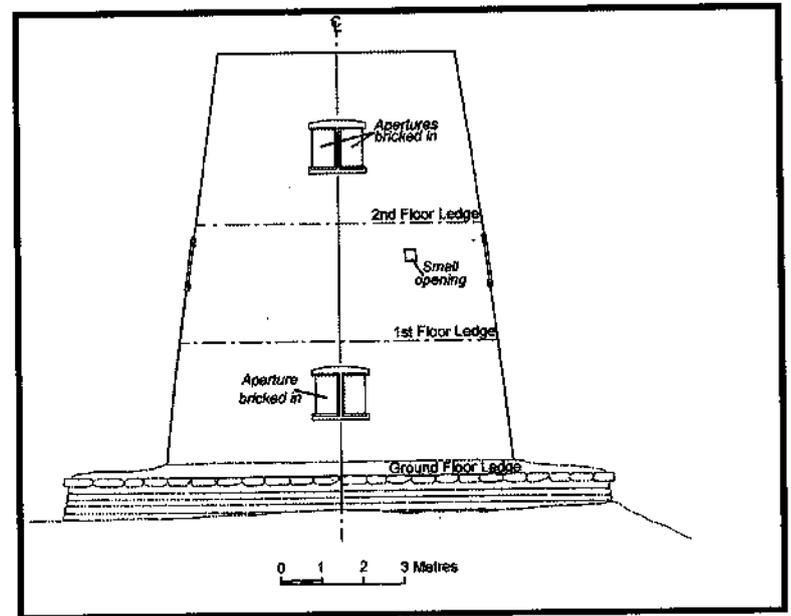


Figure 6. South elevation, external.

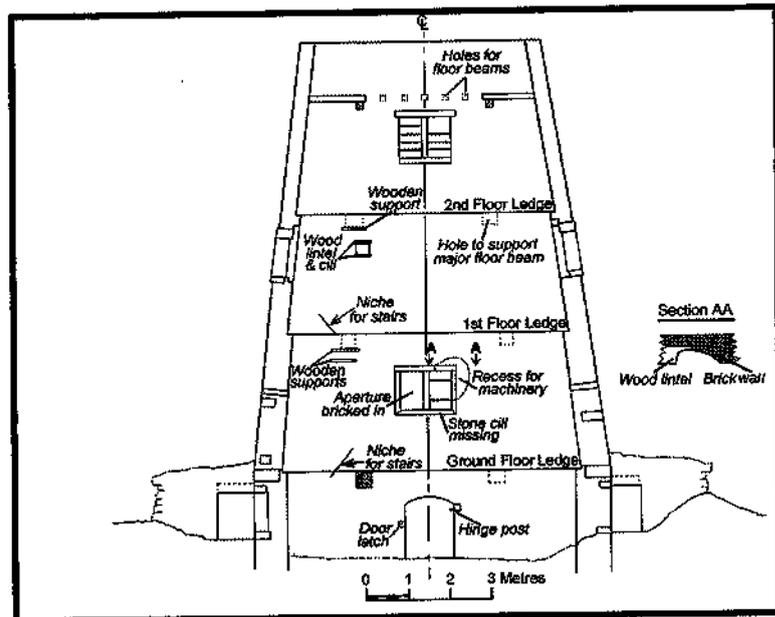


Figure 5. Northern elevation, internal.

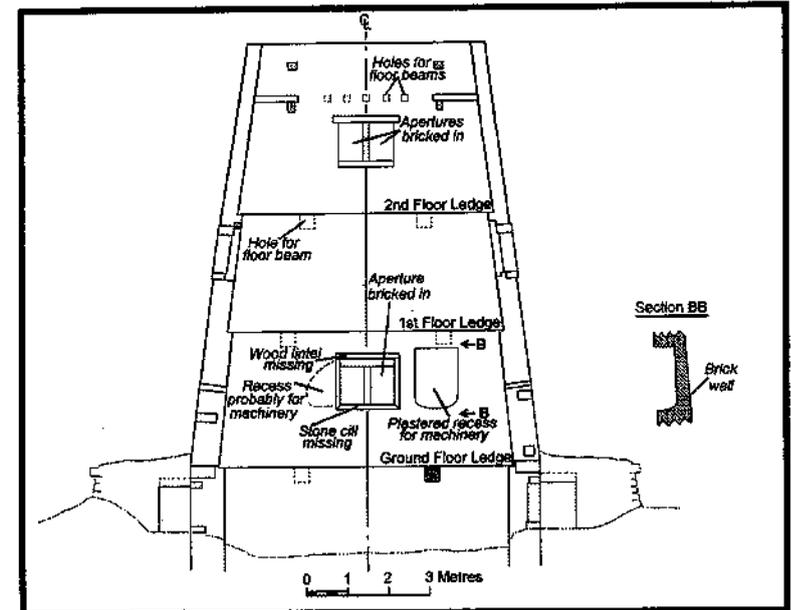


Figure 7. South elevation, internal.

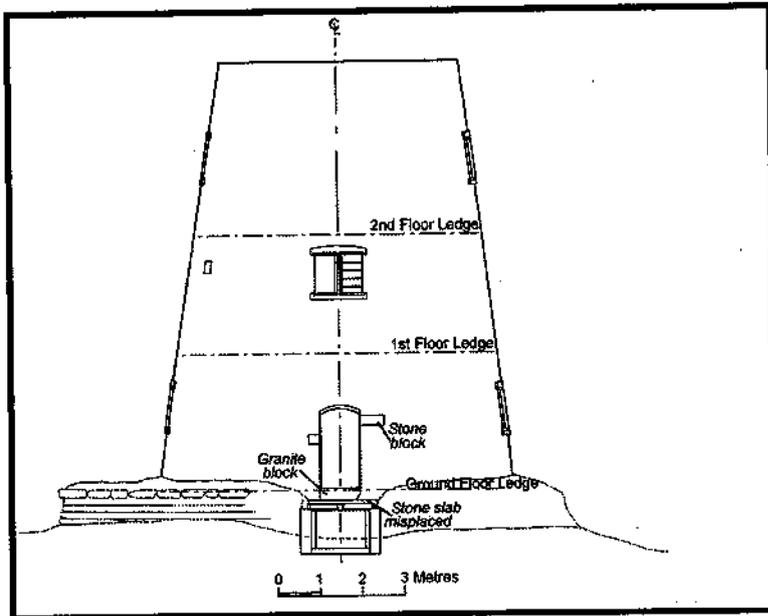


Figure 8. East elevation, external.

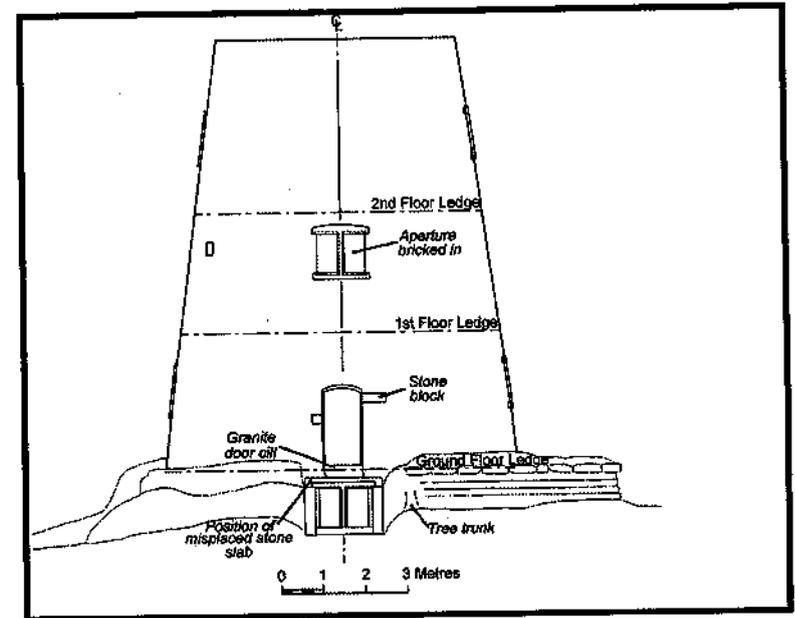


Figure 10. West elevation, external.

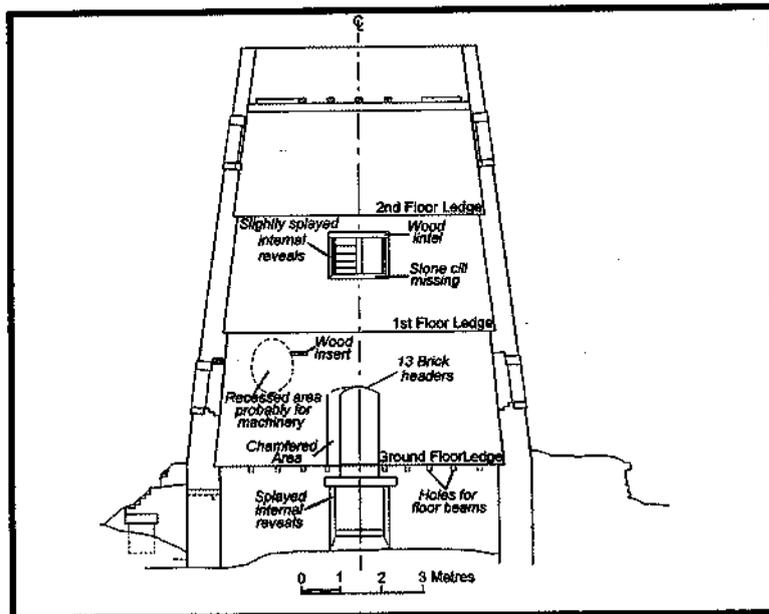


Figure 9. East elevation, internal.

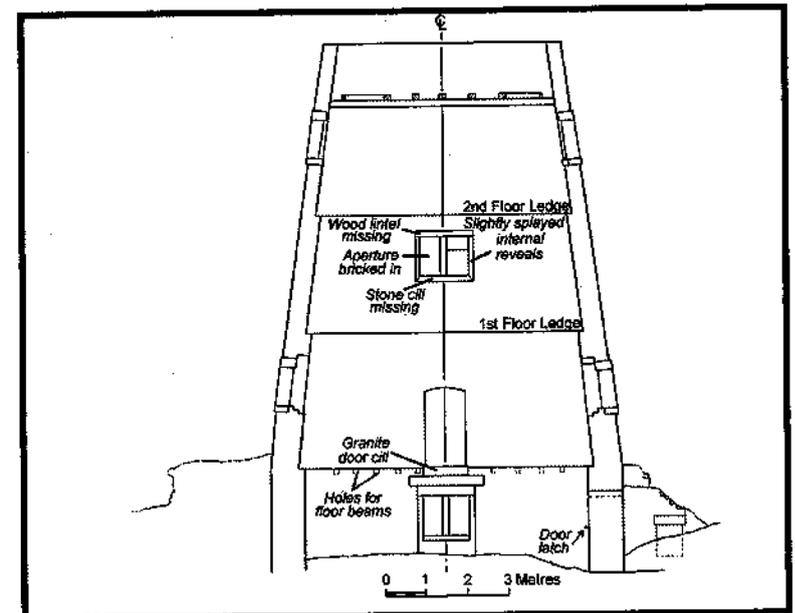


Figure 11. West elevation, internal.

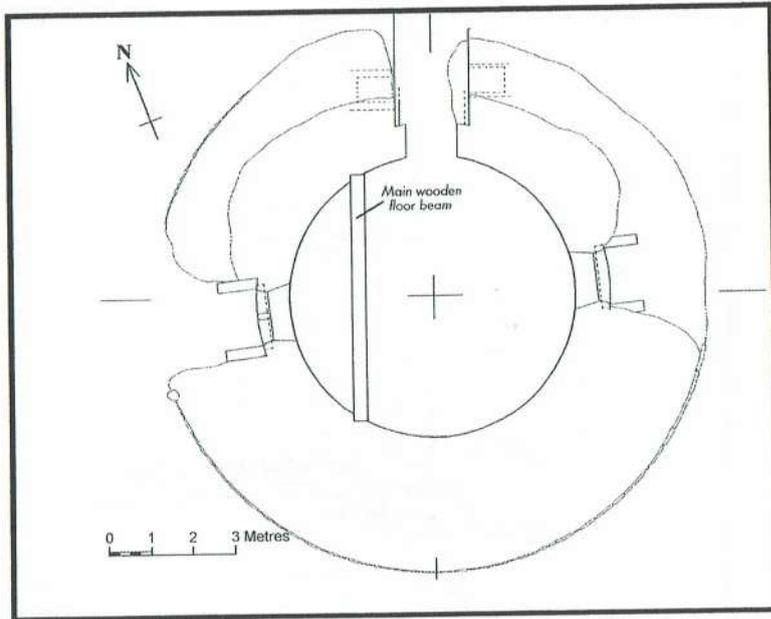


Figure 12. Plan of the Ground Floor.

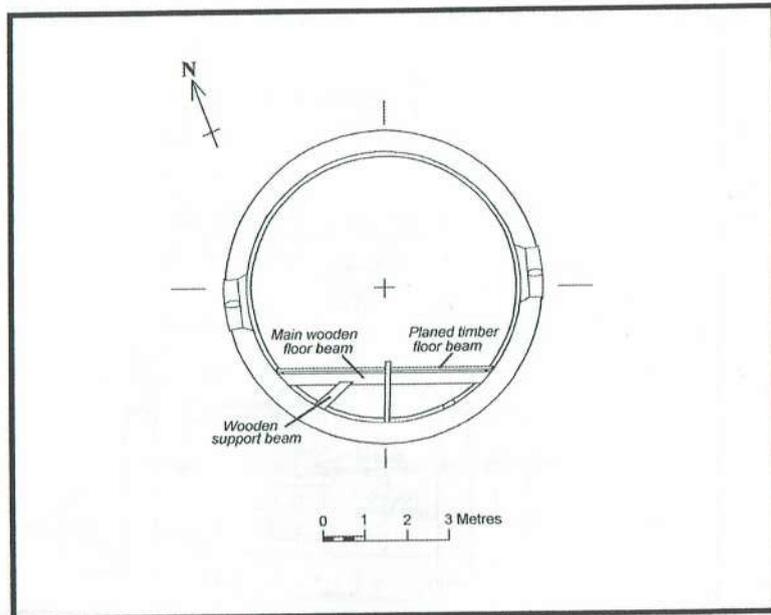


Figure 13. Plan of the First Floor.



Plate 1. Croxton Windmill in 1978 viewed from the north showing the entrance to the basement level through the artificial mound (bottom left) and the western entrance at ground floor level (right). Note how the windows are staggered on adjacent floors.



Plate 2. Croxton Windmill in 1978 viewed from the south showing the stone blocks used to make up the mound encompassing the basement level. Note that the ground floor window has vertical as well as horizontal iron bars, none of the windows had any vertical iron bars remaining in 2001.

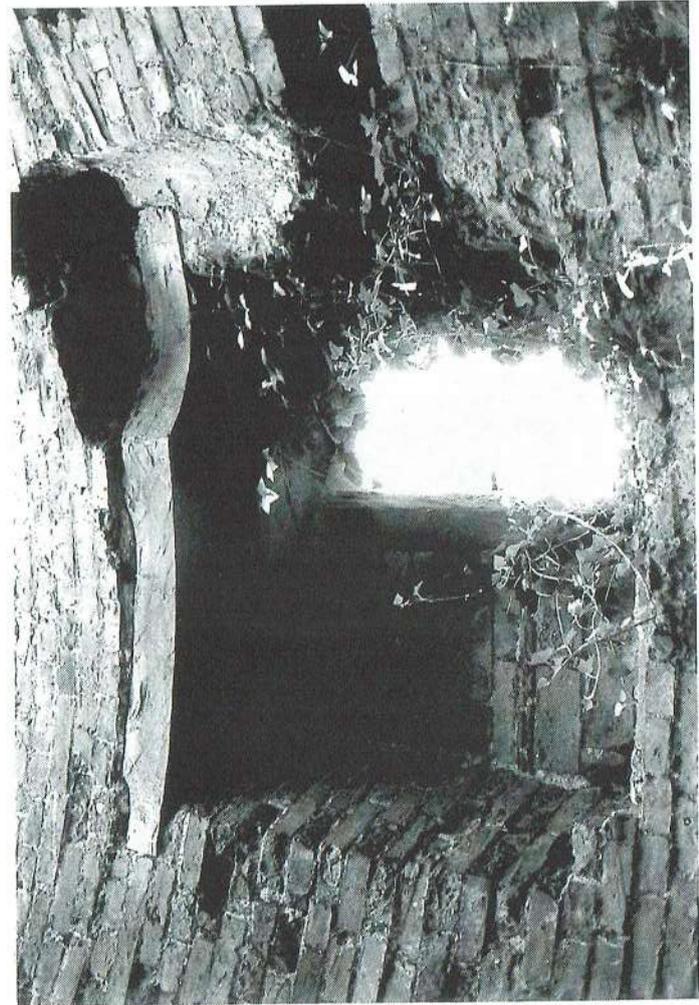


Plate 3. View of the window on the north side of Croxton Windmill from inside the mill showing where the lintel of the window and surrounding brickwork has been cut away to accommodate machinery at some time in the past.

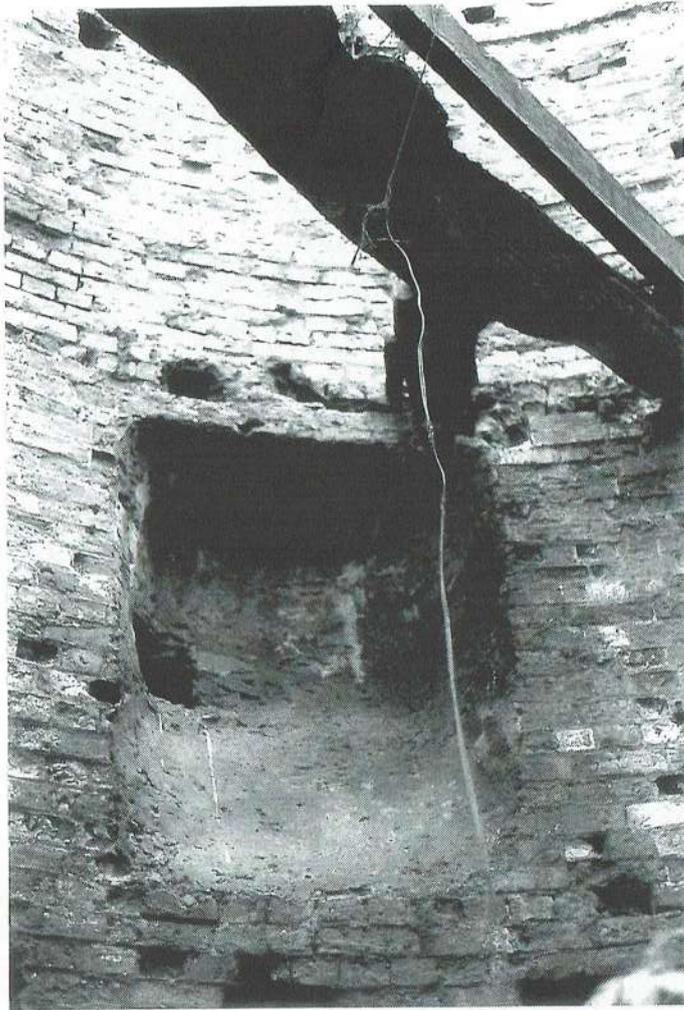


Plate 4. View of the niche cut into the internal wall of Croxton Windmill at the ground floor level presumably to accommodate machinery at some time in the past. Note that the interior of the niche has been plastered.

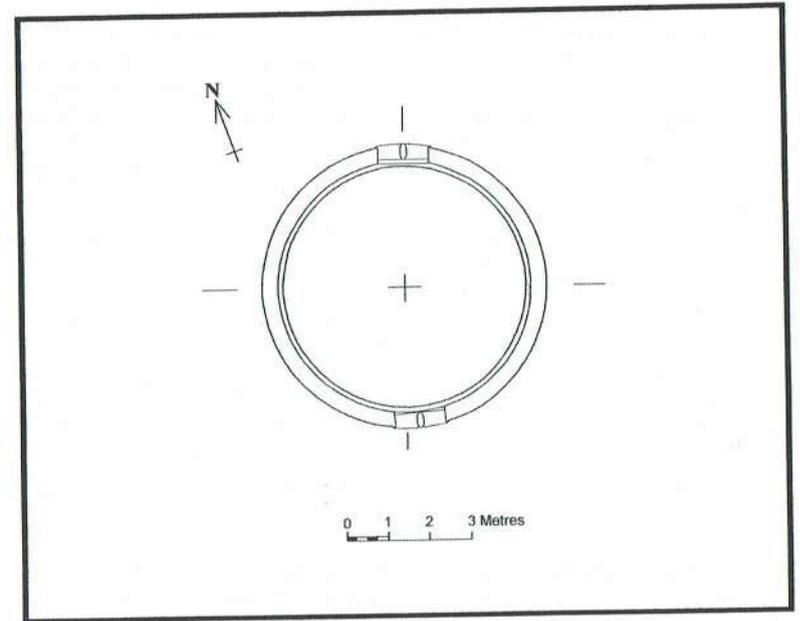


Figure 14. Plan of the Second Floor.

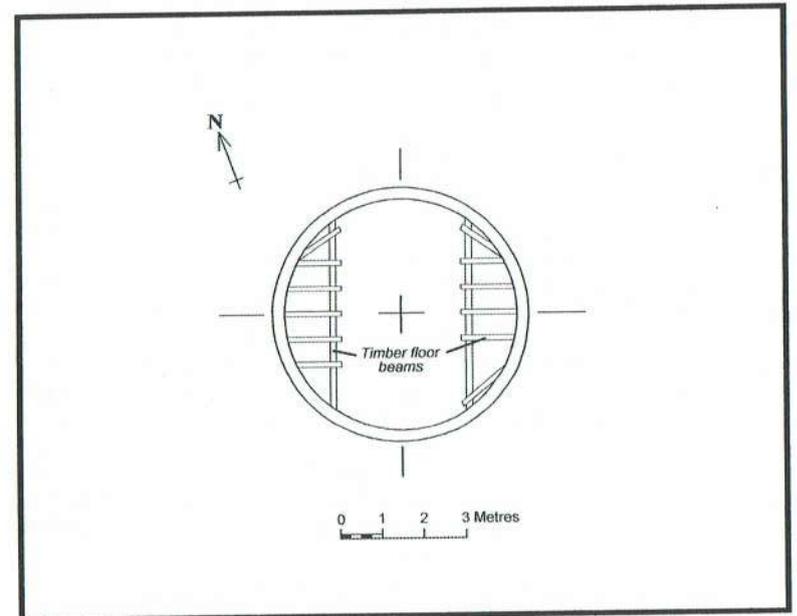


Figure 15. Plan of the Third Floor.

The accompanying beam on the eastern side is missing but there are two holes in the brickwork that indicate its probable position. These main floor beams used to rest at both ends on wooden cills, which had a height equivalent to a brick, that were inserted into the brickwork. There is a ledge on the interior of the brick tower at the ground floor level which shows the remains of the holes that accommodated nine cross beams which once rested at right angles on top of the two main beams. The floor boards would have been positioned on top of these nine cross beams.

There is also one of the main beams that supported the first floor still *in situ*, running east to west on the southern side of the mill just below the first floor ledge on the inside of the tower. This beam was assisted by two stub beams at each end, of which the one at the western end still remains in position. This first floor main beam has been reinforced by the addition of a sawn timber beam being placed parallel to, and adjacent with the original beam at some time. This sawn beam was probably added when the Home Guard used the tower in the Second World War. The northern main floor beam for the first floor and its stub beams are missing but their position can be estimated by the holes left in the brickwork. Also, in the north-western internal wall can be seen the timber insert on which this beam rested. A few brick courses lower than this support another timber piece has been inserted into the brickwork, possibly to assist in cushioning the load (see Figure 4).

There are no remains of floor beams at the second floor ledge but there are holes in the brickwork where the main beams used to be positioned and a timber support piece in the north-west wall. However there are floor remains at a third floor level. These consist of two sawn timber main beams running north to south at each side of the tower, with short sawn timber beams running at right angles from the main beams to the walls. The gap in the middle between the two main beams is spanned by two pieces of timber which do not appear to be fixed in place. The position of this third floor is probably not original and the state of the timber would suggest that this floor level was probably put in the mill for the Home Guard in the Second World War (see Figure 15).

The Equipment Recesses

On the inside of the ground floor there are a number of indentations in the brickwork which were made to accommodate aspects of the machinery. The most notable of these indentations is located in the south-west internal wall where there is a large, plastered recess which is about 1 metre wide by about 1.5 metre high. This recess has been cut deeply into the brickwork. It has a horizontal top and vertical sides but the bottom is curved and its internal surface also has curved shaping towards its bottom and sides (see Figure 7 and Plate 8). In the northern wall part of the wooden lintel of the window aperture and adjoining brickwork has been cut away to form a curved recess some 0.8 metres wide by about 1 metre high. This recess also shows signs of having been plastered (See Figure 5 and Plate 7). In the north-east wall there is a shallow oval depression cut into the brickwork measuring about 1 metre wide by about 1.25 metres high but there is no sign of any plaster left in this recess (see Figure 9). Also there is a recess in the brickwork on the eastern side of the southern window on the ground floor, about 0.75 metre wide by 1.2 metres high, which again has no sign of any plaster (see Figure 7).

The internal brickwork of the north-west side of the mill shows a niche about 0.9 metre long at an angle of 52° to the horizontal which was cut into the brickwork to accommodate the edge of the stairs that used to run up towards the north-east from the

ground floor to the first floor. At the level of the first floor, above this stair niche on the ground floor, there is another niche cut into the internal brickwork of a similar length and angle to the one at the ground floor but running up to the north-west, which accommodated the stairs from the first floor to the second floor. (see Figure 5)

Machinery

Although the history of the ownership of the windmill has been discovered in its entirety from its construction in 1777 to the present day, and most of the actual millers and their families that operated the mill have been discovered, the rest of the history of the mill is largely unknown. As far as the commercial history of the mill, no information concerning the mill's products, their prices, or the mill's customers are known.

The technical history of the mill in terms of the machinery used in the mill and its development over the period of 100 years that the mill was in commercial activity can only barely be glimpsed. A drawing made in 1890 (see Figure 16 below) shows the mill with four sails which, on the whole, have the appearance of common sails. This drawing also indicates that the windmill cap was likely to have been boat shaped with a luffing wheel, a shape common on Staffordshire windmills e.g. as originally at Werrington and Meir Heath, and still to be seen at Little Saredon.



Figure 16. A sketch based on a drawing made by Mrs. Glennie about 1890, published in *The Book of the Village* produced by the Broughton Women's Institute.

The only evidence of the nature of the internal machinery of the mill is the reference to four pairs of millstones in the 1832 sale advertisement. However the types of millstones and any information on whether the gearing driving the stones was either overdriven or underdriven has not been forthcoming. None of the sale advertisements make any mention of ancillary equipment such as grain cleaners, flour sifters and graders, although this type of equipment is most likely to have been used in a windmill supplying flour, etc. to the industrial towns of Staffordshire during the mid 19th century. Certainly the evidence of the building, which has a number of recesses cut into the internal brickwork of the ground floor, presumably to accommodate such machinery, suggests that this was in fact the case but it has proved not possible to interpret these recesses at the moment. In fact it is not possible to state with any certainty just what each floor of the mill was used for, except that the basement was most likely used as a storage area. It is hoped that the publication of this survey will stimulate discussion and speculation on the possible internal configuration of this Grade 2 listed structure.

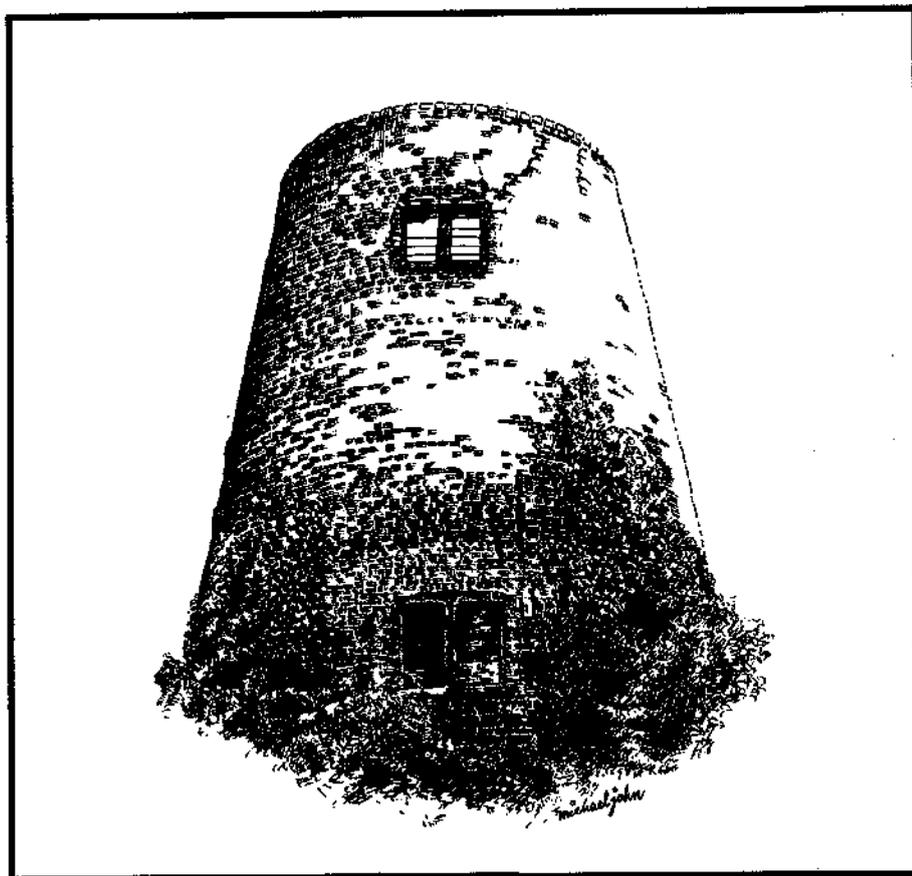


Figure 17. Croxton windmill tower in 1984, drawn by Michael John Tabbenor.

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THE MILLS AT WINSHILL BURTON ON TRENT

By Alan Gifford

Introduction

The town of Burton on Trent is situated on the western bank of the River Trent, in the south eastern part of Staffordshire about 28 miles north-east of Birmingham and 11 miles south-west of Derby. On the eastern bank of the Trent, on the rising ground opposite Burton, lies the township of Winshill. Winshill is connected to Burton by a long, multi-arched bridge that crosses the various arms of the Trent and its flood plain. The county of Staffordshire mainly occupies the basin formed by the River Trent and its associated tributaries. Over the centuries this river network has been utilised to provide an abundance of water power that contributed considerably to the industrial development of the county. Although the River Trent rises in Staffordshire, by the time it reaches Burton it is obviously a major river. The mill site at Winshill is the last one on the river in Staffordshire as about 100 yards downstream from the mill the river crosses the county boundary into Derbyshire. There have been several different types of mills on the site at Winshill, occupying three different locations, but in recent years the area has been largely abandoned. The remaining mill buildings, which have Grade 2 listing status, have been subject to various attempts at re-development in recent years.

The Corn Mill

The Domesday book refers to a mill on this site by the River Trent taxed at 18 shillings and it was probably the most important asset owned by the Abbots of Burton. Initially it only ground cereals for the monks but soon was opened on a 'multure basis' for local landowners and farmers. Under ecclesiastical influences, probably assisted by the fact there were few other corn mills close by, the site prospered. Large warehouses were built to store grain and it continued to be controlled by the monks but, no doubt, lay persons did much of the work on their behalf. There is some evidence that they diversified further and started up a tape mill on the site, using cotton and wool. In mediaeval Burton on Trent the Abbey controlled a total of four mills, Winshill, Stapenhill, Clay Mills and Moor Mill Dam, although the location of the last mill is no longer known. However, in 1545, under the reformation of the monasteries by Henry VIII, the Collegiate of Burton was dissolved and the mill passed into private hands. The mill however continued to flourish.

By the early 18th century only Winshill and Clay Mills of the original four mills of Burton Abbey, remained active. These two mills provided the then owner, Lord Paget, with a profit of between £150 and £250 per annum. In 1763 the mills, together with the weir and navigation leases, passed into the control of "The Lessees of the Trent Navigation" but by this time only the mill at Winshill was still grinding corn, as Clay Mills had by now become

a forge. Henry Evans, one of the lessees, and Joseph Wilson, the miller, operated the mill from about 1790. They imported grain in large quantities on the navigable River Trent, from as far away as Nottinghamshire and Lincolnshire.

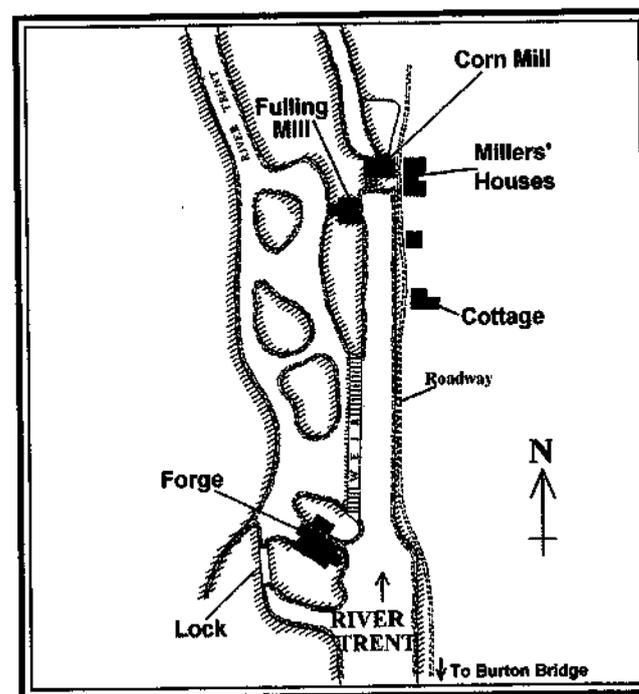


Figure 1. Burton Lower Mills at Winshill in 1760.

The Wilson family continued to operate the mill at Winshill for most of the 19th century under the name of Joseph Wilson & Company. In the middle of the 19th century the firm was run by two brothers, Joseph and Benjamin Wilson. This was a time when millers generally were making good profits but the Wilson brothers were unfortunate in their investments. The *London Gazette* of 27th April 1855 noted that Benjamin Wilson was a major creditor of a grocer and provision dealer in Burton who had become bankrupt. With this kind of financial misfortune the mill was finding it difficult to survive but a stroke of a luck and one man's eccentricity came to its aid. Sir Oswald Mosley, of nearby Rolleston, (this was the father of THE Sir Oswald who became infamous as the leader of the British League of Fascists, or 'Blackshirts', in the 1930s) deplored the disappearance, as he saw it, of wholemeal flour in favour of the then cheaper white flour. His wealth permitted him to indulge his whim and he bought the water mill at nearby Hilton to grind flour as he believed it should be done and opened a shop in Rolleston, selling bread and flour. In 1867 he bought the mill at Winshill to increase his capacity although the Wilson family continued to operate the mill under the terms of their lease until the mid 1880s.

By 1886 Joseph Wilson was getting on in years and decided he was no longer able to carry on the milling business at Winshill so he placed an advertisement in *The Miller* of 1st March, as follows:-

"To be disposed of as a going concern, in consequence of the age of the present proprietor, the excellent Water Corn Mill known as "Burton Mill", situated on the River Trent, at Burton-upon-Trent, and for nearly a century carried on by Messrs. Joseph Wilson & Co. The mill contains six pairs of French stones and one pair of Peak, a silk dressing machine, a smut machine, etc. and there are nine acres of land."

Although this advertisement does not contain a great deal of detail about the mill the presence of a smut machine does show that the grain was being cleaned prior to grinding. The mill was mainly being used to produce flour for human consumption using the six pairs of French millstones, together with some animal feed using the pair of Peak millstones. The flour produced was being graded via the dressing machine.

It has to be assumed that this advertisement was not successful because just over a year later *The Miller* of the 4th April, 1887, carried the following advertisement:-

"To be sold by auction as a going concern, in consequence of the present proprietor retiring, at the Queen's Hotel in Burton-on-Trent, in the County of Stafford, on 19th April.

All that old established and very desirable WATER CORN MILL known as 'Burton Mill', (with the goodwill) situate on the River Trent at Burton on Trent, comprising the excellent mill, with never failing supply of water, containing seven pairs of stones, new silk dressing machine, and bean duster, driven by two large iron water wheels of about 45 combined H.P.; Managers house, Waggoner's cottage, Carriage house, Hackney stables, Stables for twelve horses.

The Mill has been successfully carried out by Messrs. Jo. Wilson and Co. for nearly a century. It is in the midst of a large corn growing area and can be worked as cheaply as any mill in the country. A new wing to the mill is partially erected for the purpose of admitting the new roller milling and would, when complete, make the mill capable of 500 to 550 sacks of corn per week.

The mill and premises are held on lease for 99 years from the 5th April 1886 at the annual rent of £100."

This advertisement gives further details of the mill, notably mentioning the two iron waterwheels developing 45 horse power between them. Although old age was given as the reason for the sale of the mill in March 1886 it would seem that the real reason was that the lease of the mill had run out. If this old lease was also for a 99 year period then it is possible that the first of the Wilson family came to the mill in 1787. Since a new lease had been agreed, Joseph Wilson had been investing in building a new mill on the site to take advantage of the new technology of roller milling that was being introduced into the country at this time. Perhaps understanding this new technology was getting beyond Joseph Wilson so causing him to definitely retire although his new mill was only half complete! This time the advertisement in *The Miller* was successful and the lease of Winshill Mill was purchased by T. C. Greensmith & Co.

One of the first tasks facing the new company occurred in 1888 when the Prince of Wales visited Burton on Trent, commanding a sample of the 'Sir Oswald' bread produced from flour ground at Winshill Mill. Secondly, of course, they had to complete the building of the new roller mill which was signalled in *The Miller* of 7th December 1889 as follows:-

"After examining the various leading systems, Messrs. T. C. Greensmith & Co. of Hilton Corn Mill, near Derby have placed their order with Mr. Charles Hopkinson, of Retford, for a complete roller plant to be put in a new building they are erecting at Burton on Trent. This plant is to be on the best and most advanced lines, and second to none, and will be a model mill when completed."

After completion of the roller mill, the mill complex at Winshill became known as "Greensmith's Mill" and was not to be substantially altered during the rest of its commercial life. Although a number of other corn mills were built in Burton during the 19th century, including a windmill in Cat Street, (later to be called Station Street), these were mostly powered by steam. However these did not prove to be economic and only the mill at Winshill, with its cheap source of power from the River Trent, survived until the later part of the 20th century.

Greensmith's Mill

The old three storey mill building was of brick and stone construction, with a tiled roof, and was about 40 feet long and 25 feet wide. The windows were multi-paned, cast iron framed and those on the lower two floors had curved lintels above them. It carried a date plaque of 1745 and had a Royal Exchange Insurance fire mark, registered in 1792, giving the mill the right to attention of Royal Exchange firemen if the mill caught fire! Unfortunately both of these features have disappeared in the recent past and their location is now unknown. Access to the interior was through a large wooden, metal studded, doorway. From the evidence of the sale advertisements in *The Miller* the mill had two undershot water wheels driving seven pairs of millstones and associated cleaners, dressing machine and a bean duster. Adjacent to the mill was the miller's brick cottage, later to become part of the mill offices, and the stables for the horses used in the transport of flour in the area.

The large four storey brick and stone building that housed the new roller milling machinery of 1889 was attached to, and immediately behind, the old corn mill. The mill was fed by water from a fleam, directed from the River Trent by a large weir. A large cast iron trash guard ran across the mill stream and apart from normal debris, the occasional dead sheep and, once, a man's body have been caught up by it. In its later life the mill had a brick lean-to built on its western end, which housed the turbines. When river was in high flood the mill had to use mains electricity as the turbines could not be used which was always of concern because of the cost involved. The old mill building is linked on the first storey, at the south-western corner, to the nearby cotton mill building by a white painted covered overhead walk way. This carries, in large black lettering, the text "BURTON FLOUR MILLS".

The two undershot water wheels were soon replaced by water turbines. One of these, was renewed in 1931 with a Gilkes 55 H.P. turbine and the other, in 1937, with an Armfield 55 H.P. turbine, both working from a nominal five feet head of water. A series of elevators and worms moved the grain round the mill, starting from the very large, multi-channelled, grain silo which was built in 1935 at the eastern end of the site and into which the initial deliveries were made. This could hold sufficient supply to keep the mill running for about four weeks. The moisture content was closely controlled, and it was found to best suit the milling capability, and was most cost effective, when it was 15.5%. Automatic weighing equipment was installed such that the input to the mill could be measured at all times. All cereals were screened before processing to remove any extraneous matter. The large mill was equipped with four sets of roller milling machines,

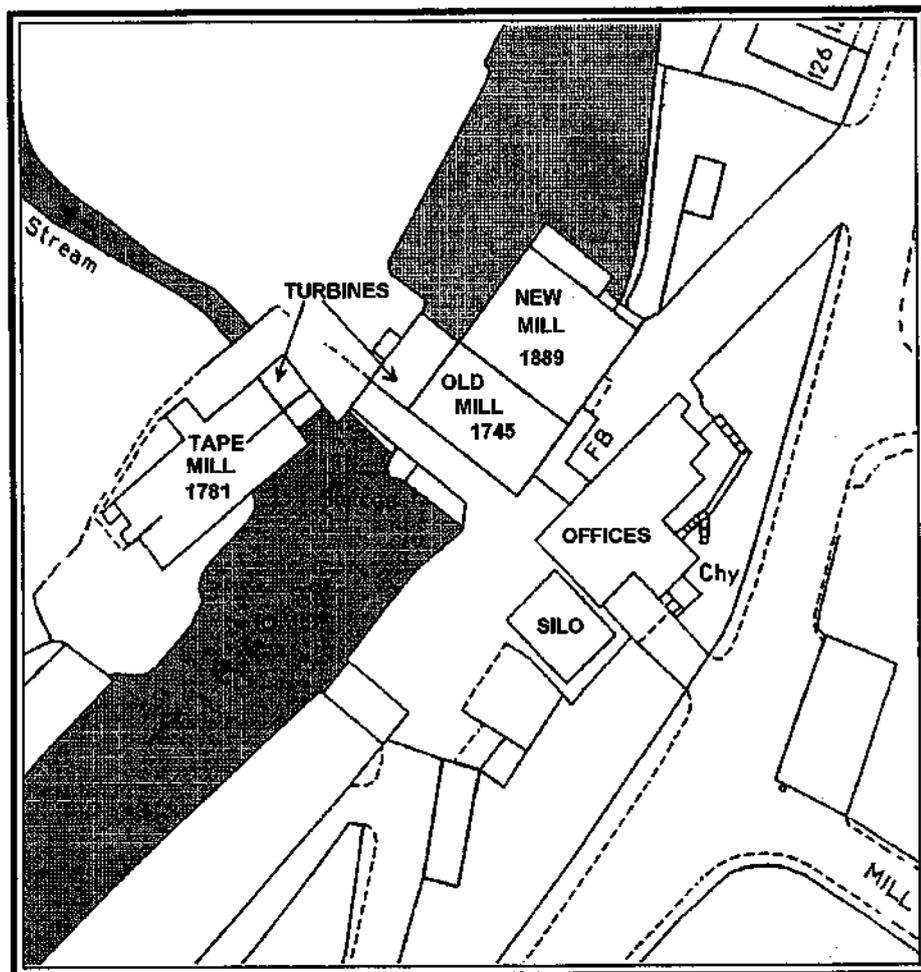


Figure 2. Plan of Winshill Mill site showing the old corn mill of 1745, the new corn mill of 1889 and the cotton or tape mill of 1781.

supplied by Simons of Manchester, the casings of which were well polished oak. The grain was milled in four passes, the product being separated by rotating plansifters between each pass. The normal output was about 9 tons per 12 hour shift or about 80 tons a week, and the target of the mill was to obtain 70/72% minimum return of white flour at all times. The mill operated 24 hours a day, Monday to Thursday, but only operated on Fridays if there was a large order book.

Originally all the flour produced was supplied in bags but market pressures led to the provision of chutes from the bagging floor, connected directly to bulk road transporters. These vehicles were initially provided by K. & M. Bulk Transport, but later

Greensmith's had their own fleet of steam lorries. Joe Marston joined the mill staff just before the Second World War, in 1935, and eventually became mill manager, working there until it was finally closed down. He said he regularly travelled the area, first on a pedal cycle, then on a motor bike and finally in a small car the company supplied, always seeking work for the mill. At this time the mill was owned by the brothers Tom and Jimmy Greensmith. Tom was an expert on grain, especially Canadian Manitoba, whilst Jimmy concentrated on running the mill. They lived close by at the bottom of Mill Hill Lane, in adjacent houses.

T. C. GREENSMITH & SONS LTD.
 Winshill's Medieval Water Mill

FLOUR MILLERS
 CORN & CAKE MERCHANTS
 MANUFACTURERS OF ANIMAL FEEDING STUFFS
 SINCE 1689

*With a history of 1,000 years behind their
 unique river site at Winshill, Greensmith's
 proudly retain the same tradition of local
INDEPENDENT service*

GREENSMITHS
 SATISFACTORY
 SERVICE WITH QUALITY
 SURVIVES
 THE TEST OF TIME

Telephone: BURTON-ON-TRENT 3029

Figure 3. Advertisement for Greensmiths, 1969.

The Greensmiths continued to operate in the post war years, but they found modern hygiene regulations increasingly difficult to comply with and, in 1991, decided to close down operations. Being members of the Millers Mutual Association (M.M.A.), when the mill closed all the roller mills and most of the other plant were removed and most of it was destroyed. The M.M.A. was formed in the 1920s and members subscribed to a fund which fostered the interests of mills, including advertising, supporting bakery schools, providing advice on the use of flour and also a 'Silencing Fund'. The Silencing Fund ensured that when mills closed down owners could apply for compensation and their trade would then be transferred to other members of the M.M.A. Application of this fund however required that all key machinery had to be removed from the building to ensure flour could no longer be produced on the site. Fortunately, however, the two turbines survived and are both currently used commercially to generate electricity, even though the mill is no longer in operation.

To ensure some measure of protection for this historic building the corn mill was listed as Grade 2 on the 24th of March, 1950, the listing reading as follows:-

"An early C 19 mill and malthouse. Red brick, three storeys; casement windows, generally with cast iron lights. Embodying the remains of the corn mill of Burton Abbey, including late medieval masonry, a two storey stone mullion window and doorway with blocked segmental head and heavy cast iron door. Stone coped gable ends ; tiles, fire insurance plaques at first floor level and a stone tablet inscribed with the date 1745".

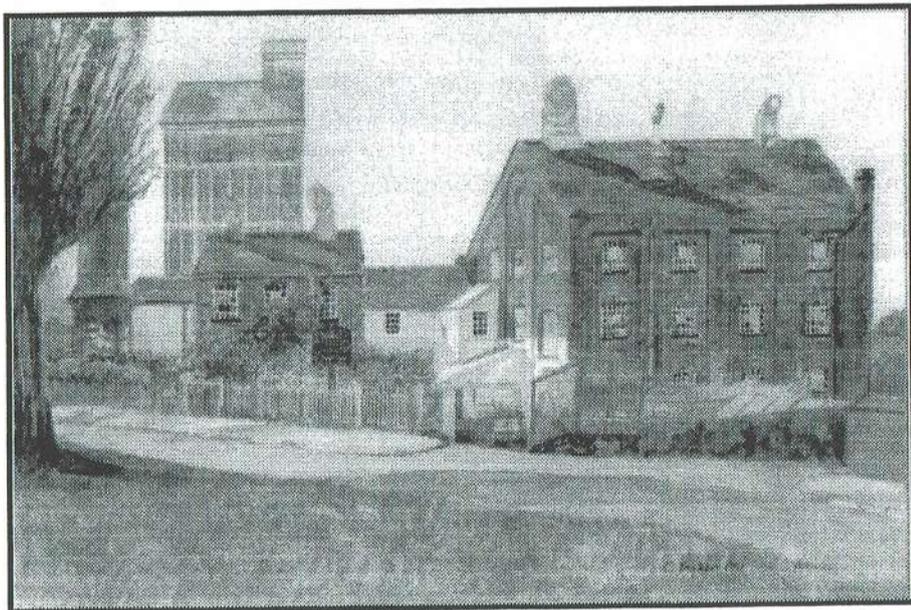


Figure 4. Drawing of Greensmith's Mill viewed from the north side c.1990. The large silo has now been demolished.

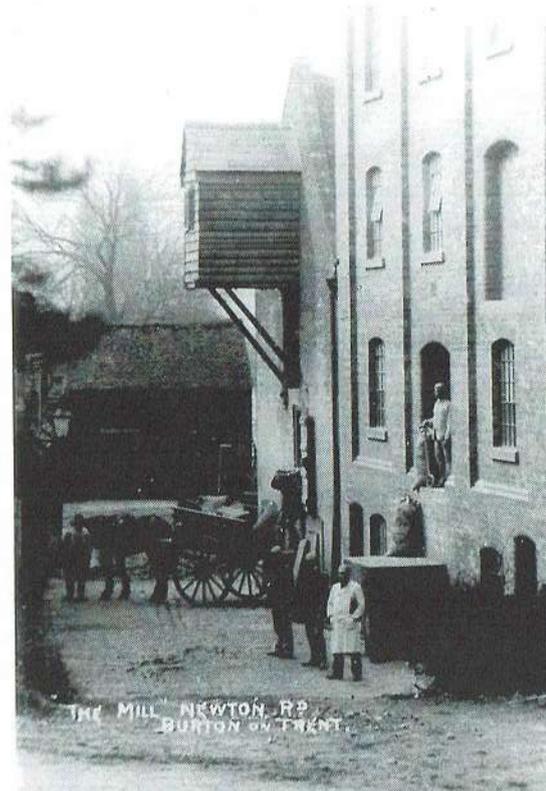


Plate 1. Winhill Mill c. 1900 with the new mill on the left and the old mill with the lucam, behind it. Note the horse transport and the method of loading.

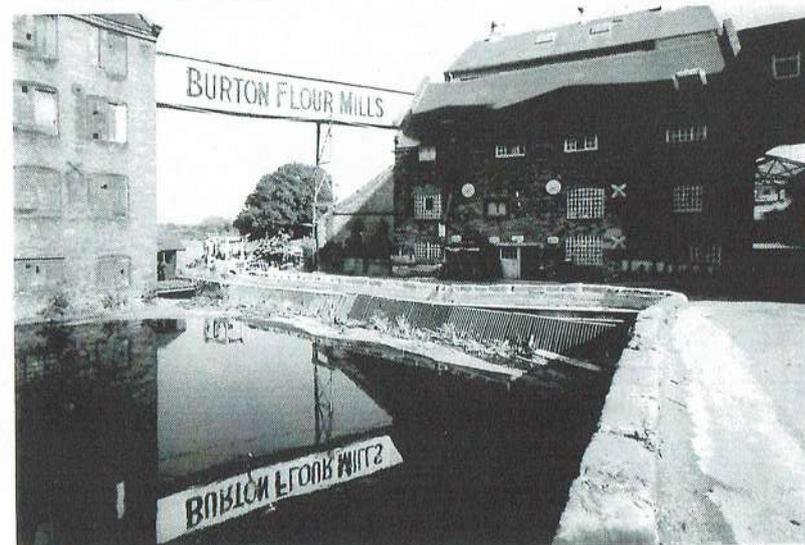


Plate 2. The old corn mill with the connecting gantry to the old cotton mill on the left.

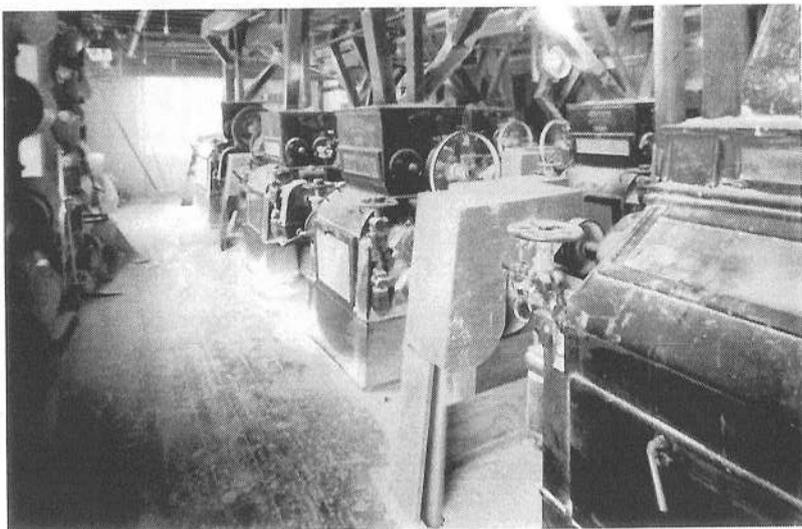


Plate 3. The roller grinding floor with spare rollers stacked on the left hand side.



Plate 5. Winhill tape mill with overhead walkway to the roller mill.

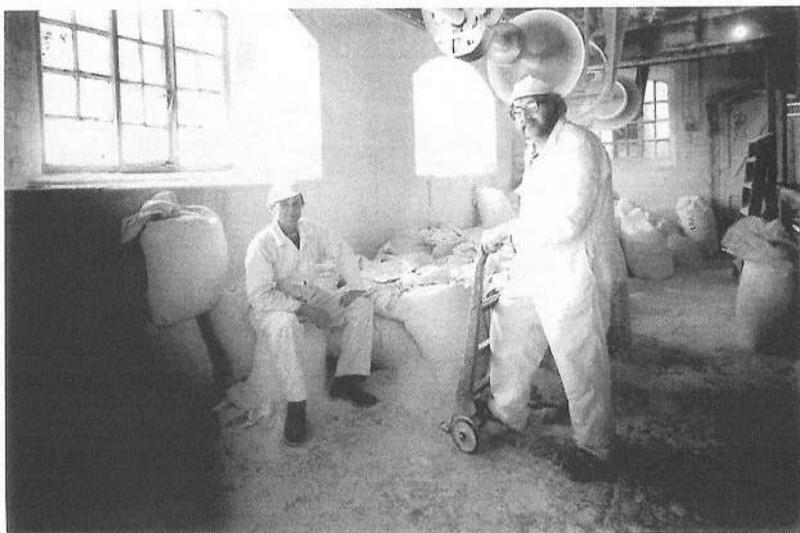


Plate 4. Staff moving sacks of grain in the old mill. Note the lineshaft and belt drives overhead.

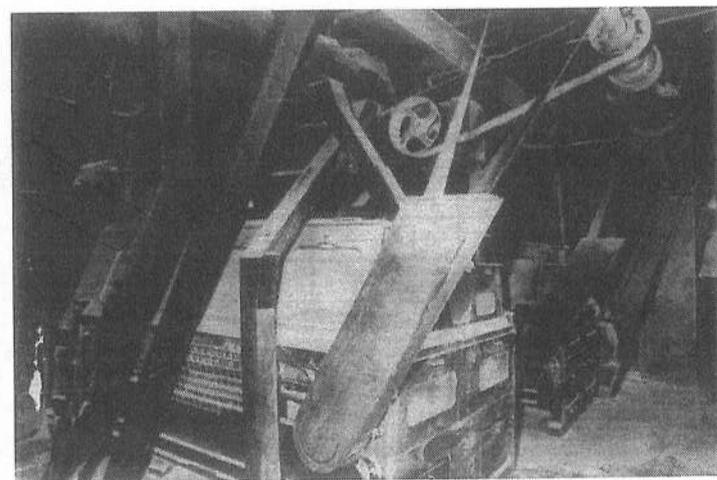


Plate 6. Some of the machinery inside the mill.

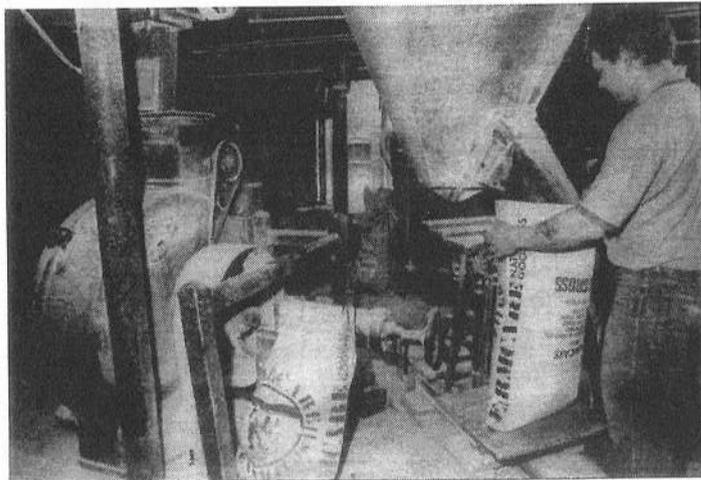


Plate 7. Bagging flour at Greensmith's Mill.



Plate 8. Pallets of animal feed in sacks ready for dispatch.

The Cotton or Tape Mill

To the south west of the flour mill and adjacent to it (see Figure 2) is another four storey brick building. This building was erected on the site of a 16th century fulling mill and in 1780 became one of the first cotton mills in Burton, operated by Robert Peel and his partner Yates, who moved to the town, leaving a riot troubled factory near Blackburn. The cotton mill was originally insured with the Sun Insurance Company, a fact confirmed by a Sun Insurance firemark, registered in 1781, located on the building. This mill was in use as a tape mill in 1851 when it was owned by Small, Taverner and Sharp, and this firm continued to operate from the site until 1903 when they moved into Shobnall Street, Burton on Trent. The continuous use of this building came to an end as late as the 1970s.

The scrape marks of a low breast waterwheel are visible on the side wall of the tape mill. In addition a turbine, of unknown rating, supplied by McAdam Brothers of Belfast, is still in place, as is some of the gearing, etc. for the sluices. It was contained in a tiled brick lean-to building but unfortunately the roof tiles have recently been stripped off by vandals. This mill has also been listed as a Grade 2 structure in its own right, separately from the corn mill. The citation reads as follows:-

"An 18th century red brick building, originally of four storeys and attic, but the first floor has been taken out; eight segmental headed windows with multi-paned iron lights; corbelled eaves; stone coped gabled ends; tiles. 'Sun' insurance plate. Formerly with mill wheel on east side."

The Forge and Flint Mill

A third mill stood about 100 yards upstream towards Burton, the site being on an island which was reached by a bridge. In 1762 this mill was described as "a forge mill" when it was taken by the Lloyd family, who added a rolling mill to the premises later in the 18th century. One of the products of this forge were blank screws supplied to Messrs Shorthose, Wood & Co. for threading at Tatenhill Mill and then later at Hartshorne Mill. In 1810 the forge was offered for sale in the Birmingham Gazette of the 6th April as follows:-

"To be sold. The complete machinery of a forge and rolling mill, near Burton-on-Trent, consisting of four waterwheels, large fly wheel, stamping and drawing helves and hammers, puddling and casting furnaces, two blast cylinders, pipes, roll frames, pillars and rolls, etc. Enquire of Samuel Bamford on the premises."

The waterwheels would have probably been used to provide air draught to the two furnaces as well as driving the hammers and the rolling mill.

In 1851 the forge was converted into a flint grinding mill which was owned by J. W. Hawthorn. In 1880 T. G. Green had a business in the building as a pottery material manufacturer, supplying material to his own factory at nearby Church Gresley. Calcined flints were ground to fine powder and used in the manufacture of white earthenware pottery. In 1921 the premises were used by a printer, Albert Brown. The building was eventually abandoned and became a ruin, being demolished when the site was totally cleared in 1948. Little remains to be seen today although various waterways can be still recognised, including the remains of a large lock which was used to bring supplies to the mill by river. This could take boats up to 14 feet beam and was used primarily to bring timber, via the River Humber, from the Baltic ports to Burton and then returning loaded with beer!

The Future of the mill complex

Planning consent was given in 1999 to convert the mill complex into 22 high quality flats. Many the external features were required to be retained, including the multi-paned windows, and the developer was keen to establish a small museum in the basement. However, the project was conditional on a promised grant, but it is understood that the grant supplier considered financial support of the re-formed Rover Car Company, at Solihull, to be of greater priority than Greensmith's Mill and so the offer to support the project was withdrawn at a critical stage. As result the developer subsequently went into liquidation and the site continues to deteriorate, although the turbines still produce electricity which is fed into the National Grid.

It is understood that negotiations are currently in hand for another developer to take over the site who will work to much of the original concept, plans for which had so tenuously been agreed. Only time will tell if the mill complex is to be saved.

Acknowledgement

Grateful thanks are extended to Mr. Joe Marston of Winshill, who worked at the mill for so many years and who has recounted his memories to me and provided some of the illustrations. Also to Fred Dicken, now working as a gardener in Willington, but who had been employed as a general worker at Greensmith's from 1945 to 1947. He then went into the army, afterwards returning to the mill for a while. He worked directly for Joe Marston and remembered him travelling on his motor cycle, having had a lift with him on many occasions.

Plates 5, 6 & 7 are reproduced by kind permission of PWS Photography, Bretby, Burton-on-Trent.

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A MILL EXPLOSION AT MACCLESFIELD CHESHIRE

By Barry Job

Introduction

Macclesfield, which is situated some 15 miles south of the Manchester conurbation, grew significantly during the industrial revolution of the late 18th century. Unfortunately the local infrastructure did not keep pace with industrial development as waterborne transport was not available until the building of the Macclesfield Canal in 1831. Due to the local geography the canal passes about quarter of a mile to the east of the town where a large canal basin was built. As part of the improvements brought by the canal, a steam corn mill was built at this basin at the same time as the canal. After a number of owners this mill was purchased by Samuel Fitton in the 1860s.

On the night of 14th September 1881, Fitton's Mill exploded with fatal results. The headlines in the *Macclesfield Courier and Herald* reported that "The Brook Street Corn Mill" was "Wrecked" with the "Engineman Buried Alive". Thomas J. Richards, the Government Inspector, investigated the cause of the explosion on behalf of the Secretary of State. It was attributed to a spark or flame, produced by a pair of millstones running empty, igniting flour dust. In a lengthy Report he went on to consider the whole issue of the explosibility of flour dust, which gives an insight into the thinking concerning the problem that was current at that time.

Mill Description

Situated in Brook Street and adjoining the Manchester, Sheffield and Lincolnshire Railway Company's canal the mill was a building of five stories, including the attic floor. It was described as being very strongly built about 50 years ago and "was one of the finest, if not actually the finest corn mill in the kingdom." The steam boilers were at the north end on the ground floor and supplied steam engines of 150 horse power. Above them, but separated by fireproof arches, were two dust rooms or 'stive rooms' which extended through two storeys of the building and had, together, a total capacity of about 13,000 cubic feet. The ground floor contained 13 pairs of rollers driven by belts. There were 14 pairs of millstones; 12 on the second storey and two on the third. Each pair of millstones was contained in a case from the upper part of which trunking communicated with a fan which caused a draught through the millstones drawing away certain fine particles of flour

termed 'stive dust' and discharging it into one of the stive rooms. The third floor also contained ten dressing machines, one bran machine and two purifiers, the other stive room received particles drawn from the purifiers. On the fourth floor were four dressing machines, each 30 feet long, a bran scalping machine and the fans for the trunking. The attic floor contained all of the wheat cleaning machinery.

Exhaust

The arrangement for causing a draught through the millstones, or the 'exhaust' as it is commonly referred to, was primarily adopted to increase the through-put of the stones, but also because the fine particles were considered to be objectionable in the product. It is also beneficial to keep the millstones cool and free from paste, but perhaps the greatest advantage was said to be that the atmosphere in the mill was kept, to a great extent, free from dust. Richards said that "The liability of workers in the flour mills to lung disease, to which the dusty atmosphere in the mills rendered them especially liable, is much reduced. Messrs Fitton and Son, with a praiseworthy regard for the comfort and health of their workmen, had connected with the 'exhaust' every apparatus in the mill Their workmen thus enjoyed, I believe, an immunity from dust which is not usual in most flour mills. To this freedom of the mill from dust must, I think, be attributed the fact that the explosion was not succeeded by a general firing of the mill As has occurred in some other cases."

Narrative

Robert Hewitson, who had been in the employment of Messrs. Fitton for over 25 years, said that he went through the mill about 8.30 p.m. and all was going well. At five minutes past ten o'clock he was startled by the explosion, which was felt all over the town. The flash, resembling lightning, illuminated the heavens and was perceptible for miles, causing much consternation and alarm. The windows of the mill house were blown in and the house itself "rocked like a cradle." The sound of falling debris was like distant thunder. Hundreds of people assembled and, being built on the canal, any flames were quickly extinguished. It was thought, at first, that one of the boilers had burst as all of the mill's roof had been destroyed and a large part of the north end was pretty well levelled with the ground. The chimney, fully 100 feet high, and part of the engine house were blown into the canal, blocking it. The mill yard was covered in tons of bricks. When it became known that Charles Johnson, the engineman, was missing the excitement was intense. "Those engaged in clearing away the debris worked with that desperate earnestness and energy which inspires Englishmen when life is in jeopardy". Fortunately for the rescuers neither of the safety valves for the boiler had been obstructed, in spite of being buried by tons of debris, otherwise a further explosion must have ensued "with results fearful to contemplate." Digging commenced in front of the boiler but after an hour the only result was the release of a cat which, "as soon as opportunity presented itself, made a speedy escape, evidently unhurt, from its enforced imprisonment." Another party began digging at the other end of the engine house. They had not been at work very long when Johnson was located and heard to moan. This good news was quickly exaggerated into his being extricated uninjured. "Some person more impetuous than discreet, communicated to his heart-broken wife that he was alive and well. The sorrowful contradiction had to be made only too soon." Although Johnson was heard several times imploring his rescuers to get him out as quickly as possible - the poor fellow was found to be suffocated when reached about two o'clock in the morning with life quite extinct. The body, which was only slightly

bruised, was then taken home. Johnson, aged 57, was described as "a careful industrious man, and a conscientious servant, having been in Mr. Fitton's employ for the last 30 years."

Thus Johnson was the only fatality. However, if the accident had occurred during the day, with up to 30 men on the premises, the death toll would have been much greater.



Macclesfield Flour Mills after the explosion, from *The Miller*, 6th February 1882

The Inquest

Evidence was given by Mr. Fitton and son, Mr. Redwood, the Manager, and several of the workmen. Redwood states that he had been connected with the mill for 30 years. When he left the mill shortly before the explosion all was going well. Hewitson said that it was his duty to ensure that the millstones were fully supplied with corn, he had only examined the meal spouts a few minutes before the explosion and "he was certain that none of the millstones had run empty."

The inquest was then adjourned and Richards, the Inspector, requested that all of the millstones were separated. They were then examined by the witnesses who agreed that the No. 3 pair had been running empty at the time of the explosion, Mr. Fitton going so far as to say that "they had been running empty since last dressed which was a week previously." A piece of cotton waste found in the eye of the stones would have been sufficient to have caused a blockage in the corn supply.

The Inquest Jury brought in the following verdict: - "We find that Charles Johnson was accidentally killed by the falling of a portion of Messrs Fitton's corn mill caused by an explosion in the stive room. There is no clear evidence how the explosion was brought about, but the Jury are of the opinion that sparks or flame may have communicated from the No.3 pair of millstones, which have been shown by several witnesses to have run empty.

Differing Opinions

Richards had made enquiries of a number of millers to ascertain their opinions on flour dust explosions. Some said that the causes of explosions in corn mills had not yet been satisfactorily explained. Some millers doubted if explosions could be caused in stive rooms by millstones running empty, whilst others disbelieved the possibility of explosions occurring there altogether. Others believed that the presence of some explosive gas was necessary, or that the extra pressure of air due to the fan played a significant part, or a certain electrical condition of the atmosphere must exist. One miller said that a stive room could at all times be entered with a naked light, except when there was observed in it the peculiar odour which is noticed when one of the millstones has been running empty. Richards concluded that: "The fact of such opinions being held is to be regretted, as explosions in corn mills are liable to be regarded as mysterious, to which they have, in my opinion, no title. The precautions also which may obviate or lessen the effect of explosions are liable to be neglected."

Practical Experiments

After referring to previous work by Professor Macadam on the explosibility of flour dust Richards decided to conduct simple experiments himself. Taking stive dust from millstones and purifiers he brought it into contact with a candle flame where it burnt quietly. He then sieved it over the flame in a dispersed cloud where it burnt with great rapidity "in an explosive manner". He then made a box where the dust could be dispersed and brought into contact with a flame. This was instantly ignited, creating pressure within the box and violently blowing the lid off. This occurred, more or less, with common flour, stive dust, purified middlings, the general dust from the beams within a mill, dust from wheat-cleaning machines and ground rice. The last appearing to be the most explosive. Interestingly he concluded that the dust must "be thickly diffused in the air, otherwise no general ignition of the dust takes place ...". He correctly went on to say "There can be no doubt of the frequency with which millstones run empty ...". The comparative infrequency of explosions ... has been a matter of much mystery ... Whether an explosion occurs or not when millstones strike fire is entirely dependent upon whether the dust and the air in the millstone cases are mixed in the suitable proportions."

Referring to Professor Peck of Minneapolis University, who determined that damp flour dust would not explode, Richards conducted his own experiments on damp dust. His results were different; whilst conceding that damp dust is less likely to be dispersed, surprisingly he concluded that dampness had no effect on explosibility, indeed, damp dust would generate a more violent explosion.

Explosibility of Coal Dust

Leaving Richards's Report aside for a moment; to set these opinions in context a comparison might usefully be made to the explosibility of coal dust. Here there was great

resistance to the acceptance that it could explode. It had always been accepted that a methane explosion in a coal mine would ignite coal dust which would aggravate the explosion. As mines became more mechanised in the mid 1800s so explosions, with major loss of life, became more commonplace. Public interest stirred the government into action and the leading scientific minds of the day were called upon to investigate the problem. Whilst the contribution of the coal dust was seen to be significant; the presence of gas was deemed essential for an explosion to occur. The problem was that disastrous explosions then occurred where gas was unknown. Independently the Mines Inspectors, William Galloway and Henry Hall, began experiments in 1875. Hall produced some powerful explosions and Galloway concluded that some explosive gas was necessary, albeit in very small quantities, for an explosion to be initiated. Other experiments produced conflicting results. Some used thickly dispersed dust, arguing that if this would not ignite then less dense dust would not ignite either, but they failed to generate any explosions. Then in 1880 the Seaham Colliery exploded with the loss of 164 lives. The government instructed Professor Abel to carry out a series of experiments. He came to the same conclusion as Galloway. Remarkably his experiments managed to produce explosions with inert dusts but he believed that coal dust by itself was not explosive. He went on to state the basic argument against the explosibility of coal dust "... if coal dust alone were explosive; then every colliery in the country would have blown up long ago." It was to be some years before it was generally accepted that coal dust was explosive with the crucial factor being its dispersal in air in the appropriate proportions, other relevant factors being its fineness, dryness, volatile content and power of the ignition source. It was to be 1894 before the danger of coal dust alone was officially recognised.

Thus Inspector Richards, by saying in 1882 that flour dust itself was explosive, was at the forefront of current thinking. By carrying out his own experiments he showed the typical inquiring mind of a Government Inspector, even if some of his results would later be shown to be at variance with accepted thinking. The resistance to the explosibility of flour dust no doubt followed the same line - if flour dust was explosive why hadn't every flour mill blown up long ago? This resistance was no doubt supported by the vested interests of the mill owners.

The Risks

In his Report Richards made reference to the Tradeston Mills in Glasgow which exploded in 1872 utterly destroying the large building. Of the 27 men employed: 15 were killed and 11 were seriously injured. This explosion was again attributed to "stones running empty and striking fire", this ignited dust in the exhaust leading to a second explosion and fire. A similar cause was attributed to the Washburn Corn Mills, Minneapolis, in 1872, said to be the largest corn mills in the world. This explosion was not disastrous but it was sufficient to set fire to the neighbouring Diamond Mill which then exploded, this ignited the neighbouring Humboldt Mill which then ignited three other mills. A total of 18 lives were lost. It was clear that a small explosion would put clouds of flour dust into the air, which could then explode violently and cause a general firing of the mill. The Miller's Mutual Fire Insurance Company reported 84 serious fires in the last six years, but Richards suggested that only 20 per cent of the explosions or fires that occurred were reported. Lesser incidents went unreported as the millers did not want to draw attention to the risks of the business.

The Insurance Companies were alive to the extra risks of corn milling, charging a very high rate for corn mills of about 18 to 20 shillings per £100 value of the mill. For the

grinding of rice an even higher rate was charged, in London it was said to be £6.6/- per £100, with some companies not accepting the risk at any price.

In a postscript Richards reported that four disastrous fires had occurred since writing the Report in January 1882; at the Ings Flour Mill, Wakefield; Skeldergate Flour Mill, York; Kirkdale Flour Mill, Liverpool and at the flour mill of Messrs Robinson, Deptford. In all cases the cause of the fires was unknown.

Solutions

Richards emphasised the dangers of stive rooms. He suggested that they could be done away with altogether with a "trifling loss", partly offset by a reduction in fire insurance premiums. He did accept that most millers would consider that they were unable to do without them. He did not consider that there was any difference in safety between forcing and exhausting fans, although many millers considered the latter to be safer. He could only suggest that stive rooms should be lightly built and entirely separate from the mill, the side of the mill facing the stive room being a strong blank wall. Thus the effects of an explosion would be substantially lessened.

He did suggest that Bahra's Exhaust system, where the dust was filtered out by a long haired flannel strainer, was preferable to a stive room. He then commented on the desirability of preventing stoves running empty.

Conclusion

Since about 1850 the sophisticated mechanisation of corn mills and, in particular, the application of the exhaust to the millstones, resulted in a number of major explosions. These often produced fatalities and the public began to express concern and alarm. Yet the causes were often described as "mysterious" or they were attributed to lightning. The Government took this concern seriously and despatched Inspector Richards to investigate the explosion at a provincial mill in Macclesfield. His investigation was lengthy and thorough and he quickly ascertained the cause. He readily accepted the explosibility of flour dust, verifying his belief with simple experiments.

This was the same approach adopted by the Mines Inspectors with regard to the explosibility of coal dust. But in their case any suggestion that coal dust alone was explosive was met with fierce opposition from the influential colliery owners and the Inspectors were vilified as a result. They had to await the support of the scientific community. This was a long time in coming, the results of early experiments proving to be inconclusive or contradictory.

Thus the acceptance of the explosibility of flour dust by the Government Inspector, and his desire to disseminate this new information, illustrates a refreshing openness. The recognition of the problem being but the first step in its solution.

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WHAT HAPPENED TO THE MILLSTONES?

By Glyn Jones

Roller milling methods were introduced tentatively in Britain during the 1870s and began in earnest with Henry Simon's small plant for McDougalls in Manchester in 1878. There were then about 10,000 addresses of millers in Britain. In 1882 Simon reckoned that there were possibly 18,000 pairs of millstones. Technical change was rapid and effective from the early 1880s with surges of practical application from 1883 to 1885 and around 1890, described by millers and milling engineers then and many times later as revolutionary change. In 1889 the National Association of British and Irish Millers (NABIM) stated that there were about 540 roller process mills in Britain; they could have produced most of the flour required, confirmation of the rapidity of the advance of the new methods. The clearest evidence was in the increased milling activity at the ports and loss of flour trade amongst rural businesses. In geographical terms, the incidence of new methods was prominent across Lancashire and Yorkshire and on the Severn estuary. The south-east was not dominated by London until after 1900 but was affected by the overall national pattern from the 1880s. Here is a general description of the situation in Kent, with some notice of adjacent counties.

Traditional milling methods were strongly represented in south-east England until the second phase of the diffusion of roller milling around 1890. From then on there was a steady reduction in the viability of mills that did not have steam power and use roller milling methods. In Kelly's directories for Kent there were 262 entries for millers in 1882 and 255 entries in 1887, but from 1891 onwards there was a sharper and continual fall; there were only 116 entries in 1915 and many of them were then probably provender millers or millers who relied heavily on provender trade.

Many millers in small rural windmills and watermills who had depended on a mixed trade in both flour and provender¹ were adversely affected by the development of town mills, by the boost given to the town mills by roller milling and by improvements in transport. Coles-Finch (1933) provided a detailed study of the "rise, decline and fall" of the small rural mills of Kent² particularly the windmills, and from records of the millwrighting firm of Holman Bros., of Canterbury, he compiled a list of 77 windmills that were still in use about the year 1900.³ Kelly's directory for 1899 showed 107 entries of millers using wind power.⁴ Holmans were the best-known millwrights in east Kent and their reputation extended much further afield. These estimates suggest that there was a widespread use of windmills in Kent at least until the turn of the century. The last windmill to be erected in Kent, for use in grinding corn, was put up by Holmans at Swingfield, near Folkestone, in 1885⁵ according to Coles-Finch (1976) who in 1928 suggested that in the Rochester area it was "since 1883 that the greatest number have been thrown out of use".⁶ Coles-Finch (1976) stated that "By 1903 many of our windmills had ceased to make flour, and the old wood-heated ovens in the bakeries attached to many of them had already been destroyed.

Already did the baker's van from the near town call from house to house with 'Cottage', 'Tin' and 'Coburg' loaves and fancy breads".⁷

Coles-Finch referred to the year 1903 partly because he had studied the Ordnance Survey maps of 1903-1910, but also because he was particularly aware of the changes in the milling industry around the turn of the century. The context of change may be set on a wider basis than the county of Kent. Nationally the process of scaling up of plant capacities by the successful firms and the associated process of industrial concentration were acquiring fresh impetus. The problems of the country millers were coming to be seen in sharper contrast to those of the port millers and there is a large amount of evidence of this in commentaries in the milling journals and in reports of meetings of the National Association. At the Association's convention in 1903, held at Folkestone, one of the main subjects of deliberation was *'The improvement of British home grown wheat'* and another was the *'Supply of food and raw materials in time of war'*,⁸ the subject of the Royal Commission which started taking evidence in May 1903. Both these topics of discussion drew attention to the continued importance and the uncertainties of home grown wheat.

The English wheat situation was a matter of serious concern for millers throughout the south-east of England and East Anglia. The practical rather than theoretical importance of the home grown crop was indicated in a statement in the journal *Milling* in 1903: "Almost all the millers in Kent are large users of native wheat and in most (of the larger) mills it is common practice to make two mixtures, one mostly of strong foreign wheats and another in which Kentish wheats largely figure".⁹ The first of these mixtures produced the bakers' grades of flour and, although foreign wheat made up the larger proportion of the grist for making bread flour, Kentish wheat was also an important constituent.

Kentish millers were affected by variations in the quantity, the quality and the price of native wheat, but they had grown used to these problems. In many cases they had long-standing, though firmly business-orientated relationships with local wheat farmers. Some millers in the south-east also had farming interests, but this has not been specially noted in the case of Kent. The clearest and commonest hazard for the users of native wheat were deficiencies in harvest yield or harvest quality, both of which could be affected by the weather. In the background, there was the general trend of decreasing wheat acreage. In 1903 the wheat acreage in Britain fell to less than 1.5 million acres. Previously, it had been lower only in 1895 and it was to be lower again only in 1904, before a slight recovery to an average of about 1.7 million acres between 1905 and 1914.¹⁰

For many Kentish millers the rural or small town environment in a predominantly agricultural county was conducive to the maintenance of traditional and conservative attitudes. East and south of the Medway towns there were no large centres of population and, although the county stretched to the outskirts of London, the metropolis had a previous reputation of indifference to bread quality. So when roller milling was introduced in Britain there was no surge of early interest in the London area which might have encouraged south-eastern millers generally to question the standards of local tastes.

Apart from J. & H. Robinson, and S. P. Mumford & Co., both at Deptford,¹¹ there were few mills in Kent that could be said to have developed to at least a medium size by national standards by 1903; the leaders then were Cannon & Gaze Ltd. at Erith,¹² Wingent & Kimmins Ltd. at Chatham¹³ and G. W. Chitty & Co. at Dover.¹⁴ Detailed information about Mumfords is not available, but twelve well-known milling businesses have been

listed in the following table.¹⁵ Their roller milling capacity was in aggregate between 110 and 120 sacks per hour in 1903 and if Mumfords' capacity was comparable with Cannon & Gaze's, then the twelve mills in the table together with Mumfords could have supplied most of the requirements of the population of Kent, by two-shift working. The bigger mills in the north-west of the county probably worked longer hours and a further complication is that some of the millers in the list were 'mixing millers'; they bought strong foreign flour and blended it with their own products. Therefore it appears that in 1903 there was still some trade for very small businesses and possibly for some of the surviving traditionalists in Kent, but that even in this largely agricultural and traditional area the scope for the small country millers who did not modernise had been considerably curtailed.

Although many of the larger Kentish mills were at towns on the Thames estuary or at seaport towns they were not necessarily on quayside sites. Cannon & Gaze and Wingent & Kimmins could receive wheat direct from barges, but neither of the Dover firms were at the docks, as their mills had been sited on the River Dour, to make use of water power, and Hudson's mill at Ramsgate was not at the harbour.¹⁶ These three east Kent firms had much of their foreign wheat carried by sailing barges from the Thames estuary and they incurred the extra costs of Port of London charges and of the transport from landing points in Kent to the mills.

Many of the predominantly family firms had long traditions as millers, the Hudsons from early in the eighteenth century, the Cannons, the Chittys and the Mannerings¹⁷ at Dover at least from early in the nineteenth century. The millers of east Kent regarded themselves as country millers, the Dover millers using the term specifically, and the appropriateness of the description was increased by their previous experience. The Pledges made use of wind, water and steam power at Kennington, near Ashford,¹⁸ before building a new roller mill alongside the railway at Ashford in 1890. The Hookers acquired an existing mill at Canterbury in 1891 and installed a roller plant, previously they had been windmillers at several rural sites near Canterbury and had made their first experiments with roller milling at a watermill at Chartham, near Canterbury.¹⁹ The Hudsons had been windmillers at various sites in north-east Kent before C. J. Hudson bought the Isle of Thanet Steam Mills at Ramsgate in 1891. Roller milling had already been introduced there on a small scale but the plant was remodelled and increased in capacity for Hudson.

In north-west Kent, the Cannons had used water power and steam and had a large business and several mills before they took up roller milling. In 1881 Stephen Cannon was working 13 pairs of stones at Erith and in 1887, in partnership with J. T. Gaze, he acquired a mill at Dartford and then had 25 pairs of stones. Cannon & Gaze Ltd. installed their first complete roller plant in 1892 at Erith, concentrating their flour milling business there; they continued as provender millers at Bexley, but then gave up two other mills. Thus a number of Kent millers were included in the second phase of the diffusion of roller milling, which started at the end of the 1880s. To those mentioned above, West & Wright of Maidstone should be added.²⁰ Mannerings at Dover and Gilletts at Faversham²¹ seem to have taken up full roller milling methods in 1895, though Mannerings had previously worked a combination plant.

Amongst the country millers, G. W. Chitty & Co. of Deal and Dover were outstanding. Although they did not have the large urban market potential, which the millers in north-west Kent possessed, they converted to roller milling during the surge in the first main phase of the diffusion of the new methods. The first of two millers with the name of G. W. Chitty succeeded his father in business at Deal in 1836. He took over two windmills,

and later acquired another; Wellington Mill and the North End or Great Mill, both at Deal, had 3 pairs of stones and Sandown Mill, near Deal, had 2 pairs.²² About 1856 a steam engine was installed at Wellington Mill, the number of stones was increased to 6 pairs and the use of wind power was discontinued at that site. In 1865 Charlton Mill at Dover was bought. Built about 1850, Charlton Mill had been worked on water power by the Aerated Bread Co. Chitty fitted 10 pairs of stones and installed a steam engine.

LEADING KENT MILLERS IN 1903 (see notes 9 & 15)

Name of firm	Location	Capacity sacks/hr in 1903	Date of first roller plant	Main supplier of roller plant used in 1903	Member of NABIM in 1901?
J. & H. ROBINSON	Deptford	35	1882	SIMON	YES
CANNON & GAZE	Erith	16	1892	ROBINSON	YES
S. K. KEYES	Dartford	7		SIMON	YES
WINGENT & KIMMINS	Chatham	12			YES
WEST & WRIGHT	Maidstone	(i)	1888	SIMON	YES
H. S. PLEDGE & SON	Ashford	7	1890	DELL	YES
T. & T. G. GILLETT	Faversham	5	1895	WHITMORE & BINYON	
W. HOOKER & SON	Canterbury	(ii)3	1891	DELL	
KINGSFORD & CO.	Canterbury		1901	ROBINSON	
C. J. HUDSON	Ramsgate	5	1891	SIMON	YES
G. W. CHITTY & CO	Dover	12	1885 (iii)	TURNER	YES
W. & E. MANNERING	Dover	5	1889 (iv)	WHITMORE & BINYON	

(i) Acquired by Cannons in 1905, as The Medway Milling Co. Ltd., having 10 sacks/hr capacity in 1907.

(ii) There was also a small water mill at Chartham.

(iii) This refers to the Carter plant of probably 8 sacks per hour capacity, before which there were experiments with Wegmann machines and use of Nagel & Kaemp disc and roller equipment at Charlton Mill, Dover.

(iv) In the records of Buckland Mill for May 1889 there is a note "Mill stopped, putting in Simon's Roller system", but further information is lacking.

In 1877 G. W. Chitty was a member of a party of millers who visited Vienna and Budapest, led by Harrison Carter. As he was the oldest member of the group he became known as "the father of the Vienna party". He had also visited the Nuremberg exhibition in 1876, purchasing a Wegmann roller machine. According to an advertisement by Wegmann's agent in Britain, Chitty had Wegmann machines at both the Deal and Dover mills in 1879. At Dover, a combination plant was installed, using Carter and Wegmann rolls and Hungarian and G. T. Smith purifiers, in conjunction with stones and in the early 1880s Nagel & Kaemp disc and roller equipment was in use. In 1885 a Carter complete roller plant of 8 sacks per hour capacity was installed at Charlton Mill.

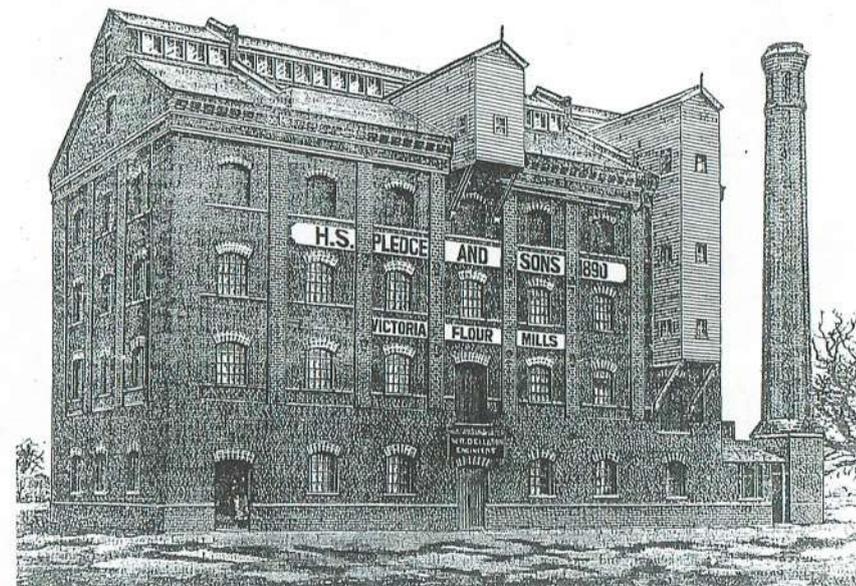


Plate 1. Pledge's Victoria Flour Mills at Ashford, built 1890. (*The Miller*, February 1891.)



Plate 2. Chitty's Charlton mill at Dover, c. 1900. (Photograph taken by C. W. Chitty.)

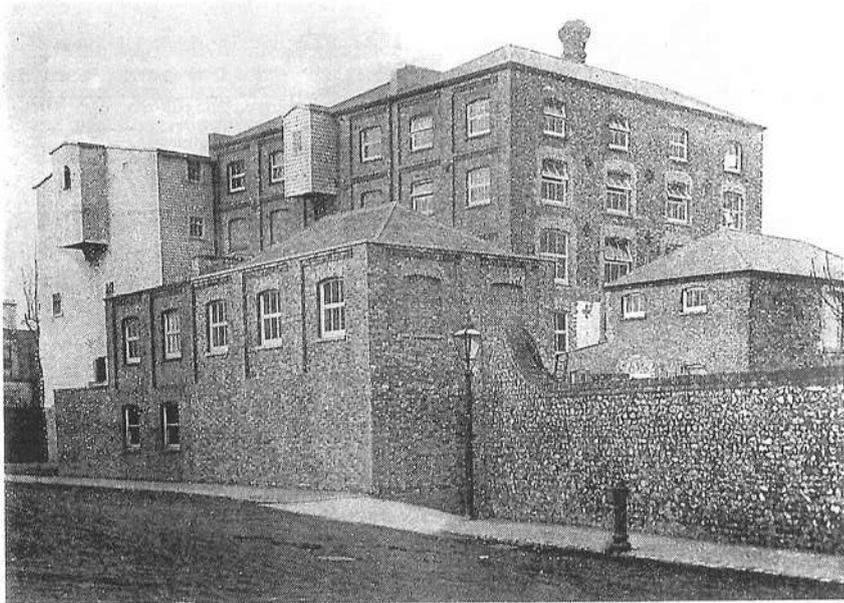


Plate 3. Mannering's Buckland Mill at Dover. (*The Miller*, April 1895.)

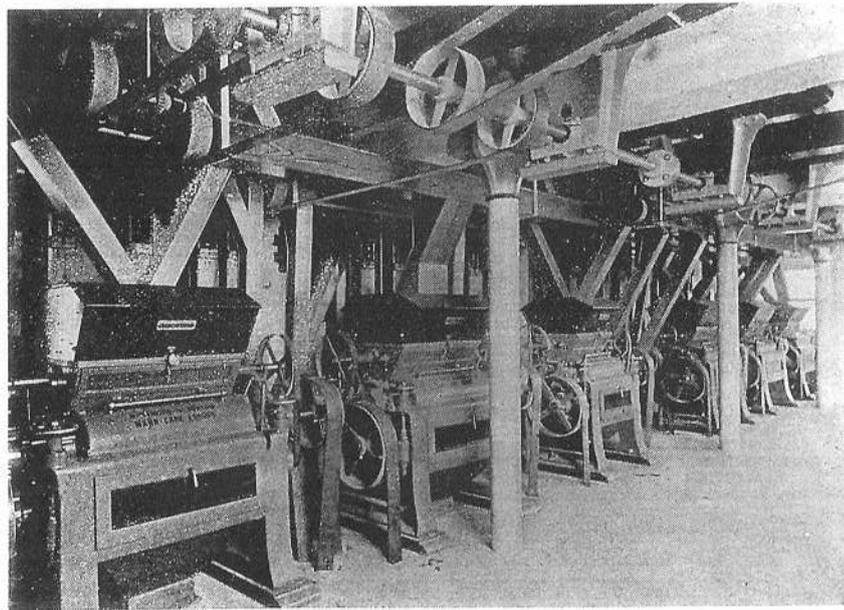


Plate 4. The roller milling floor at Buckland Mill. (*The Miller*, April 1895.)

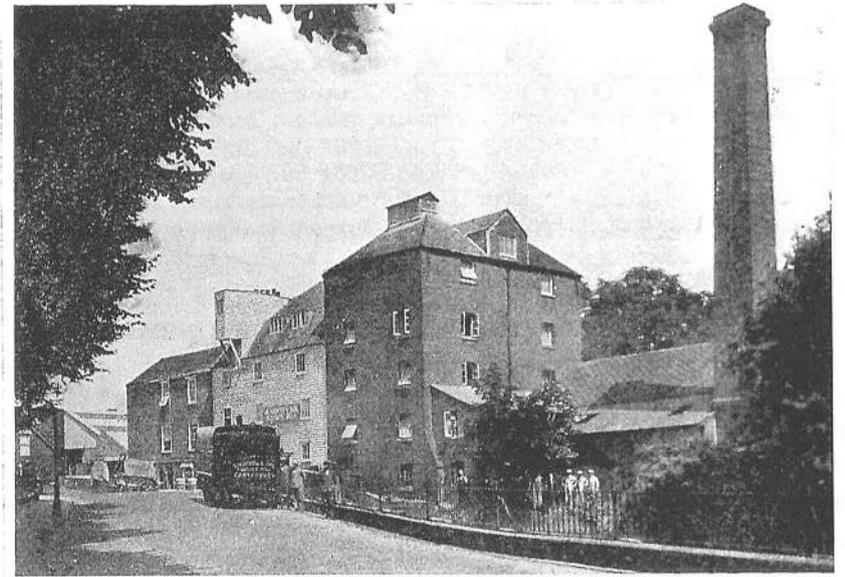


Plate 5. Hooker's Westgate Mill at Canterbury. (Photograph from the firm's notepaper.)

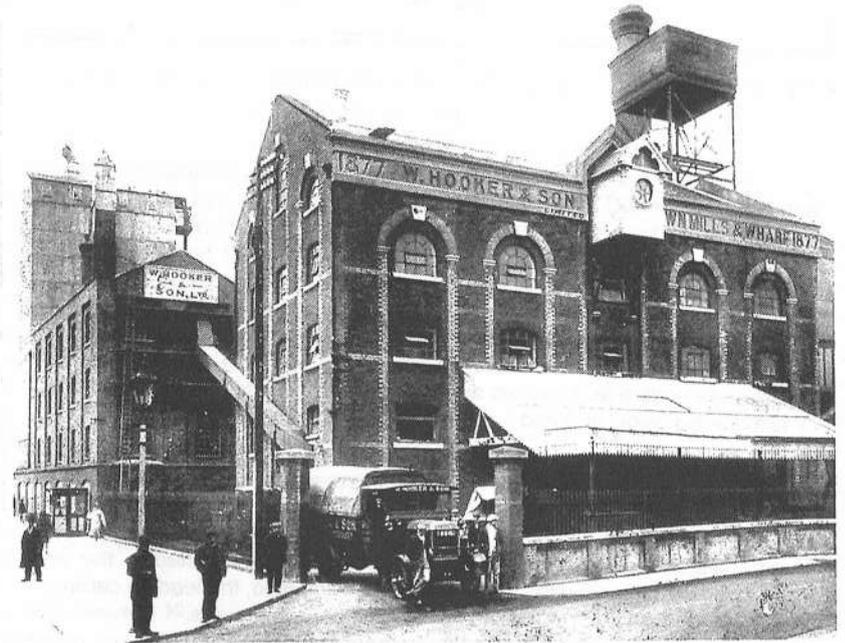


Plate 6. Town Mills, Chatham, formerly Wingent & Kimmins. (*Milling*, November 1929.)

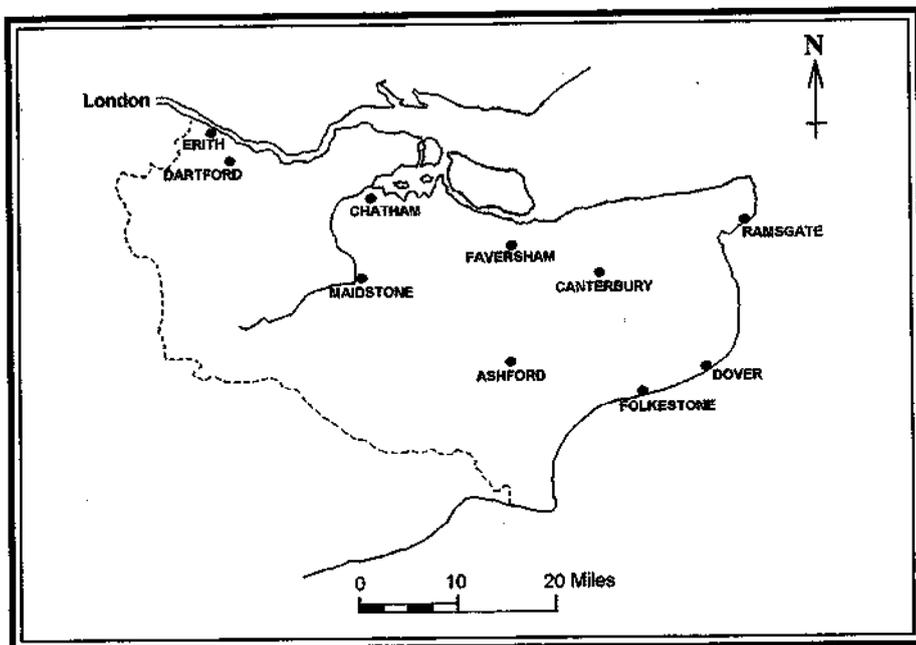


Figure 1. Map of Kent before boundary reorganisation showing the location of roller milling plants in 1903.

From 1890, the business was concentrated at Dover and Wellington Mill at Deal was stopped. Shortly afterwards the elder G. W. Chitty died and control passed to his sons, G.W. and Edward Chitty. Development of the mill continued through the 1890s, with improvements to the roller plant, the installation of a 50 horse-power engine and the replacement of the breast wheel by a turbine. Fire protection sprinklers and electric lighting were also installed. In 1903 the main machinery included Turner roller mills, Holgate, Higginbottom and Carter purifiers and centrifugals from Turners and Dells; there were six breaks and twelve reduction stages. By 1907 the mill was equipped with a 200 horse-power engine and had two auxiliary turbines. The milling plant had been remodelled by Briddon & Fowler and had a capacity of 12 sacks per hour; there were then five break stages.

In 1906 G. W. Chitty & Co. Ltd. was formed, the company being registered with a capital of £80,000.²³ By then, Wilfred Chitty and Charles Woodland Chitty, sons of the previous principals of the firm, were taking active parts in the commercial and technical aspects respectively. Charles Chitty was particularly interested in the development of laboratory testing and in collaboration with William Jago, the leading cereal chemist of the time, he was a pioneer in the introduction of flour improvers.²⁴ Between 1909 and 1912 several patents were taken out for wheat treatment and flour treatment processes and in 1912 a company was formed to exploit them, being registered as Woodlands Ltd.²⁵ In the 1920s the eminent cereal chemist D. W. Kent-Jones started his industrial and analytical career as chemist to Woodlands Ltd.

The lists of millers in Kelly's directories for Kent show some of the general patterns of change in the milling industry there. Until the late 1870s they were merely lists of the names and locations of firms, but later publications showed whether millers used wind, water or steam power. In the early 1880s many entries were still not categorised in that way, but by 1887 the uncategorised entries had fallen to a sixth of the total number, so that from the end of the first phase of the diffusion of roller milling in Britain the directories indicate the steady decline of the traditional country milling trade. This is shown in tabulated form here.

KELLY'S TRADE DIRECTORIES FOR KENT MILLERS LISTED IN PARTICULAR YEARS

CATEGORISATION	1878	1882	1887	1891	1895	1899	1903	1907
WIND		67	78	90	79	74	57	46
WATER		37	56	55	58	59	53	39
WIND & WATER		4	7	4	2	3	2	0
WIND & STEAM		17	26	24	30	26	25	24
WATER & STEAM		22	27	32	20	17	18	21
WIND, WATER & STEAM		1	4	7	5	4	3	4
STEAM		11	16	13	9	9	10	10
UNCATEGORISED		103	41	22	19	13	9	11
TOTAL	283	262	255	247	222	205	177	155

KELLY'S TRADE DIRECTORIES FOR SUSSEX MILLERS LISTED IN PARTICULAR YEARS

CATEGORISATION	1887	1891	1895	1899	1903	1907
WIND	81		53	40	35	21
WATER	74		61	56	58	50
WIND & WATER	4		2	1	3	2
WIND & STEAM	23		27	29	27	22
WATER & STEAM	29		32	33	29	26
WIND, WATER & STEAM	1		1	0	0	1
STEAM	15		16	21	18	19
UNCATEGORISED	14		16	18	15	10
TOTAL	241		208	198	183	151

**KELLY'S TRADE DIRECTORIES FOR ESSEX
MILLERS LISTED IN PARTICULAR YEARS**

CATEGORISATION	1888	1892	1894	1898	1902	1906
WIND	82	79	73	54	37	26
WATER	35	34	37	34	27	23
WIND & WATER	7	8	4	3	2	1
WIND & STEAM	44	47	42	40	37	27
WATER & STEAM	29	33	31	32	37	38
WIND, WATER & STEAM	2	2	2	2	0	0
STEAM	17	15	17	20	22	24
UNCATEGORISED	19	10	10	9	11	14
TOTAL	235	228	216	194	173	153

The available statistic is the number of entries of millers in a directory and it is not possible to distinguish between flour milling and provender, nor to relate the numbers of firms to milling capacity. The entries in the directories included medium, small and very small businesses and in some cases one entry represented several separate sites. It has been possible to find lists for Kent at intervals of four years, from 1887 to 1915 inclusive and similar lists of Sussex milling firms for the period 1887 to 1907 with the exception of 1891, also lists of Essex milling firms for slightly different dates, from 1886 to 1906.

From 1887 onwards, the numbers of entries for the counties of Kent, Sussex and Essex show remarkably similar decreases. The total number for the three counties, taken together, fell from 731 firms in 1887/1888 to 459 in 1906/1907, a drop of 37%. The number of entries categorised as wind, water or wind and water power, without steam, decreased from 424 in the three counties in 1887/1888 to 208 in 1906/1907 a drop of 51%. The number of entries that included wind power decreased from 349 in 1887/1888 to 174 in 1906/1907, a drop of 50%, but the inclusion of wind power in those 174 entries suggests a reluctance to give up traditional sources of power, even though they may have been used infrequently and mostly for provender milling.

During the 1970s it was still possible to visit two working roller mills in Kent: Rank's mill at Ramsgate, on the site where Hudsons had developed the Isle of Thanet Steam Mills and the Victoria Flour Mills at Ashford, where the Garnham family had succeeded H. S. Pledge & Son Ltd before the 1914-18 war. It was also possible to explore the interiors of the Town Mills at Chatham, which had just been stopped and from which the machinery was being removed and the empty Buckland Mill at Dover. Parts of the sites of Chitty's Charlton Mill at Dover²⁶ and Hookers' Westgate Mill at Canterbury were still discernible.²⁷ Charlton Mill was destroyed by shell fire in 1944.²⁸ Hookers' Westgate Mill burned down in 1954 and a similar misfortune stopped the Victoria Flour Mills at Ashford in 1984. Mannerings' Buckland Mill was stopped in 1957, but the buildings survived and it was possible not only to see the interior of the mill, but also to examine some of the mill records in the office;²⁹ these records were later placed in the County Archives Office. At the Barton Mills in Canterbury, where Kingsfords produced flour, provender milling continued.

Cannons bought West & Wright's mill at Maidstone in 1905 and the business there became known as the Medway Milling Co. Ltd. In the 1920s, J. & R. Robinson Ltd, of Deptford, Cannon & Gaze Ltd. of Erith and the Medway Milling Co. Ltd. were included in

the Associated London Flour Millers Ltd., which was absorbed by Joseph Rank Ltd. in 1933.³⁰ Wingent & Kimmins Ltd. at Chatham closed down in the mid-1920s and after standing idle for about two years the Town Mills were bought by Hookers of Canterbury, who formed W. Hooker & Son Ltd., Chatham. Hookers and Hudsons amalgamated in the 1950s and later were taken by E. Marriage & Son Ltd. of Colchester³¹ who, in turn, became part of Hovis-McDougall Ltd. The Chatham and Ramsgate mills were included in RHM Flour Mills Ltd. after the acquisition of Hovis-McDougall Ltd. by Joseph Rank Ltd. in 1962.

What happened to the early roller mills? Of the buildings that contained them only a few still exist in Britain, sometimes turned to other use. The site of the ex-Hooker mill at Chatham is a car park. Robinsons large site at Deptford has also been cleared. Marriages' East Mill at Colchester is a hotel. Unlike windmills with renewed sails, and water mills with wheel intact, the early roller mills have gradually receded into anonymity.

In the journal *Milling*, John Mannerings wrote nostalgically about Buckland Mill at Dover in 1957: "On June 6th of this year the feed ran off the breaks for the last time, and the manufacture of flour ceased on the river Dour". His family had owned three small watermills before they acquired Buckland Mill in 1865. He saw the irony of 'many a country mill silent by its stream' in conjunction with his own situation.³²

NOTES

1. William Coles-Finch, *Watermills & Windmills*, 1976, p. 192, commented on Chitty's Wellington Mill at Deal: "Unlike most windmills, this one was devoted exclusively to the making of flour and had three pairs of stones for that purpose."
2. Coles-Finch, 1933, recorded with regret the disappearance of the windmills. A new impression of his book was published by Arthur Cassell at Sheerness in 1976. Jenny West, 1973, has added to that major account, while seeking the remnants at a later date; see *The Windmills of Kent*. C. E. Bennett has recorded the surviving physical evidence of many of the water mills in Kent in her paper 'The Water Mills of Kent, east of the Medway', *Industrial Archaeology Review*, Vol. I, No. 3, 1977.
3. Coles-Finch, 1976, p. 142.
4. Detailed statistics are presented later. Kelly's directories for Kent may be found through 'Kent Directories', by W. F. Bergess & B. R. M. Ridell, Kent County Council, 1973.
5. Coles-Finch, 1976, pp. 288-89.
6. Coles-Finch, *Life in Rural England*, 1928, p. 174.
7. Coles-Finch, 1976, p. 145.
8. See *Milling*, June 1903, pp. 481-85.
9. *Milling*, June 1903, p. 431. An article 'Flour Milling in the County of Kent' on pp. 431-38 gave brief descriptions of many firms and mills in Kent.
10. J. Percival, *Wheat in Great Britain*, 1934 & 1948, p. 56-57.
11. Henry Robinson (1832-1900) was the treasurer of the National Association and his firm defended the legal case of the Germ Milling Co. v. Robinson in 1886.
12. Cannon & Gaze's mills were described in *The Miller*, May 1893, pp. 84-85; March 1895, pp. 70-71; January 1903, pp. 634-36; July 1906, pp. 282-84. Stephen Cannon was President of NABIM in 1903: see *Milling*, April 1903, p. 274

13. Wingent & Kimmins' mill was described in *Milling*, December 1902, p. 440; June 1903, p. 433; November 1929, reprint: 'The Chatham Mills'.
14. G. W. Chitty & Co.'s mills and the firm's principals were described in *The Miller*, April 1890, p. 54; January 1893, p. 446; January 1907, pp. 708-9; July 1915, p. 273, July 1924, p. 438; and in *Milling*, June 1903, p. 435-36; June 1924, pp. 676A, 676B; December 1930, pp. 700-1, 710.
15. *Milling*, June 1903, p. 431-37 gave estimates of capacities.
16. Hudsons' firm: *The Miller*, September 1913, p. 411 and in *Milling*, June 1903, p. 435; December 1950, reprint: 'Two Hundred and Fifty Years of Progress'; December 1951, pp. 610, 614.
17. Mannerings' mill was described in *The Miller*, March 1895, p. 12; April 1895, p. 79 and in *Milling*, December 1957, pp. 734-35.
18. Pledges' mill was described in *The Miller*, February 1891, pp. 477-78 and in *Milling*, June 1903, pp. 436-37; June 1925, pp. 766-67.
19. Hookers' mills were described in *Milling*, June 1903, pp. 434-435; June 1921, reprint: 'W. Hooker & Son'; November 1929, reprint: 'The Chatham Mills'.
20. West & Wright's mill was described in *The Miller*, August 1888, pp. 241-42; *Milling*, May 1911, pp. 564, 566.
21. Gilletts' firm was described in *The Miller*, December 1895, p. 778 and in *Milling*, June 1903, p. 434.
22. Coles-Finch, 1976, pp. 192-93. Charles Chitty stated that his grandfather had four windmills.
23. Memorandum and Articles of Association of G. W. Chitty & Co. Ltd., incorporated on 9 July 1906.
24. D. W. Kent-Jones, *Modern Cereal Chemistry*, 1939, pp. 351-54.
25. Memorandum and Articles of Association of Woodlands Ltd., incorporated on 16 September 1912.
26. The site was acquired by the Dover Engineering Co. A brick building in Bridge Street was part of Chittys' premises; it would have been on the extreme right of the photograph here taken by C. W. Chitty about 1900.
27. The photograph of Westgate Mill at Canterbury shows the buildings as they had appeared for many years, probably since the turn of the century.
28. The business was taken over by Charles Brown & Co. Ltd. of London.
29. This emphasised the misfortune of the loss of firms' own records, as even in this case little was found that related to the actual running of the mill or to its machinery. In *Milling*, December 1957, p. 734, John Mannering (1911-1985) described a reaction to new equipment: "Millers of the past were notoriously lax in keeping records of their activities and the alterations to their plants."
30. In *The Master Millers*, published by Joseph Rank Ltd in 1955, p. 63, it was stated that a majority of the share capital was purchased in 1932.
31. E. Marriage & Son Ltd. published 'The annals of one hundred years of flour milling', dealing with their history from 1840 to 1940.
32. Conversations were recorded in 1975 and 1976 with John Mannering, Charles Chitty and Herbert Hooker.

SOME UNUSUAL AND LITTLE KNOWN WIND ENGINES

By Mildred Cookson

It is sad that wind engines are not thought of in the same light as wind and watermills. They were once a common sight across the country, raising water for the cattle on a farm and less commonly providing power as barn top mills to work a pair of millstones, a threshing machine, saw mill or some other farm machinery. In this country we are now lucky if we see one at work. Even the ones that stopped work some years ago are disappearing rapidly; the farmers no longer want the bother of their upkeep. Time moves on and the once common wind engine is now rapidly becoming an endangered species, extinct in most parts of the country. One exception is the wind farm at Repps, Norfolk, where Mr. Morse has single-handedly restored several wind engines from different countries. Also a native wind engine in Hampshire is currently being restored with help from the Heritage Lottery Fund.

As an avid collector of mill material, wind engines have been a special interest of mine and I have accumulated a great deal of relevant information and photographs. Unfortunately many wind engines can now only be found in catalogues, but even so it is important to keep records and publish particulars of those that were invented many years ago and no longer survive.

I should think anyone who has an interest in wind engines has come across the names *Eclipse*, *Climax*, *Aermotor* and *Titt*. As well as these, well known makes, many others have been recorded not only in England, but also the United States, South Africa, Australia and the rest of the world. Some of the material in my collection describes home made engines that apparently function adequately for the job in hand.

Over time I have come across several references to wind engines of types that, I believe, no longer exist, and of which little is known. Below is a brief summary of these, most of which are of British manufacture. Further research is needed on some, and hopefully in the not too distant future I will be able to present a more complete picture.

The first two examples (see Figures 1 & 3) bear a remarkable resemblance to the French "Bollée" wind engine (see Figure 2). The Bollée castings were beautifully made and so were very expensive, compared with the simple wind engine. It is thought that about only 1,000 were ever produced. I wonder if once the Bollée patent ran out, the design was taken up by Clarkson of Prestwich, Manchester, who produced the one illustrated in Figure 1. Detailed comparison of the Clarkson Wind Engine and the Bollée at Souilly (see Figure 2) underlines the close resemblance; the similarities include a circular balcony.



Figure 1.
The Clarkson Wind Engine.

The Clarkson consisted of "a rotor or a number of rotors, one behind the other, revolving in a casing with fixed guide vanes between and of opposite pitch to those of the rotors, and having a further casing to admit a fresh supply of wind to the rotors behind". The cylindrical casings are open at each end with the larger opening facing the wind. The wind catches a number of wheels with feathered vanes fixed to a shaft revolving in bearings inside the casings. When the wind has passed between the vanes of the front wheel, it is directed by the guide vanes to the second wheel and is again taken up by guides and passed to a third wheel and so on, the action each time increasing the effect of the wind on the shaft and improving efficiency. The Clarkson illustrated above (1919) was erected by the Air Power Co., of Prestwich, near Manchester on the estate of Lord Derby. This small engine was designed to work in a 12 m.p.h. wind, but could start under load in a wind of only 7 m.p.h. The wind wheel is only 5 ft. diameter and is designed to lift 100 gallons of water per hour to a height of 50 ft. in a 12 m.p.h. wind, or about double that quantity in a 15 m.p.h. wind. All the Air Power wind engines were fitted with roller bearings, a starting and stopping arrangement and an automatic gear to cut off all wind above any desired velocity. They were mounted on a strong steel tower, with a ladder and platform as shown.

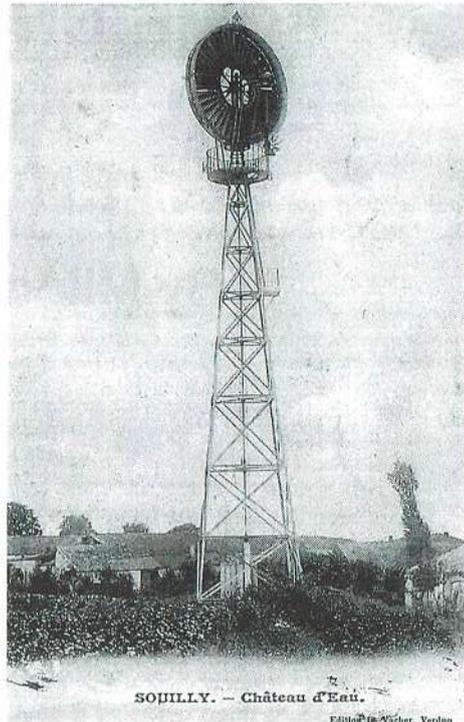


Figure 2.
Bollée at Souilly, France.

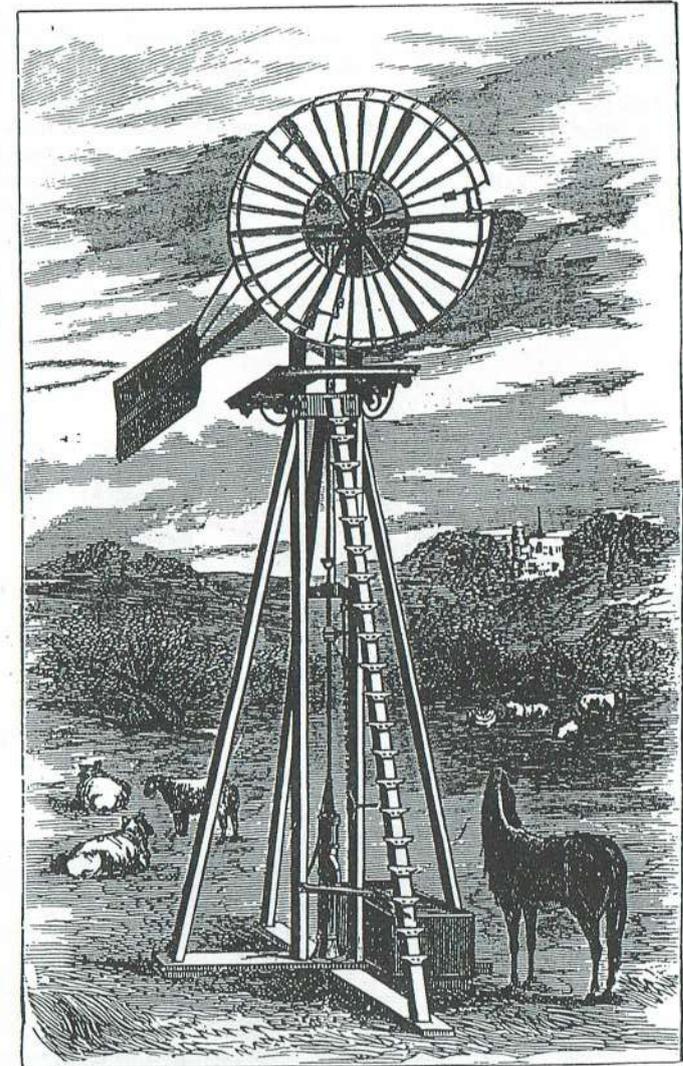


Figure 3. Hett's Improved Windmill.

Hett's "Improved Windmill" (see Figure 3 above) is the second wind engine that is similar (but only superficially) to the Bollée. The manufacturer stated (1879) that if one of the vanes becomes detached or broken on the Hett windmill it would not damage the wheel. It was also fitted with centrifugal regulating weights to draw the cloth off when running at excessively high speeds. It could also be stopped in an instant by simply placing the vanes edgewise. One of these was installed for an agriculturist, for raising water, for grinding, and for all kinds of barn work. It was stated in *The Implement and*

Machinery Review at the time that "Mr. Hett was taking the wind out of the sails of our American friends" (Mr. Charles L. Hett was also known for his water turbines).

Hett contributed another unusual wind engine, in this case with an annular sail, in a letter to *The Miller* in 1887 (see Figure 4). This mill was based on the Corcoran type, a design developed in the USA. The particular example had been constructed for pumping purposes in India the previous year. He went on to explain the mill: "The mill top is fitted with a side vane, on which the wind presses and tends to turn the mill round so as to

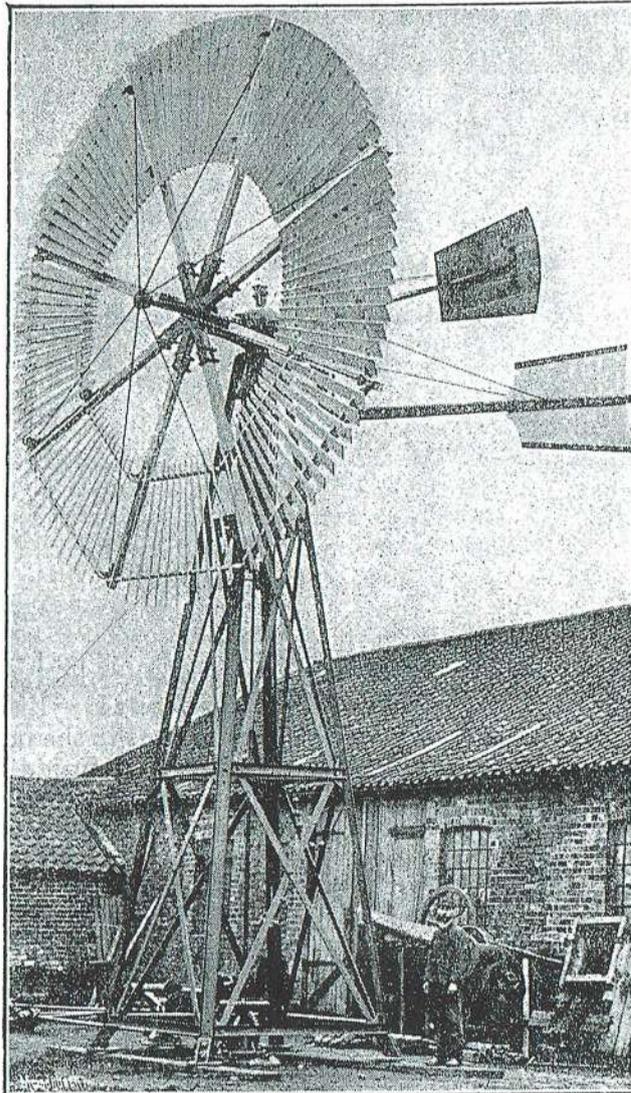


Figure 4. Hett's annular windmill.

present the edge of the wheel to the gale. The tail vane revolves on a vertical spindle where it joins the top. It is kept in position at right angles to the wheel by a chain and weight. When the wind runs beyond its nominal velocity its action on the two vanes decreases the angle between them, and at the same time lifting the weights to a greater or less degree. This action places the wind wheel obliquely to the breeze, and in storms the edge only receives the blast... The Americans were also the first I believe to supply automatic stopping gear to windmills engaged in pumping. Halliday's list of many years ago shows a simple and efficient, but at the same time rather makeshift arrangement of this kind. I have applied an improved hydraulic regulated gear, which will stop the mill by closing a cock anywhere on the rising main, or by the action of a ball tap when the cistern is full. The same gear prevents any excess of speed in the mill. The future use of the wind power for driving purposes appears problematic, especially in this country. For pumping for water supply purposes, it is likely to be adopted more extensively now that efficient

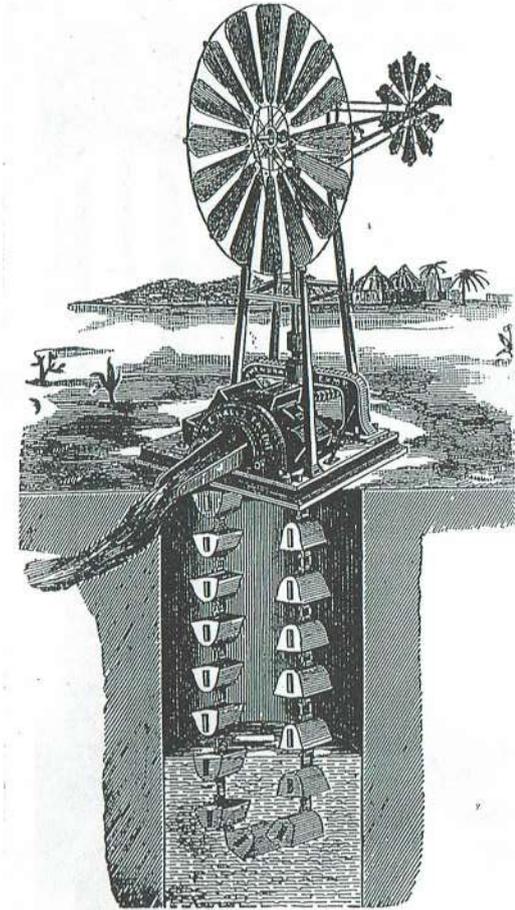


Figure 5. Hall's Noria Pump.

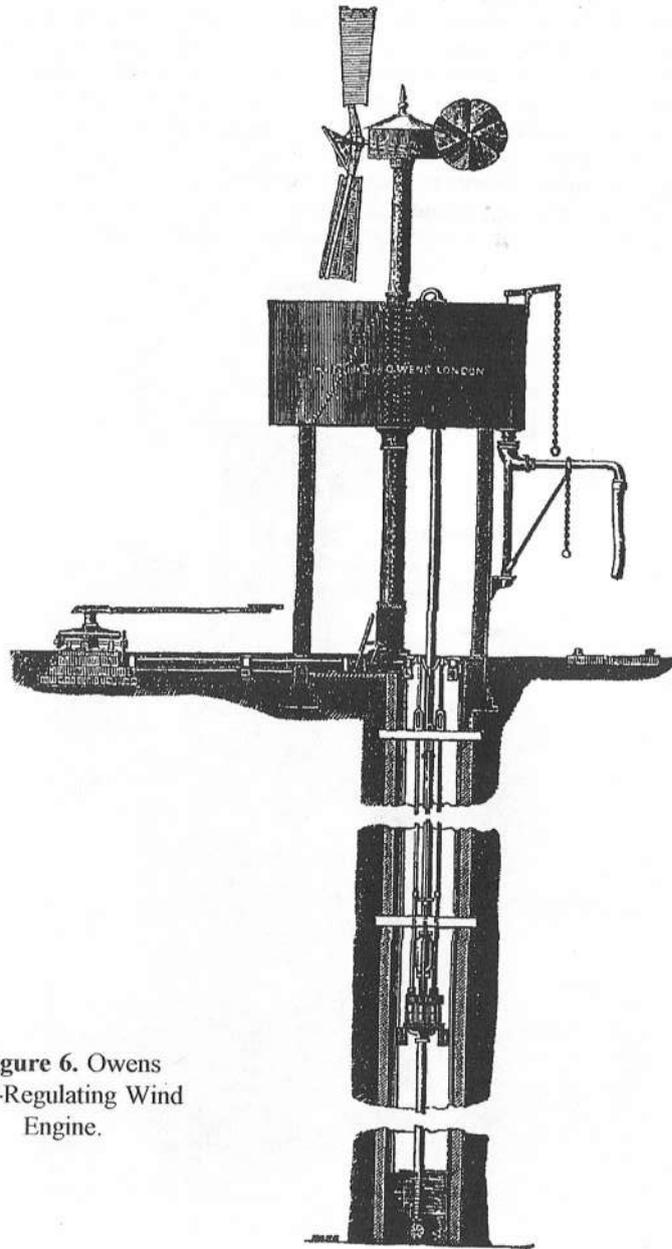


Figure 6. Owens
Self-Regulating Wind
Engine.

automatic gear prevents the catastrophes which occurred to many of the earlier annular mills employed for pumping." Further illustrations of this mill appeared in *The Implement and Machinery Review* the previous year.

Hall's Noria Pump (see Figure 5) was "suitable for drainage, irrigation and dredging and the like" and was "capable of doing the roughest work and yet needing comparatively little power". Mr. C. E. Hall of Sheffield was the manufacturer of this wind engine (1885), which could also double as a watermill and a tide mill. It was advertised as a favourite for foreign merchants, such as tea growers, sugar manufacturers and agriculturists who had to resort to irrigation. Gold mining companies, and others who had to raise large quantities of alluvial soil, sand etc. on tidal rivers or running streams, "should also have found it of value". By a novel combination with an undershot wheel, the force of the tide or the stream could be utilised for working the pump. Buckets were hung from the centre in a continuous chain. The lifts were made to raise water any height up to 80 feet, and in quantities varying from 1,000 to 400,000 gallons per hour. In hot climates this flexible design could be adapted to bullock power to lift to heights varying from 20 to 80 feet.

Another unusual wind engine is the Owens "Self-Regulating Wind Engine" (see Figure 6) manufactured by Messrs. S. Owens & Co., of Whitefriars Street, London. Its



Figure 7. A homemade wind engine, possibly of French origin.



Figure 8. A homemade wide engine, possibly of Spanish origin.

uses were numerous: for pumping water; grinding corn; threshing; crushing oats; cutting chaff and sawing timber. They were made in powers varying from $\frac{1}{2}$ to 12-horse power. The $\frac{1}{2}$, 1, and $1\frac{1}{2}$ -horse power engines were adapted for water pumping only, but the higher powers in addition to pumping, were capable of driving any class of machinery. The one illustrated (1881) was designed for the Central Argentine Railway Company, for driving a set of triple barrel pumps in a deep well. This model in this particular illustration could also be used with animal power when wind power was not available. The manufacturers could supply the wind engine with iron or timber uprights, or set it up to be built on a stone or brick tower.

Two unusual "homemade" wind engines are included here (see Figures 7 & 8) as I would be very interested to hear from anyone with any information on them. The only information I have is that the originals are postcards, one printed in French on the back, the other in Spanish.

Other photographs that have recently come into my possession are shown in Figures 9 & 10. The unidirectional wind engine (see Figure 9) has on its reverse "Canadian National Railways". Research is under way to find out more about this rather strange looking invention. The Storm King (see Figure 10), well known to a few members of the wind engine fraternity, is included as it is one of my favourites! Figure 10, dated



Figure 9. An unusual Canadian rooftop wind engine.

about 1890, shows a Storm King manufactured by the Judson Manufacturing Co. of Oakland California. The advertisement attached to the picture states "These Mills are made mostly of wrought and malleable iron, uniting great strength with lightness in the construction. The Improved Solid Wind Wheel being free from all complications, its entire power is devoted to operating the pump or other machinery, thus developing more power by 20% than any other windmill of the same diameter. Its self-regulating properties are perfectly automatic, doing away entirely with the objectionable springs or weights used by other mills."

Further Reading

T. Lindsay Baker, *A Field Guide to American Windmills*, 1985, is by far the best book on wind engines, although it is devoted to N. America. The Internet-able can buy it from Amazon.com for \$90. It is, however, very heavy (size not style!) so will cost a lot in postage.

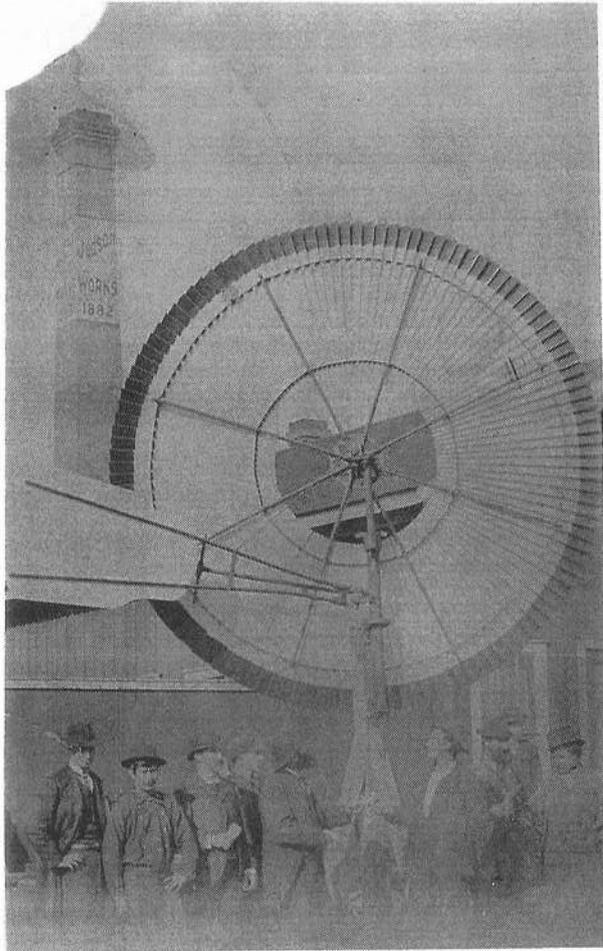


Figure 10. A Storm King wind engine.

A. Gaucheron & J. K. Major, *The Éolienne Bollée*, TIMS, 1985, and *Les Éoliennes Bollée*, FFAM, 1995, are useful reference books including a listing of all Bollées known at the time of publication. Both are available from the SPAB bookshop.

Photographs are from my collection, although quotations and some of the illustrations come from: *The Miller*: 2nd May 1887, p90. *The Implement & Machinery Review*: 2nd October 1879, p 2510; 1st Dec. 1881, p 3996; 1st July 1885, p7337; 1st June 1886, p 8343; 1st September 1919, p701. The Rural History Centre, University of Reading, kindly provided the articles from *The Implement & Machinery Review*.

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