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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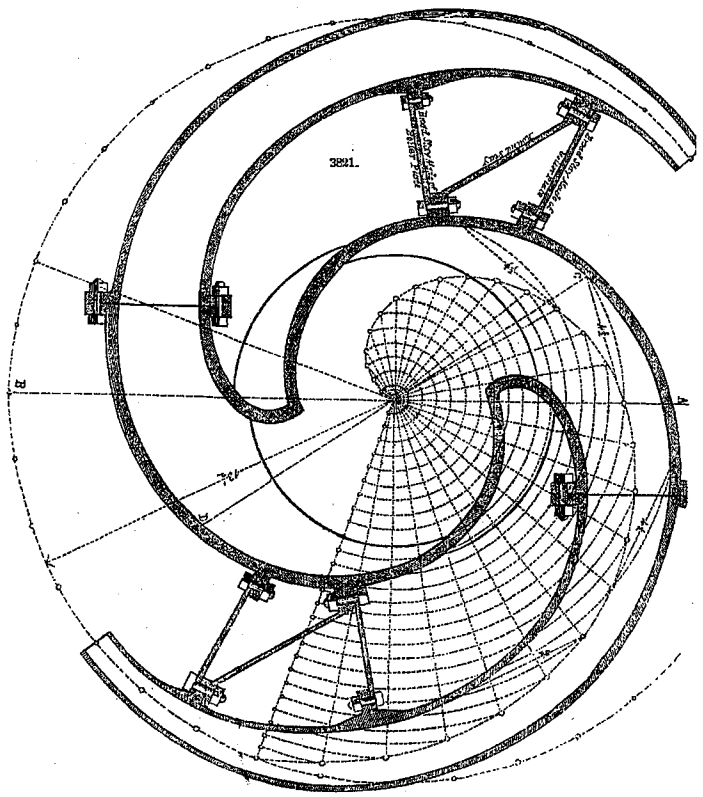
Wind and Water Mills

Number 24



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: A sectional plan view through Whitelaw's turbine shown in *Appleton's Dictionary of Machines, Mechanics, Enginework and Engineering* by D. Appleton & Co. published in New York in 1855 (see pages 22 & 23).

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CLUN MILL, SHROPSHIRE

By Tim Booth

Introduction.

In the 1980s, Clun Mill Youth Hostel was visited by Gordon Tucker as part of his survey of the mills of this region published in 1991 by the Midland Mills Group as "*Some Watermills of South-West Shropshire*". Gordon commented on the rare Whitelaw turbine and, of course, provided much information about the millstones, his particular interest. The mill was visited again in the mid-1990s and a preliminary survey of the machinery was carried out, largely to help provide information to YHA members about how the mill had worked. The Midland Mills Group then visited in June 1998 as part of a tour of Shropshire mills.

In September 2002 the Group received a request from the hostel manager to support an application for a grant from the Heritage Lottery Fund for work at the mill including a new roof, additional toilet facilities and provision for campers as well as carrying out superficial restoration work on the machinery. The Group found that it was unable to support some aspects of this plan and worked with YHA and South Shropshire's Conservation Officer to produce an alternative. This provided all the necessary hostel facilities without unduly compromising the mill and its machinery. As part of this scheme, the Group agreed to clean-up the mill machinery and to provide a mill trail and interpretation panels for visitors.

While carrying out this work in February 2004, the opportunity was taken to survey the main machinery. It became clear that not only were we working on most interesting and unusual machinery but that there was much documentation in Shropshire Archives which would indicate what was fitted when, and how much it cost, as well as telling us about the decisions which were made when choosing it. Thus this article was conceived.

An Outline History.

Clun Mill stands a few hundred yards north of the town beside the lane running out towards Guilden Down. This is certainly not the oldest mill site in the parish and not even the last survivor, only operating until 1926.

The first known reference to a mill at Clun occurs in the Domesday Survey, recorded as *"a mill which serves the court"*. The most likely site of this mill is beside the River Clun, just north of the castle, where the tithe map notes the site of a former fulling mill.

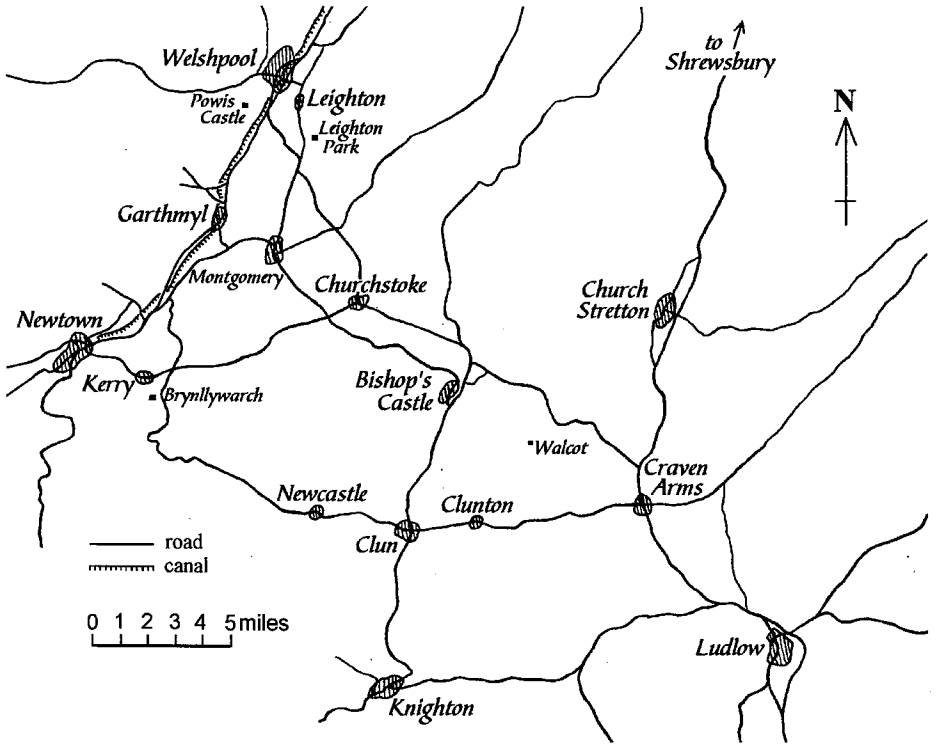


Figure 1. A map of part of Shropshire between Welshpool and Ludlow showing the location of Clun.

It has so far not been possible to determine when the later site was first established although its construction involved the cutting of a long leat from the River Unk near Bicton, NNE of Clun, which ran to a pool of considerable size, more than 300 yards long and up to 100 yards wide, just north of the town. It is unlikely that a leat more than ¾ mile in length, followed by a channel to carry the tail water back to the river of about ¾ mile, would have been dug before medieval times. It has been suggested that this site may not have been developed until the seventeenth or eighteenth century.

The first reference definitely associated with this later site is a document dating from May 1764 which is a mortgage of the Walcot Estate, including Clun Mill with garden, pool and lands, then occupied by John Davi(e)s.[1] A letter about a dispute in 1825 over maintenance of the lane past the mill produced a statement by John Vaughan, nephew of John Davies, who claimed to have been brought up at the mill from about 1775 and to have helped Davies to fetch stone from the castle to repair the mill and the walls in the mill pound.[2] No doubt

many buildings and boundaries in and around Clun were constructed or repaired using material from the castle; presumably why little more than the masonry of the keep survives today. This letter also notes that John Davies died in 1821.

John Davies was succeeded at the mill by his widow, Jane, who is named as occupying the property on a map of 1825.[3] This map also gives the first indication of the disposition of buildings on the site and some clues to the arrangement of the machinery of the mill. A leat is shown leaving Clun Pool and opening out into a small pond which divides into two short head races immediately behind the mill buildings. This implies that there were two waterwheels and therefore two sets of machinery and at least two pairs of millstones. It is quite possible that each waterwheel only worked one pair of stones via one-step gearing, a system virtually unchanged since water powered milling was first introduced to this country by the Romans. Although improvements to mill gearing are thought to have started elsewhere as early as the seventeenth century, many of Shropshire's mills, particularly in the remote south-west of the county, remained unimproved until the nineteenth century.

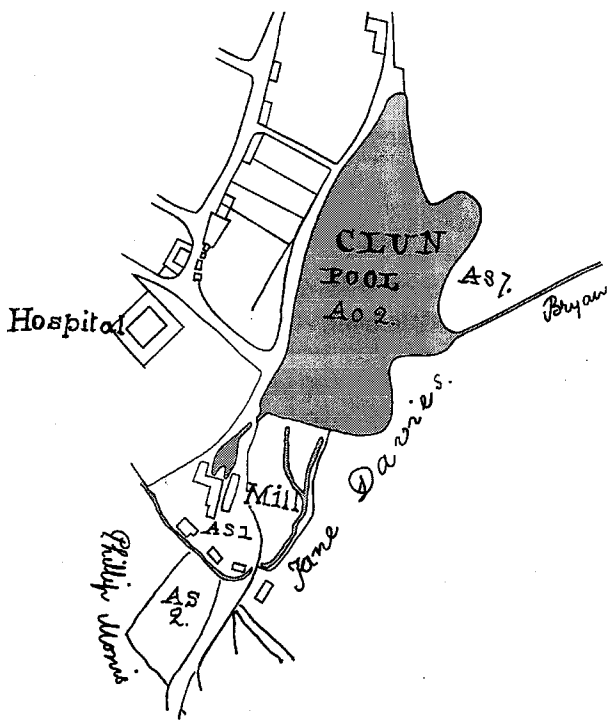


Figure 2. Part of the map of 1825 showing Clun Mill with two short headraces.

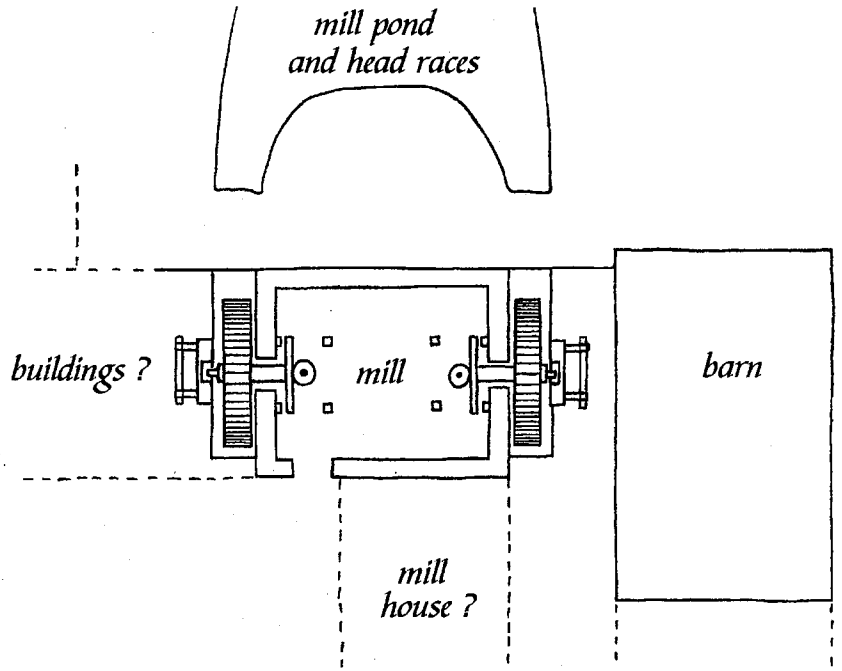


Figure 3. Possible general arrangement of mill buildings and machinery before reconstruction in 1851/2.

John Hickman was miller through the 1840s and possibly earlier.[4] He owned a few acres of land on this side of Clun, including the house and farm buildings just across the lane from the mill. Ownership of the Walcot Estate had by now passed to the Earl of Powis and from the late 1840s protracted deliberations began about the future of the mill. These deliberations seem to have focused on whether to improve Clun Mill or Clunton Mill, two miles east of Clun, to serve this locality. However, with the bulk of the local population centred on the town of Clun, the decision should have been a formality. The hesitancy implies that some factor favoured Clunton Mill. Perhaps it was in a better state of repair or its machinery was already improved and capable of greater output than that at Clun Mill. Equally, it could have been thought that the River Clun, which powered Clunton Mill, was a more reliable source of water than the leat and pool from the lesser River Unk. Nevertheless, serious consideration was apparently given to selling Clun Mill to John Hickman rather than make a major financial investment to ensure its commercial viablity.[5] In the event, at the end of his tenancy, the Powis Estate purchased John Hickman's land and looked to find ways of improving the return on the property.

Refurbishment of the Mill and its Machinery.

During the early part of 1850 the Earl of Powis's agent, Joseph Newill, sought estimates for the improvement of Clun Mill as a means of assessing its rental value for a new tenancy. The first, dated March 1850, was for alterations to the mill buildings and those on the neighbouring property purchased from John Hickman.[6] It included taking down and rebuilding one gable of the mill, putting in a new stone floor 18in. higher than the existing, renewing the slate roof and demolishing most of the other old buildings on the site. One building which was to remain was the barn which needed a new slate roof and two new doors. The estimated cost of all this was just over £107. Repairs to outbuildings and farm buildings on the neighbouring property were estimated at nearly £70, with an additional £30 *"for back wall if needed".*

The full estimate, dated April 1850,[7] reads as follows:

"....To repair the machinery part of the mill including 1 pair of new stones £120
If put to work (as it should be) with 3 pair of stones then extra £25
£145

If Clunton Mill is discontinued the stones from there and the dressing mill and other things could be removed say £40
£105

To repair mill building new roof and what is necessary estimate £176 say £200
(a note in the margin says this will probably be £30 more)
NB This includes House, Barn etc. upon the part purchased from Hickman which is about £100 £305

Present rent of Clun Mill and Land £52-10s-0d
house and land purchased from John Hickman 10 acres £40 - 0s-0d
£92-10s

W. Mickleburghs valuation £83
John Williams offers £80"

Only one month earlier, John Williams had also applied for the tenancy of Clunton Mill. By 13th. April, the rent had been set at £82-10s per annum, inclusive of Tithe. The mill and other buildings were to be put in good repair by the landlord and the mill was to have three pairs of stones. The rent was not to be charged until the work was completed.[8]

Neither of the above estimates is signed though the second appears be in the hand of John Poundley, agent for John Naylor's Montgomeryshire estates at Leighton near Welshpool and Brynllywarch near Kerry. John Naylor came

from Liverpool and had made a considerable fortune in banking and other commercial enterprises.[9] He invested heavily in his estates, developing forestry and quarrying as well as improving the agricultural land. To serve these enterprises, he erected model farms and workshops and wherever possible, the power to drive machinery in these buildings was provided by water turbines. Eventually there were at least six and possibly as many as nine at work on the two estates.[10] Although it was John Naylor, and later his son Christopher, who provided the finance for these schemes, it seems to have been John Poundley who promoted them.

The next estimate to arrive on Joseph Newill's desk was from a different source, a millwright called William Davies who offered to reconstruct the machinery, largely in cast iron, for £172-13s.[11] This included a waterwheel, 14 feet diameter by 4 feet wide for £52 plus conventional upright shaft and spur gear machinery to drive three pairs of stones. Presumably the two existing pairs were to be re-used as the estimate only includes one pair of 4 feet diameter French mill stones delivered at Welshpool, *"warrented at the best quality..... £24-0s-0d".* Various notes in the margin suggest reducing the cost by using a different quality of castings and excluding the waterwheel.

This was followed at the beginning of June by an estimate from John Poundley of which only the covering letter has survived. It was almost certainly for fitting a turbine and involved increasing the head of water available by raising the bank along one side of Clun Pool.[12]

"...The cost of excavating and embanking for the reservoir if raised as was talked about would be nearly as follows

Embankment 830 yds at 6d £20 - 15s - 0d
Middle Gutter 84yds - 1/- £4 - 4s - 0d
Pentrough through dam head £4 - 0s - 0d
£28 - 19s - 0d

The cost of 126 ft. more piping 15" diameter delivered at Garthmyl from the best market will be £30.

The difference in cost is so very inconsiderable to the advantage gained that I would thoroughly recommend the use of piping....."

Garthmyl would have been the most convenient point on the Montgomeryshire Canal to tranship heavy loads for Clun. The final stage of the journey would have been the relatively level road through Montgomery and Bishop's Castle. A letter of 10th. June confirms that the estimate included all the machinery, including the *"sack tackle and dressing mill"* but not the third pair of French millstones which Poundley concluded *"were to be had from Clunton Mill".*[13]

It would seem that neither Newill nor the Earl of Powis were entirely convinced about such a radical alteration or, more likely, the financial investment required.

On November 15th. 1850, Poundley submitted two sets of proposals for the mill, one using a waterwheel and the other a "reaction wheel".[14] The available head of 16 feet was reckoned to be sufficient to drive two pairs of stones and dressing machinery. Poundley strongly recommended a reaction wheel and pulley drive for smoother running. Eleven days later he submitted further details and a set of estimates *"from our engineers in Scotland"* for various combinations of machinery.[15]

Plan 1 was for a 16 feet diameter by 3 feet 9 inches wide waterwheel driving three pairs of stones through conventional gearing all in cast iron, including the hurst and stone pans, plus auxiliary machinery for £490. As above but with a reaction wheel (turbine) was quoted at £410. Plan 2 was for a *"reaction wheel, pipes and pulleys for driving the old machinery"* and is priced at £70, surely an error. Plan 3 appears to have included a reaction water wheel driving three pairs of stones by belts with *"framing and geering for dressing machine, sack tackle, etc."* all for £337.

Unfortunately none of the accompanying plans are available to confirm this. Poundley strongly recommended Plan 3 as *"the best and cheapest arrangement and would without doubt be the cheapest and most powerful corn mill within my knowledge hereabouts estimated to grind and dress 20 bushels per hour"*. It is to be hoped that the missing plans gave rather more comprehensible detail than the letter.

Early in 1851 John Hamer and his brother Henry made a bid for the tenancy of the mill, once it had been improved[16].

> "....the Landlord to put the mill and buildings in good tenantable repair - to take down the old mill house and stables adj(oining) the mill - the upper end of the barn now boarded and thatched to be taken down, the other part of the barn in which the threshing machine is, to have a new roof and to be left as a barn and bay.
>
> Pigsties to be built near the house, there are none there at present and those at the old mill house are in a ruinous state.
>
> They (the Hamers) purpose to find the Dressing Mill which will cost about £18 and to find what stones are necessary so as to work 2 pair of stones if a new pair is required they will cost £24 so that he would not be at a cost of more than about £40 at the outside, but he will do all the carriage.....
>
> Informed Mr. Hamer the rent would be £90 per annum."

The old mill house, adjoining or close to the mill, had been unoccupied since the start of John Hickman's tenancy as he had used the farmhouse across the lane from the mill as the mill house.

On February 5th. a new estimate for castings arrived from Evan Watkin, miller at Brompton Mill near Montgomery[17].

"2 ly shaft gudgeons weight	2cwt	0qr	0lb
1 mortice pit wheel	16	0	0
1 do crown do	5	2	0
1 do spur do	13	0	0
2 do pinions	3	3	0
1 do fly wheel	6	0	0
2 do pinions	2	0	0
2 upright shaft gudgeons	1	3	0
2 chucks for shaft	0	2	0
2 pulleys for hoisting tackle	1	0	0
	51	2	0

at 14s per cwt £36 - 1 - 0

Sir

I have sent the estimate hoping you will agree with my proposals if not I should be glad to see you before the mill is finally let

from

Yr obedient servant

Evan Watkin"

Although the rest of Watkin's proposals have not survived, it appears that he was offering to refurbish the mill, probably re-using one of the existing waterwheels, using as much estate timber as possible. An accompanying estimate refers to a new waterwheel shaft, upright shaft and (timber for) a dressing mill.[18] It concludes that the work could be completed for £101 including *"workmanship"* and a new pair of stones. A new threshing machine would be an additional £10. Equally, he was clearly keen on being considered for the tenancy and a note on the bottom of this letter in Joseph Newill's hand reads *"since let to him"*.

Although Evan Watkin may have been given the tenancy, it was John Poundley's plan that was favoured for re-fitting the mill. Yet another persuasive letter arrived on Joseph Newill's desk in March 1851.[19]

"March 10, 1851

Dear Sir,

On referring to the plans I would strongly recommend you on the part of his Lordship to adopt the Reaction Water Power rather than the primitive and cumbrous machinery of 200 years standing. I have practically experienced the working

these mills for 14 years and find them more economical and less expensive than the Water Wheels now in use and in all ordinary cases the Water Mill has the advantage of compactness and simplicity of erection, requires less extent of Building to contain it and usually much less expense is incurred in bringing the Water upon it.

By placing a wheel on the Reaction principle and taking the advantage of the loss in power as at present you will possess a Corn Mill capable of doing double the work with the same manual labor as at present (and additional Mill Stones may be added at a future day) at a cost very little more than the Castings named in the Estimate sent.

Mr. Naylor gets the same description of Castings delivered on the ground at Leighton under £7 pr ton.

It is strange that this County possessing greater advantages than most other counties for Water Power should have neglected the proper application to this day; and remains without improvement more than two centuries under that particular head.

I am aware that great prejudice exists in any innovation that may lessen labor but I think you would be justified in doing that which would be most advantageous to Landlord and Tenant for you may rest assured that there is no more need of geer wheels in the working of a Corn Mill than there would to work a Locomotive Engine.

Trusting an early day next week may suit your engagements

I am Dear Sir

Your very obt servt

J N Poundley

PS.

A Water Wheel of larger dia than the one in use will require new internal machinery. the difference of the Velocity of the different sized Wheels is in ratio with the circumference consequently you cannot apply a Water Wheel of larger dia without altering the speed of the millstones which is important."

While the gist of Poundley's argument was easy enough to follow, some of his expressions certainly caused confusion. His next letter to Newill, one month later, included the following clarification;[20]

"…. an high pressure locomotive engine will be expensive to work in yr. neighbourhood owing to the great consumption of coke and is only applicable to work a circular saw….."

Of course, ever the opportunist, this did give him the excuse of suggesting adding a saw mill to the plans for Clun Mill!

Although the plans for the machinery have not yet been found, a drawing does exist of Poundley's design for the new front elevation of the mill showing a

two storey building with an attic floor with a segmental headed window either side of a central door on both the ground and first floors and a central semi-circular window to the attic floor. An accompanying sketch is similar but with a segmental headed window to the attic. The drawing also shows the outline of an adjoining building. There is also a cross section of the new mill showing the arrangement of the roof trusses and main floor beams. There are several detailed estimates in pencil of materials required for this building as well as a synopsis.[21]

"Estimate for Repairing Clun Mill Lady Day 1851

Carpenters Work

To takeing down the old Floors renewing the same new Roofing new Door frames Doors & Windows Labor only for the Sum of £25-0s-0d

Mason Work to the Mill

To takeing down part of the side wall rebuilding the same parts 3 feet thick building new Gable end and extending the side walls to the same length as the barn plaistering one Coat inside new Flag Floor Roof ne Slated extending the Culvert 20 yards long from the waterwheel for the sum of £33-15s-0d

Materials and sawing except timber & Hauling £57- 7s-0d

£25- 0s-0d

Total of Mill £116 - 2s-0d

Carpenters Work to Barn

To takeing of old Roof new Roofing the same new Floor over Stable Racks & Manger to Do To new Door Etc. £10-5s-0d

Mason Work to barn

To building new Stone partition new Slateing Roof Paveing Stable pointing or plaistering walls over Stable for the Sum of £8-10s-6d

Materials and sawing except timber & Hauling £26 - 9s-0d

Total of Barn £45- 4s-6d"

This building work was probably carried during the second half of 1851, possibly leaving one waterwheel and its machinery in workable condition so that the new tenant, Evan Watkin, could maintain some level of trade. It has been claimed that remnants of this wheel survived into the twentieth century.

A surviving account for expenditure on Clun Mill states that on October 27th. 1851 Randolph Elliot & Co. were paid £136-12s-10d for *"Reaction water wheel and connections for Clun Mill".*[22] However, it would appear that installation

commenced early in 1852 as on February 12th. John Thomas was paid £3 for *"stone sleepers for Machinery"*. On March 25th. John Morris received £17-10s-3d for *"Castings to Machinery"* and £10-15s was paid for *"Carriage of Machinery from Liverpool to Welshpool by Canal"*. A millwright called Thomas Matthews charged £18 for *"putting up Machinery - setting spindles, etc."*

John Poundley was very much involved at all stages of the work and received a total of £42-14s-7d comprising £24-12s-7d which he had paid for *"putting up water wheel and internal machinery"*, £5-10s for *"Gutta Percha Bands for Wheels"* and £12-12s for *"Plans of Mill - machinery and attendances superintending the Erection of Machinery etc."* From this, £30-10s was deducted for money received by Poundley from Evan Watkin for *"work done in interior of the mill as by Agreement...£25"* and the Gutta Percha bands. Gutta Percha was the new wonder product of the period, derived from the gum of various Malayan evergreens. There are innumerable patents applying it to all manner of uses including driving bands for mills. Unfortunately there is no record of the additional work inside the mill which Watkin requested though it may have been for cleaning and dressing machines.

Subsequent Repairs and Alterations.

On January 19th. 1853 Randolph Elliot & Co. received a further £25-5s-6d for more castings although the reconstructed mill had been at work for less than a year and the millwright William Davies was paid £1-5s-6d for effecting sundry repairs. There is no explanation for this though a letter from Poundley to Newill dated January 5th. 1854 might provide the answer.[23]

"Dear Sir

I beg to enclose you my account for business done for Lord Powis in 1853 also the wages I have paid for the reinstatement of Clun Mill machinery which I trust will be the last complaint by Watkin. The mill I believe does well now but it has suffered by negligence sadly and had it not been powerfully made it must have gone to pieces long ago.....

When may I expect the honour of a visit to Leighton I am induced to repeat the invitation because I have a great wish that you should see our wheels and machinery at work which I think will convince you that Watkin to say the least of it does not properly attend to the instructions given to him in working the mill machinery.

Watkin thro' his pugnacity went as far as to persuade one of our principle tenants here not to allow me to erect a turbine to work his barn machinery and thro' his and Davies's interference it lay on the ground nine months altho' mill and machinery was paid for by Mr. Naylor."

Poundley susequently received £3-3s for his attendance and £4-16s-4d which he had paid *"to Thomas Morris for work at Clun Mill"*.

It is difficult to tell the true cause of these problems. Of course, Poundley was quick to blame an incompetent miller and millwright though the tone of his letter suggests a concern that Newill might not have been quite so certain. Both Davies and Watkin had probably only ever worked with conventional mill machinery and both had estimated to supply such machinery for use at Clun Mill. It would be easy to understand their suspicion of the turbine and its belt drives as well as a little resentment that their own proposals were rejected.

There is no further record of repairs for the next twenty years until William Stuttle of Coleham Foundry in Shrewsbury was called in to inspect the turbine. His report in a letter dated Jun 24th. 1874 states that the turbine had dropped ¾ inch and moved sideways 1 inch and would need new castings and brasses to correct this.[24] To effect repairs the turbine would have to be dismantled and might need entirely replacing. Not surprisingly, Evan Watkin had asked him to enquire about the cost of a new turbine. A following letter on July 2nd., primarily to arrange a date to remove the turbine, includes two quotes for replacements from unspecified sources of £90 and £95 *"in London"*.[25] Presumably the necessary repairs were carried out though there is no account to confirm this.

Evan Watkin continued at the mill into the 1880s aided by his sons John and Edward. Edward is recorded as farmer and miller until late in 1889 when he was declared bankrupt and his tenancy terminated. A valuation of his property in the mill was made on January 11th. 1890.[26]

"Valuation

of three pairs of mill stones - a smutter - flour dresser - eight boltin cloths - chain - block and pulleys - stone dressing machine - 23 mill picks - mill chain - shafting for working mill by steam - two spindles and repairing mill wheel at the mill - Clun - in the County of Salop made the seventeenth day of December Eighteen hundred and Eighty nine between Mr. Edward Watkin of Clun of the one part (as seller) and the Rt. Hon. Earl of Powis of the other part (as Landlord and purchaser).

I, the undersigned being duly appointed hereby value and appraise the same to be at the sum of Ninety four pounds and ten shillings.

(signed) Hubert Watkins
Licensed Valuer

	£94 -10s
Deduct value of Boltin Cloths & mill picks taken to by Incoming tenant	£5
	£89-10s"

The incoming tenant was Aaron Davies from Newcastle Mill, a few miles west of Clun. By this time flour mills relying on grinding by millstones were finding it very difficult to compete with the products of the large roller mills which had been set up at ports and major population centres. Other than a total refit the favourite course of action was to try to improve the cleanliness of the grain prior to milling and to sieve the meal more finely to remove as much bran as possible. Aaron Davies asked J. J. Armfield and Co. of Ringwood in Hampshire to estimate for suitable machines to replace the existing ones and was supplied with the following;[27]

"Wheat Cleaner - One No. 0 Vertical Eureka Smutter 10-15 bushels p.h. with shaking screen £25
dust room ventilating trunk and cowl £7
wheat elevator £12
pulley & belt to drive smutter from turbine £4
labour, sundries £10
£58

Dressing Machinery - One No.1 stone meal scalper with division in pollard £19-10s

one Centrifugal standard D. No. 4 clothed with silk £25
two pulleys and belts to drive from existing shaft £3-10s
one elevator for meal from millstones £11
spouts, etc. £3
labour, sundries £9-15s
£71-15s

£129-15s"

Apparently Armfield & Co. were also asked to inspect the state of the turbine and other drive shafts in the mill. They sent in an estimate on January 20th. 1892 for various repairs and a new turbine shaft as they found the existing one to be broken at *"the socket that unites it to the shaft"* for a total of £41-18s. This estimate was rejected by the Estate so Armfield & Co. supplied an amended one on Februaury 9th.[28]

"Rearranging and relining 2¼ lay shaft on stone floor - detaching coupling - supplying 2 new gun metal bearings £2-6s
rearranging and relining upper layshaft - supplying new wall box and bearings and one hanging bracket £5-7s
raising existing turbine, setting shaft, trimming journals - refitting four bearings and supplying one new one, with carriage complete
adjusting turbine bearings and shaft £19-10s
£27-3s"

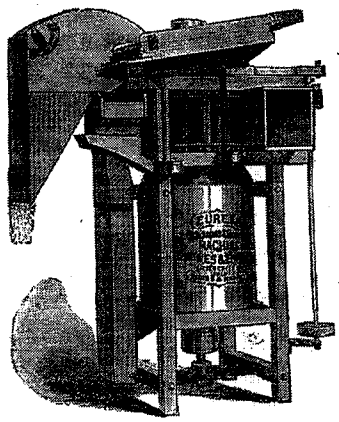


Figure 4. Advertisement from *The Miller* in 1887 for a similar grain cleaner showing the initial feed sieve, missing on the one at Clun Mill.

This work was all completed during the first half of 1892. From subsequent letters it would appear that Armfield & Co. carried out rather more work than was included in both estimates.[29] It would seem that they included an additional intermediate shaft in the drive to the dressing machinery for which neither Davies nor the Estate would pay. Equally, when refitting the turbine shaft they found it necessary to replace the four bearings which they had intended to refit and again the Estate declined to pay.

Aaron Davies's tenancy ended in 1894/5 when the mill was taken on by his elder brother Thomas who also had a grocery and bakery business on the High Street in Clun.[30] Thomas Davies purchased the mill from Powis Estate in c.1902. Thomas's son Richard was the next miller from c.1910 until after the First World War. The last miller was William Jones who was there until milling ceased in 1926. After a few years as a farm store, the mill was purchased by the recently formed Youth Hostel Association and, after conversion work costing £50, opened to members in 1931. It has remained a Youth Hostel ever since and for most of that time was very little altered from its days as a mill. The stone floor remained a large open room, the women's dormitory, until fairly recent times. However, today's members require less spartan facilities and this was subsequently divided into smaller rooms and toilet facilities were added throughout the first floor. The millstones disappeared behind partitition walls and this area was used to store mattresses. The top floor of the mill remained untouched until c.2000 when it

was radically altered to provide sleeping accommodation for the summer warden and a group leader. The latest and hopefully last major alterations were carried out in 2003 and included the addition of a lean-to building against one wall of the mill. However, part of this work included opening up the area around the millstones and allowing the surviving machinery to be a prominent feature once more.

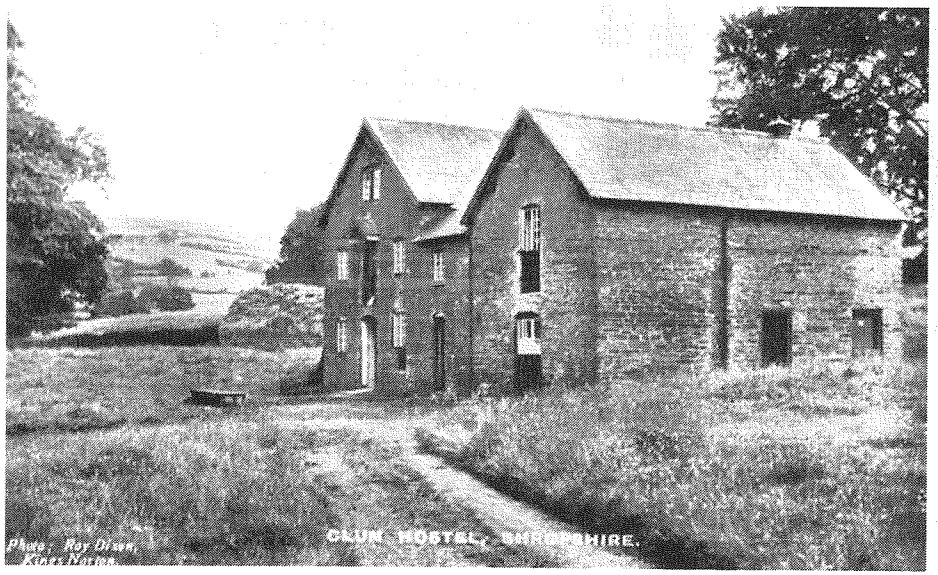


Figure 5. Clun Mill shortly after conversion to a Youth Hostel. The kiln ventilator can still be seen in position. (Reproduced by kind permission of Ian Langford.)

Description of the Mill and its Machinery.

The Watercourses.

Understandably, as the mill ceased working in 1926, relatively little survives of the watercourses which served it. The site of the weir on the River Unk is still evident though little more than a bend in the river and the first part of the leat from here to the A488 Clun to Bishop's Castle road has largely disappeared. The stone parapet of the bridge carrying the road over the leat survives on the western side as does the section of the leat along the east side of the road. The next short section has been infilled but after that remains as a shallow depression running towards the site of Clun Pool. The pool remained open but overgrown until the 1960s when an attempt was made to clear it. This only succeeded in

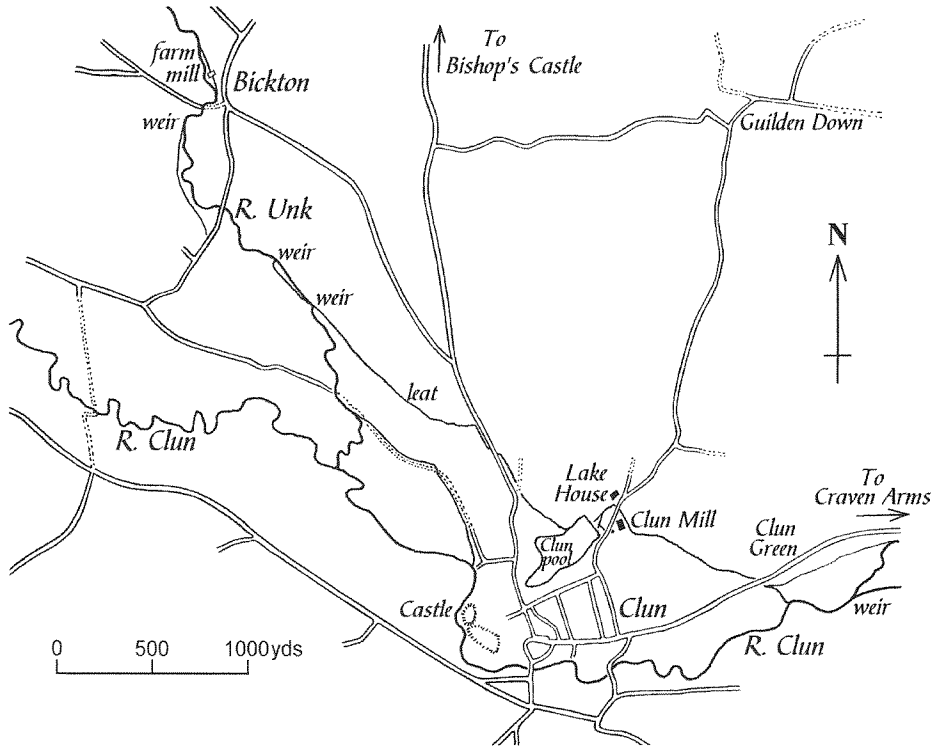


Figure 6. The watercourses serving Clun Mill.

damaging the clay lining and all the remaining water drained away. Subsequently all but the north-east corner of the pool has been infilled and turned into a large playing field. The remaining section, nearest to the mill, remains as an overgrown depression. During 2004 moves were started to conserve what is left of the pool with a view to re-filling it. This plan has come up against some opposition and, at the time of writing, the future of the pool is in doubt. The dam at the north-east end of the pool remains intact with two overflow channels and a short leat running towards the mill. This passed under the lane to open into a small header pond, now infilled to form the Youth Hostel car park. From here an underground 18in. diameter cast iron pipe descends the bank and emerges in a chamber immediately behind the centre section of the mill buildings. A flat area of ground behind the buildings marks the site of the earlier mill pond and head races, several feet lower than the later head pond. Presumably this indicates that Poundley's proposal to raise the pool dam was carried out.

The two overflow channels from the pool combined and flowed through a narrow valley across the lane from the mill before turning abruptly south-east, passing under the lane. The channel then followed the boundary of the mill yard before continuing as a field drain, still carrying water, through low-lying meadow land until it passes under the B4368 at Clun Green, ½ mile east of the town, and enters the River Clun. The tail water from the turbine ran through a culvert under the mill yard before emerging just south of the cart shed and running into the overflow channel. The culvert is still open for about the first 20 feet to a collapse where the foul water drain from the Youth Hostel cuts through it. The short open section is now just a faint depression.

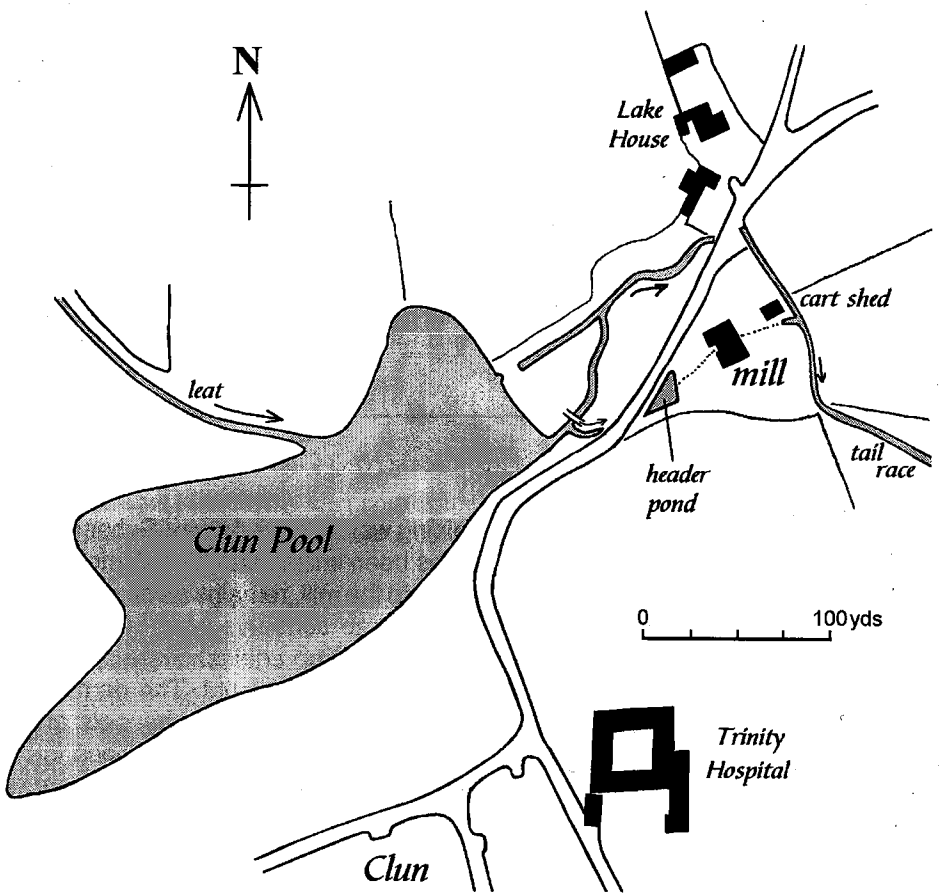


Figure 6. The watercourses close to the mill.

The Buildings.

The mill buildings consist of two parallel wings connected by a narrow central section all in stone with slate roofs. The northern wing is the former barn which was divided into two sections in the refurbishment work of 1851. The eastern section comprised the stable with a granary above. The stable is now a sitting room but retains its cobbled floor, hay rack and feed trough. The granary is now a dormitory and retains no original features. The western section of this wing consists of a corn drying kiln. On the ground floor the brick firebox and vaulted flue are intact. Looking up inside the kiln it is possible to see the remains of the iron baffle plate suspended below the brick arching and stone blocks which support the complete floor of clay kiln tiles. The kiln floor has been boarded over and it is now only possible to view the glazed upper surface of part of one of the tiles. There is no reference to the construction of this kiln in the documentation in Shropshire Archives. The ventilator on the roof of the kiln survived into Youth Hostel days but not into recent times.

The southern wing was the mill. Its eastern gable is as designed by John Poundley but with a segmental headed window on the attic floor as shown in Poundley's sketch rather than the semi-circular headed window on his measured drawing. The hood over the loading door to the stone floor was removed many years ago but was reconstructed in 2003, if rather disfigured by the inclusion of a security light. The ground floor window to the north of the door has a hatch below its sill which once allowed the passage of the belt from a portable engine which was used to drive at least one pair of stones when the water level in the pool was low. All the window frames are modern replacements. The southern wall of this wing is now masked by a lean-to building, in stone with a slate roof, erected in 2003 to house toilet and drying facilities for campers. Unfortunately this has covered features which predate the 1851 reconstruction of the building and provide information about the arrangement of the earlier mill. Before the erection of the lean-to it was possible to discern the gable end of the earlier mill within the fabric of the western section of the south wall. It was 1½ storeys high with a central wheel arch and a window immediately above, both blocked long ago. Both these features still survive in the new lean-to but are now difficult to view and interpret. The distance from the centre of the arch to the retaining wall of the old mill dam is sufficient for the wheel pit to have accommodated a 14 feet diameter waterwheel. The western wall of this wing is built into the old mill dam. A change in the quality of the masonry work a few feet above the higher ground level marks the level of the wall plate of the earlier mill. Immediately above this is the centrally placed window which lit the later stone floor, although the line of a jamb and blocked opening on its north side show that it was not always positioned thus. The lower part of this wall was doubled in thickness in 1851.

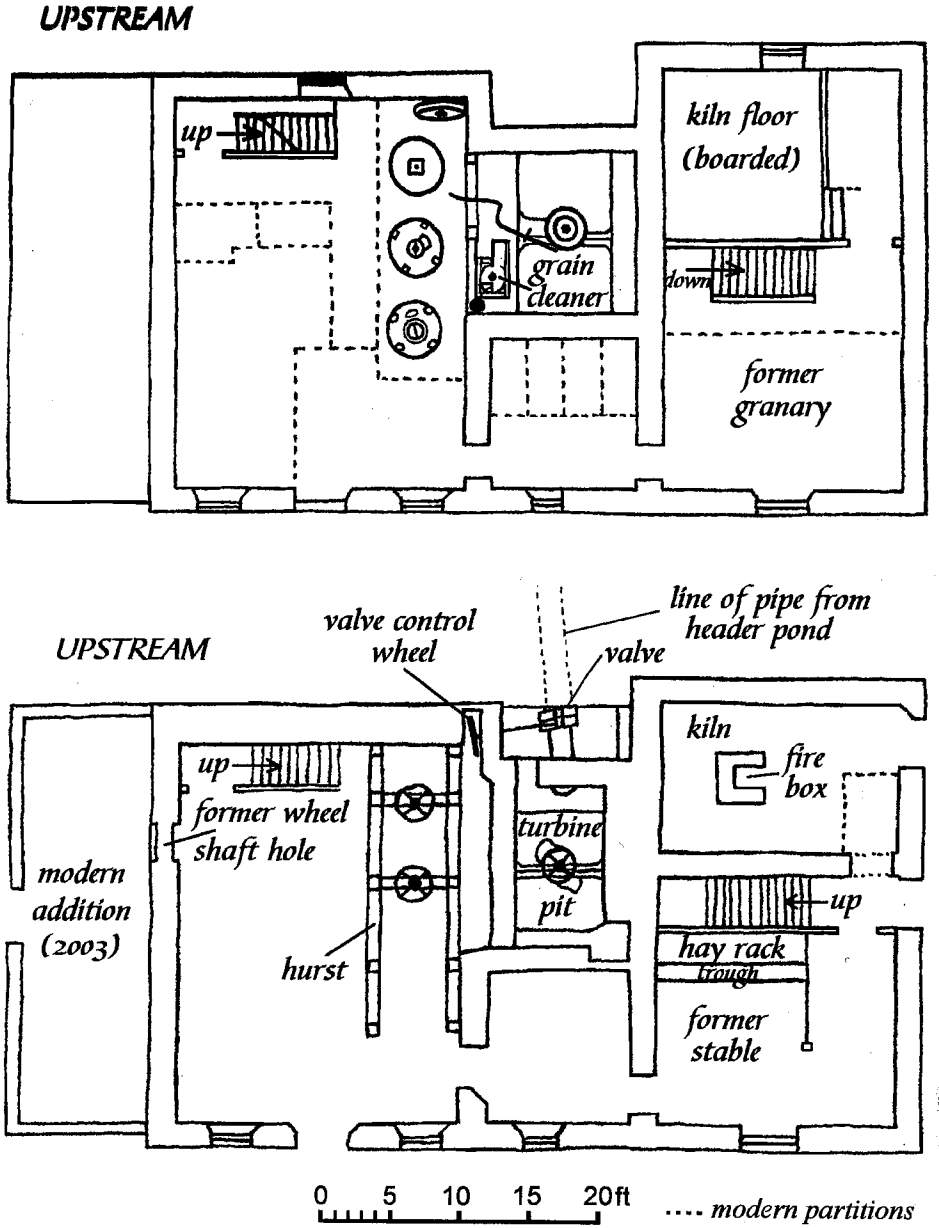


Figure 7. Layout sketches of the ground floor (bottom) and the stone floor (top) of Clun Mill.

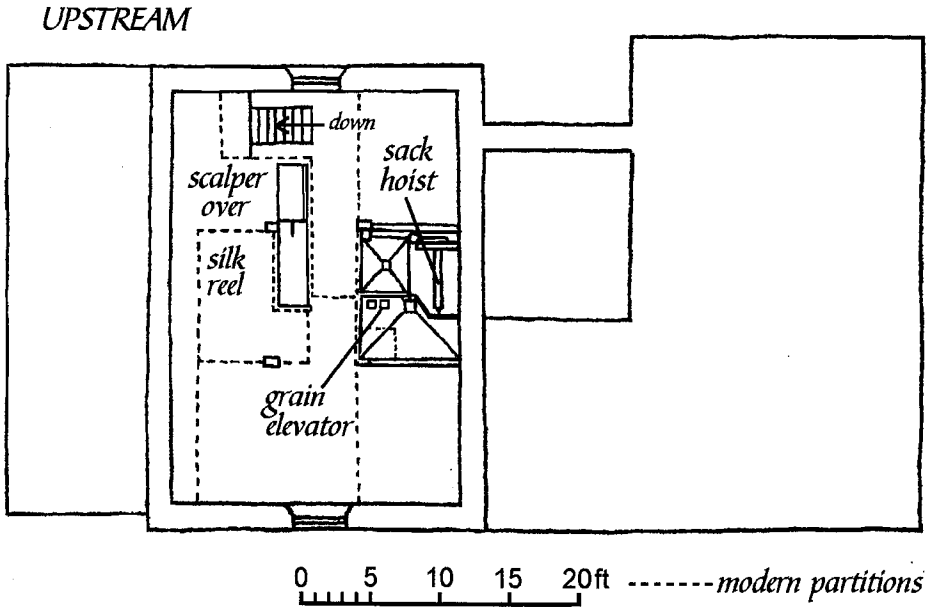


Figure 8. Layout sketch of the top floor of Clun Mill.

The western part of the central section of the building covers the turbine pit, formerly the site of a second waterwheel, and is open to its roof. The original wheel pit was widened and carefully lined with brick to take the turbine but the outlet for the water was via the existing culverted tail race. The rest of the central section comprises a small room on the ground and first floors and Poundley's design shows a window lighting each. The ground floor one was later opened out to form a rather narrow door but is now a window again. The purpose of these rooms is not known though the ground floor one did give access to the turbine pit via a doorway which has since been partly infilled.

The only other building remaining on the site is a wooden shed east of the mill which used to be the cart shed. It had become extremely dilapidated by the early 1990s and YHA proposed its demolition. However, valiant fund raising by the warden ensured sufficient money for its restoration in 1994.

On the other side of the lane, north of the mill, stands Lake House. This was the home of John Hickman and became the mill house during his tenancy. Its farm buildings have been converted into dwellings.

The Machinery.

Within the turbine pit, part of the 18 inches diameter cast iron water inlet pipe can be seen dropping vertically to disappear behind the brick lining of the pit. It re-emerges from the paved bed of the pit immediately below the turbine rotor. The turbine, or *"Reaction Water Wheel"* as John Poundley called it, is of the type patented by James Whitelaw, a Glasgow engineer, and sometimes known as a Scotch turbine[31]. This was developed from Barker's mill, attributed to Dr. Robert Barker, which was first described in the 1740s. This consisted of a vertical tube with two hollow horizontal arms at the bottom. Water was poured down the vertical tube and emerged through nozzles at the ends of arms set at 180° to each other. The reaction created by jets of water emerging from the nozzles was sufficient to turn the central column. By 1775 the device had been

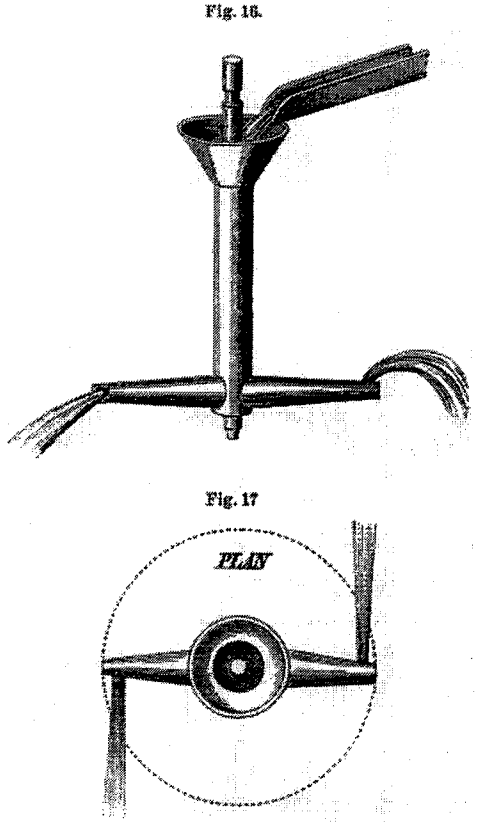


Figure 9. The basic arrangement of Barker's Mill which operated in a similar manner to a modern garden sprinkler. (From J. Glynn, *Power of Water,* 6th edition, 1879.)

improved by introducing water from below which allowed greater heads of water to be used and, by providing some lift, reduced the wear on the bottom bearing. Whitelaw patented his adaptation of Barker's mill in 1839, claiming to have improved the machine by curving the delivery pipes. However, something very similar is illustrated in the 1819 edition of Bélidor's *"Architecture Hydraulique"* in the additional notes and drawings provided by Navier. The only truly original part of Whitelaw's design seems to be the governor, spring loaded plates which would move outwards and block the jets if the speed of the rotor became too great. His first turbine was installed near Paisley, apparently for a Mr. Stirrat who then joined him in business.

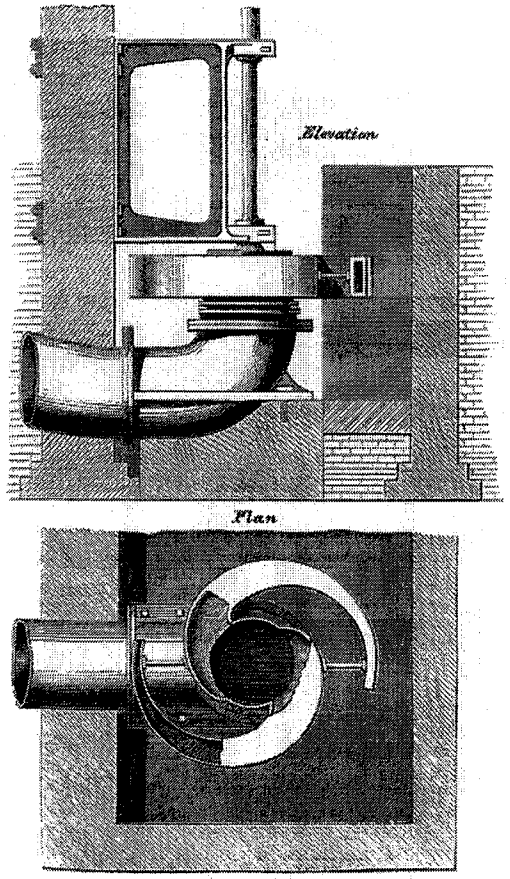


Figure 10. The general arrangement of a Whitelaw turbine with the water supply pipe entering the turbine from below as in the installation at Clun Mill. (From J. Glyn, *Power of Water*, 6th edition, 1879)

The turbine at Clun has a maker's plate which reads, "**Whitelaw & Stirrat's Patent - No. LXIX Made by Randolph Elliot & Co. Glasgow**". Presumably the number 69 means the total number of such machines constructed by that time, late in 1851. During the 1850s this type of turbine was largely superseded by more efficient types and only a handful are known to survive, one being on the Leighton Estate for which John Poundley was agent[32]. The rotor has a diameter of 4 feet 6 inches and the maximum head of water available is estimated as having been about 18 feet. The two nozzles are rectangular slots measuring 10 inches by 2 inches with the plates of the governor fully withdrawn. The springs of the governors are housed within the curves of the arms and there is no other apparent means of operating them other than centrifugal force. Quite how effective they were is open to speculation, especially as both the rotor and governors are now seized solid. The rotor turned anti-clockwise driving a 3 inches diameter vertical shaft. The shaft is supported by three bearings mounted on iron girders across the pit and a fourth, at the top, on a timber bearer. The lowest, just above the rotor, is much larger than the others and supports the shaft at a point where it is within a substsantial sleeve. Perhaps this is the repair to the broken shaft effected by Armfield & Co. in 1892.

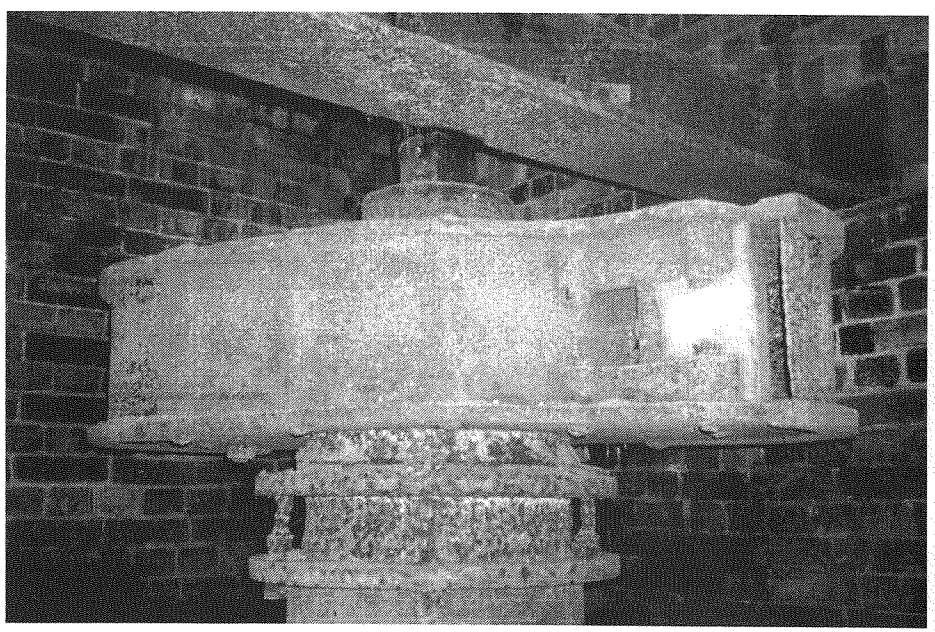


Figure 11. The Whitelaw turbine at Clun Mill showing the plates used to govern the speed of the turbine.

Immediately above the second bearing is the first of two wide iron pulleys, both 26 inches diameter and 12½ inches wide. These line up with the fast and loose pulleys on the spindles driving the upstream and middle pairs of millstones. The pulleys and spindle for the downstream pair of millstones are missing but were apparently driven by a belt running round the lower half of upper pulley on the turbine shaft. This 6 inches wide section of the pulley has been built up in wood, increasing its diameter to 28½ inches. Between the third and fourth bearings on the turbine shaft are two further pulleys. The lower one, 29 inches diameter by 4½ inches wide drove the grain cleaner. The one immediately above is a fast and loose pulley consisting of a pair of 18 inches diameter by 6 inches wide wheels, the upper being the loose one. This carried the belt for the first stage of the drive to the meal dressing machine and the sack hoist.

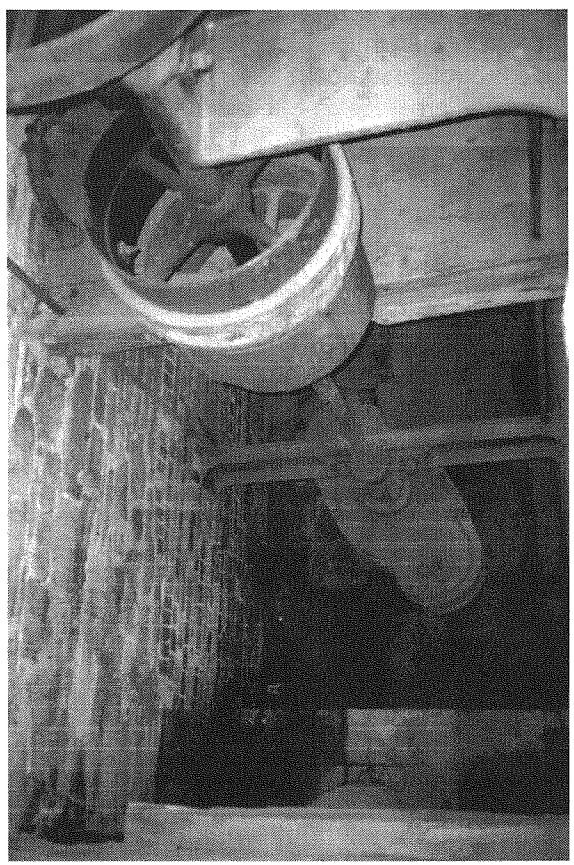


Figure 12. The view down into the turbine pit showing the turbine and the drive pulleys for the millstones.

On the ground floor of the mill the hurst frame supporting the millstones is intact, consisting of oak posts all about 8 inches square. Presumably it was decided to reduce the cost of Poundley's machinery by using timber from the estate rather than the cast iron columns which he proposed. Equally, instead of cast iron stone pans, the millstones rest on heavy oak planks. The timber bridgetrees are still in place for the upstream and middle pairs of stones although the tenons which should protrude through the mortices in the front posts of the hurst have been cut off and the tentering gear removed. The iron screws were found "stored" on the top floor of the mill. As stated above, the iron pulleys and driving spindles for these two pairs of stones are also intact. The plummer blocks bolted to the bridgetrees for the footstep bearings of the spindles are unusual in that the bearing boxes are cast diagonally. The pulleys are fast and loose pairs, each 28 inches diameter by 6 inches wide. This means that the stones would turn a little slower than the turbine. To achieve a stone speed of 120 r.p.m. the turbine needed to rotate at about 130 r.p.m. The fast and loose pulleys for the third pair of stones are missing but, assuming they were the same size as the others, this pair of stones would have turned at about the same speed as the turbine. It is not known when these were removed or whether there was a

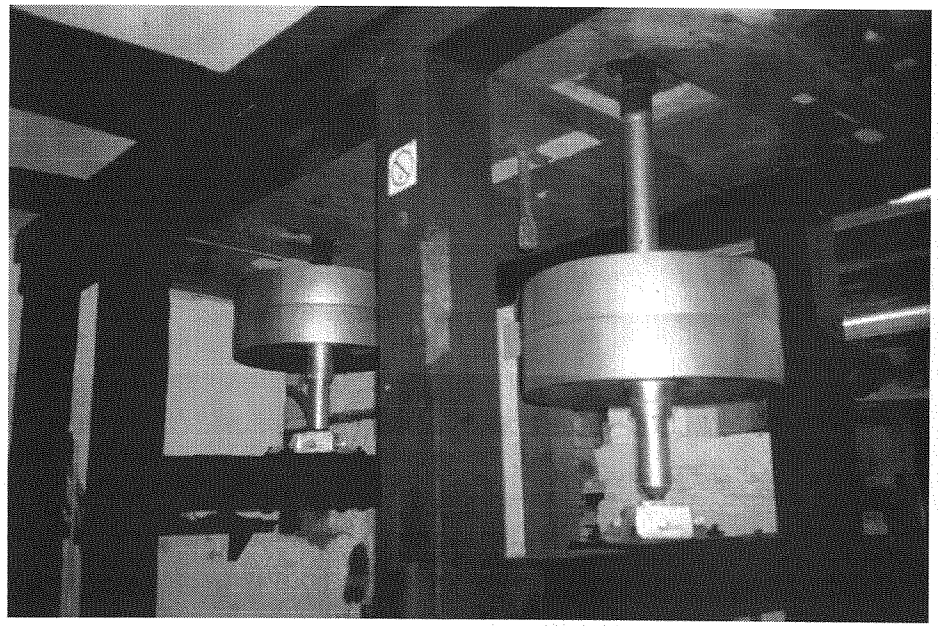


Figure 13. The hurst frame with two sets of fast and loose pulleys that drove two pairs of millstones. Notice the cut-off bridgetrees and the forked hanger for the lever that moved the belt between the two pulleys on the stone spindles.

different arrangement here as this pair of stones was the one sometimes worked by a portable engine. The forked iron hangers which provided the fulcrums for levers to move the belts between the fast and loose pulleys are still in position, fixed to the oak planks which support the stones. Between the middle and downstream stones, two square holes in these planks mark the position of the elevator which collected the grain from the cleaner before lifting it to the bins. The hurst frame is now entirely open but was presumably boarded during the mill's working days. The levers to move the belts would have protruded through the boarding and hatches or doors would have provided access for inspection or maintenance. A door at the upstream end of the hurst would have given access to the large handwheel, set in a slot in the rear wall of the mill, which operated the valve in the turbine water feed pipe. It must have been rather alarming to have to walk so close to the driving pulley of the upstream millstones when it was rotating at about 120 r.p.m.

The stone floor is still reached by the original mill ladder though this is now enclosed as a fire precaution. Until the 1980s the stone floor remained as one open room but has now been divided into two smaller units plus a toilet and shower. The millstones are enclosed in a separate compartment and until 2003 this had solid partition walls. The top half of one wall has now been glazed and the compartment illuminated so that the millstones can be viewed from a corridor. All three pairs are French burrs and turned anti-clockwise. Of the downstream pair of stones, the runner is 48½ inches diameter with four circular balance boxes. The two surviving covers are marked "**Davies & Sneade - Liverpool - Established 1817**" while the cast iron eye ring reads "**Davies & Sneade - 19 & 21 Cheapside - Liverpool**". A cast iron oval plate set in the back of the stone reads "**Davies & Sneade - Cheapside - Dale Street - Estd. 1807 - Liverpool**". Even if Davies & Sneade were unsure when the firm was founded, this stone certainly dates from after 1853 when that particular partnership commenced. The middle runner measures 48 inches diameter with four rectangular balance boxes. There is a plate at the eye which reads "**Cotton & Davies - 22 Cheapside - Liverpool**". As this partnership ended in 1853, this stone could have been installed in the 1851/2 reconstruction. The runner of the upstream pair has been lifted and leans against the upstream wall. It measures 48½ inches diameter and is a rather older type than the others with a domed back and no maker's plates. Although now fitted with a gimbal rynd, the slots for three earlier types of rynd are still evident, a conventional bridge, a three-arm rynd and a four-arm rynd. Several holes in its working face have been filled with lead so it is hoped that this pair of stones was reserved for the production of animal feed!

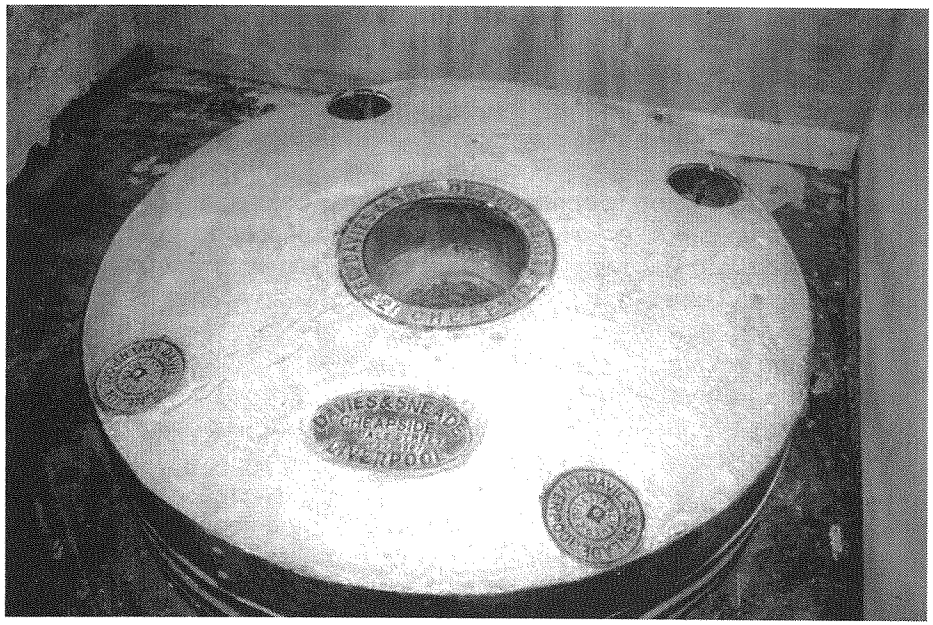


Figure 14. The top of the downstream runner stone showing the four balance boxes, nameplate and eye ring.

There are other millstones, or parts of stones, around the site. Several French burrs and the parts of a sandstone conglomerate stone were found in the bank supporting the old mill pond. A millstone grit stone of about 3 feet diameter has been used as a lintel over an entrance to the turbine pit. Outside one of the converted farm buildings of Lake House is a 4 feet diameter millstone grit stone while a 3 feet 11 inches diameter granite runner stone, with the slots for a four-arm rynd, is in use as a garden table.

Behind the millstones is the framework of a timber partition which separated the stone floor from the upper part of the turbine pit. Presumably this was once boarded with doors giving access for maintenance. Immediately beyond the partition is the grain cleaner, a "**Eureka Separating and Scouring Machine**" by S. Howes of Silver Creek, New York. It is their model No. 0 with a capacity of 10-15 bushels per hour. It was driven by a belt from the 29 inches diameter pulley on the turbine shaft which ran round a 6 inch pulley on the vertical shaft through the scouring drum. This might seem an awkward position for such a machine but it had the benefit of allowing all the dirt and chaff to be discharged into the tail water. The machine is in remarkably good condition, only lacking its initial feed sieve.

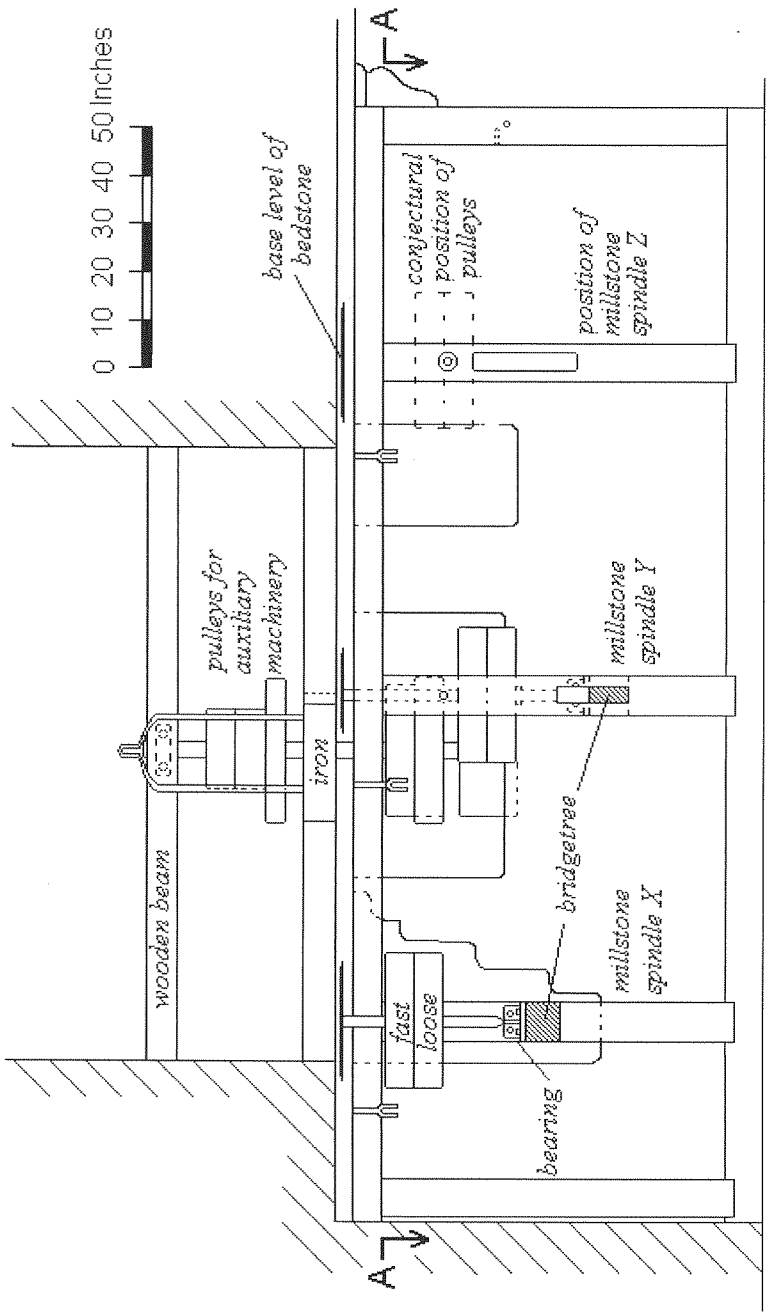


Figure 15. Elevation view of the wooden hursting looking northwards with the three belt openings in the wall and the turbine shaft and pulleys in the background. Millstone spindle X is shown as a section taken at the spindle.

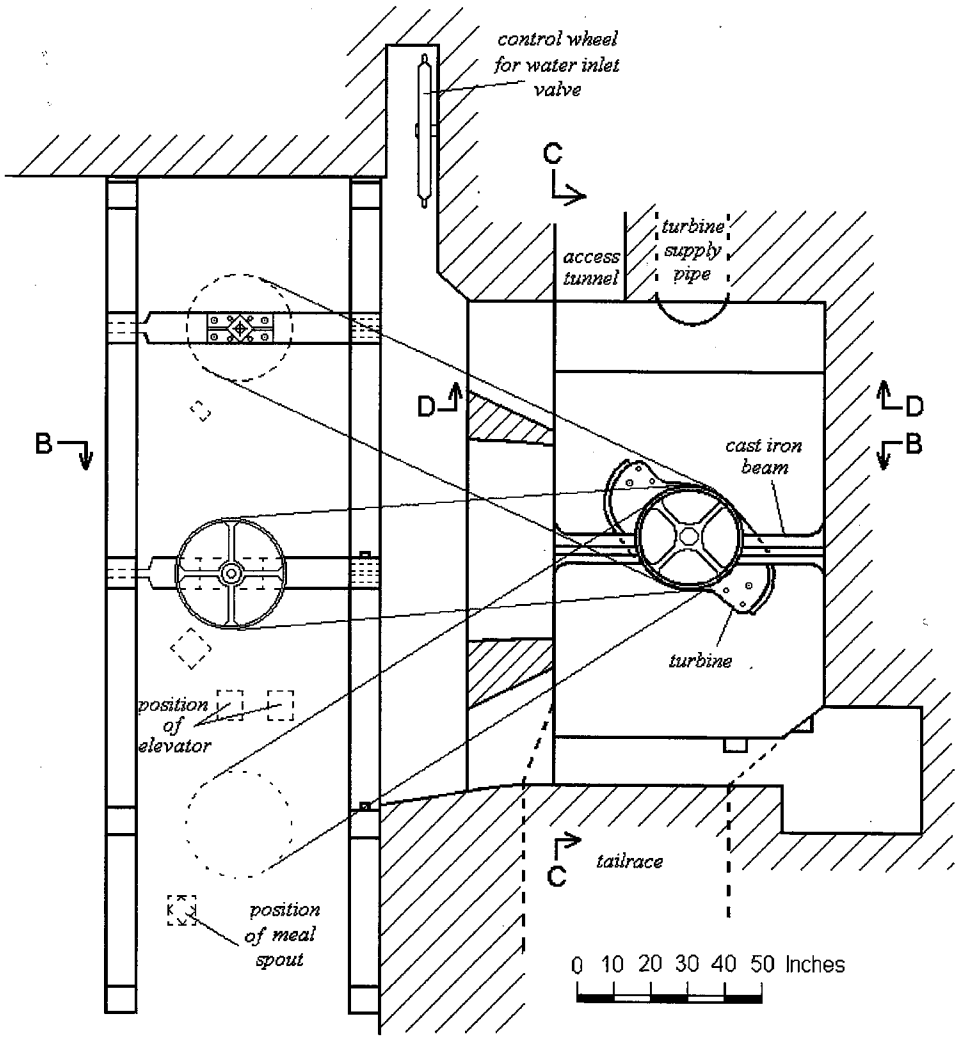


Figure 16. Plan of the hursting and turbine pit (view AA on Figure 15) with the millstone drive belts shown in place. Millstone spindle X is shown at the level of the footstep bearing. The position of the elevator, meal spouts and hangers on the ceiling are shown dotted.

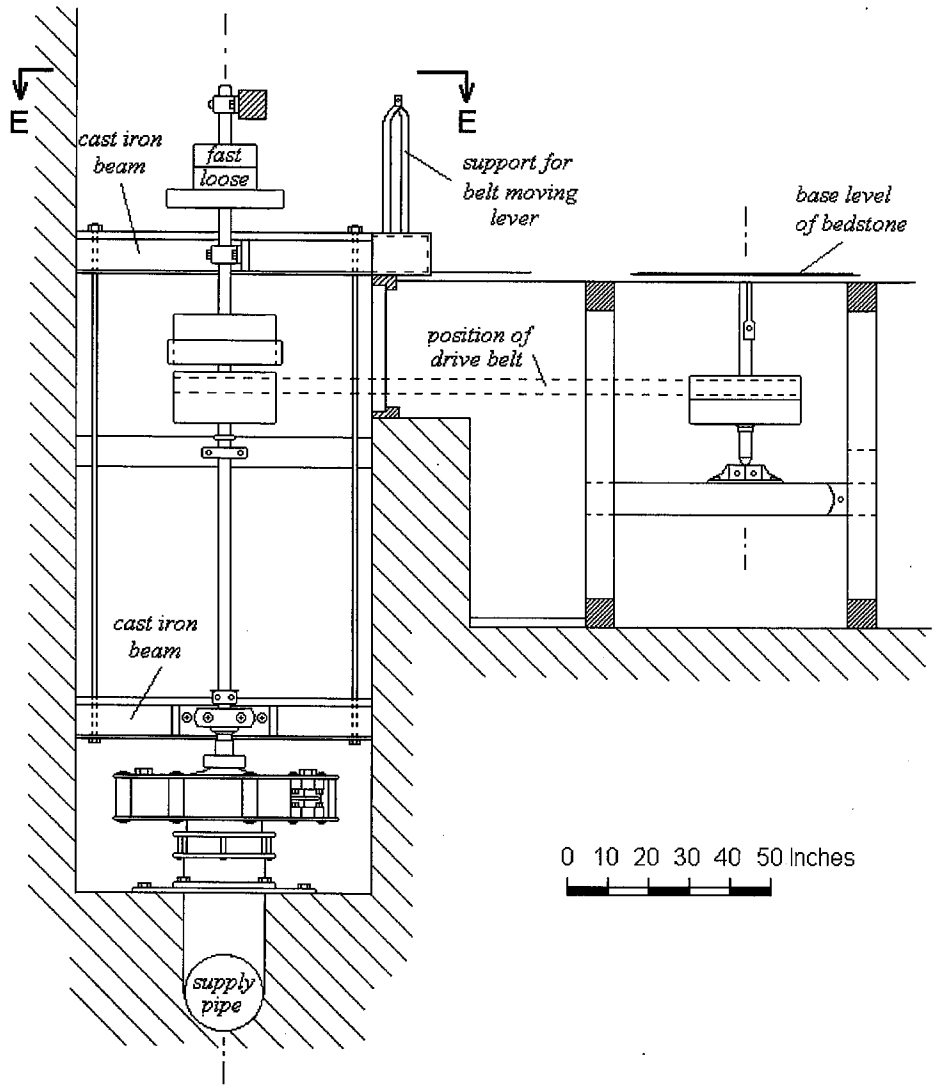


Figure 17. A section through the mill at BB on Figure 16, showing the relationship between the turbine and the hursting. The position of the drive belt from the lowest of the pulleys on the turbine shaft to the millstone drive pulleys on spindle Y is shown. The two cast iron beams provide support for two of the bearings for the turbine shaft. The tie rods between the two iron beams are used to align the equipment during installation of the system. Normally these two bearings would have been sufficient support for the turbine shaft but two other bearings have been used, mounted on wooden beams.

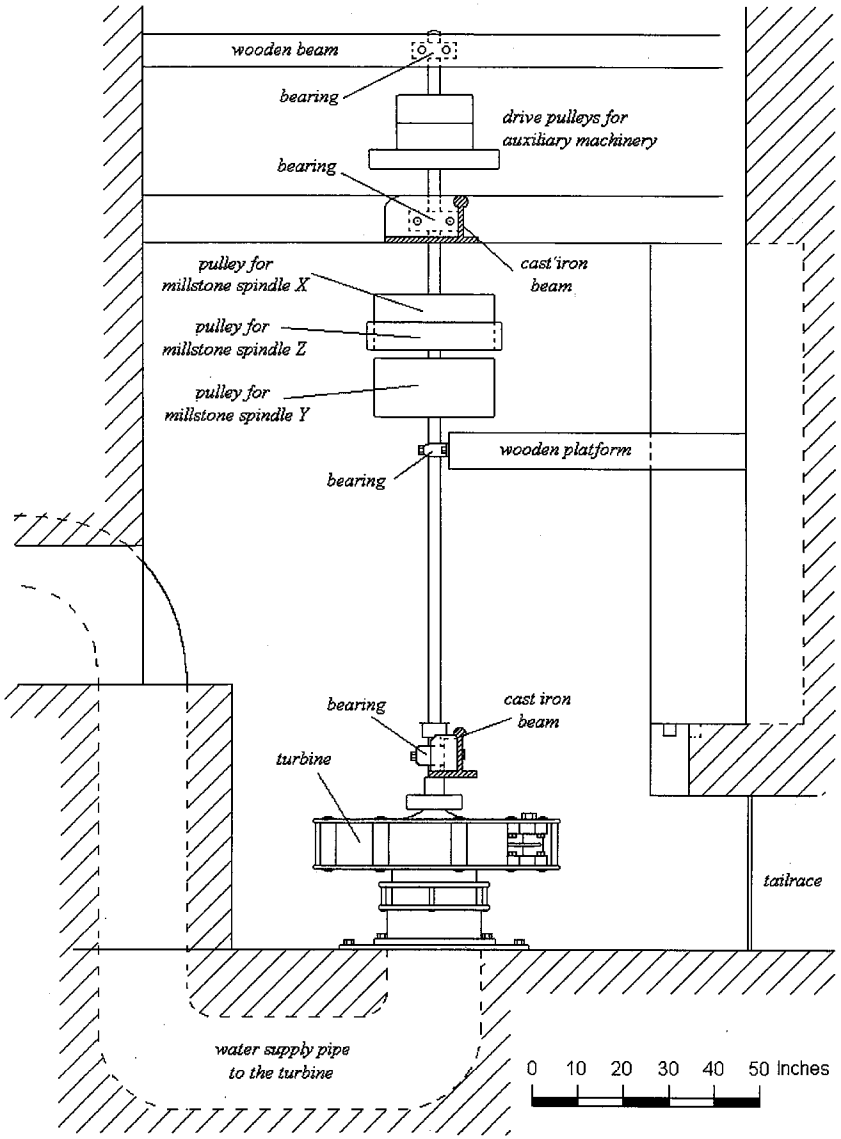
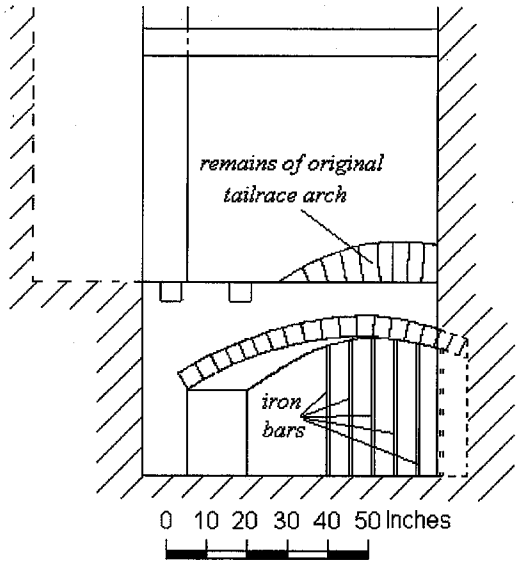


Figure 18. A section through the turbine pit at CC on Figure 16 showing the turbine installation. Also shown are the cross-section profiles of the two cast iron beams supporting two of the turbine shaft bearings. The depth of the water supply pipe below the bottom of the turbine pit is estimated.



Figures 19. A view of the tailrace end of the turbine pit at DD on Figure 16, showing the offset tailrace and remnants of the arch of an earlier tailrace once used by one of the previous waterwheels.

Also within the area at the top of the turbine pit is a long curved iron lever, which would have protruded through the timber partition, mounted in a forked iron frame which provides a fulcrum. The lever raised and lowered the belt which would have run round the pair of fast and loose pulleys at the top of the turbine shaft. This belt must have passed between the upstream and middle pairs of stones, turning through 90° as it did so, as there are score marks on the timber sill of the partition. It would then have turned a pulley on a short intermediate horizontal shaft supported by stands mounted on the stone floor to transfer the drive to the dressing machine on the floor above and to a lineshaft at ceiling level which would have driven the sack hoist and the grain elevator. Two hangers for the latter remain in position. There are three lengths of shafting with pulleys in the mill but not in their working positions. The shortest, 42 inches long, carries four pulleys and could well be the intermediate shaft referred to above. However, all traces of any mountings for the stands needed to support such a shaft were obliterated when the stone floor was re-boarded many years ago. Confusingly, neither of the two other lengths of shaft would fit the bearings of the two hangers which remain in position so it may be that there was further line shafting for which all signs of hanging are now hidden. It is difficult to envisage just how these drives were positioned without causing a dangerous obstruction.

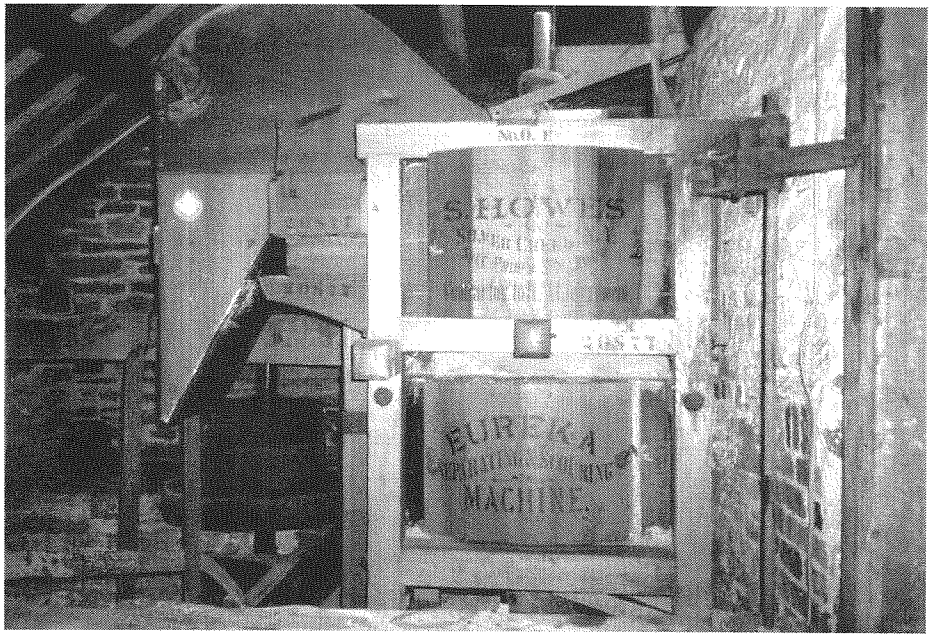


Figure 20. The Eureka separating and scouring machine. The fast and loose pulleys on the turbine shaft that provided power to some of the auxilliary machinery and the long arm that moved the belt between the pulleys can be seen to the bottom left.

Until c.2000, the top floor remained virtually unaltered from the mill's working days. Again approached by the original ladder, it was only used for storage. However, at that time YHA decided it was necessary to provide additional accommodation so the whole of the attic walkway was demolished to give access to a self contained warden's flat at the east end and a bedroom at the west end. The dressing machine, sack hoist and bins were blocked in behind partly glazed partitions. Despite the mill being a listed building there seems to have been no requirement for consultation or even a proper photographic or measured survey. It is hoped that YHA can be persuaded to rectify some of the damage done by removing unnecessary partitions and opening up part of the roof structure.

Before these alterations, a short ladder from the bin floor rose to the attic walkway, almost 7 feet wide, which ran the full length of the building. Poundley's cross-section of the mill does not show a walkway and to give the headroom to accommodate one, the collars of his roof trusses have been cut away and replaced by curved iron straps bolted to the main beams. There is no record of when this work was carried out although it was noticeable that the lower part of

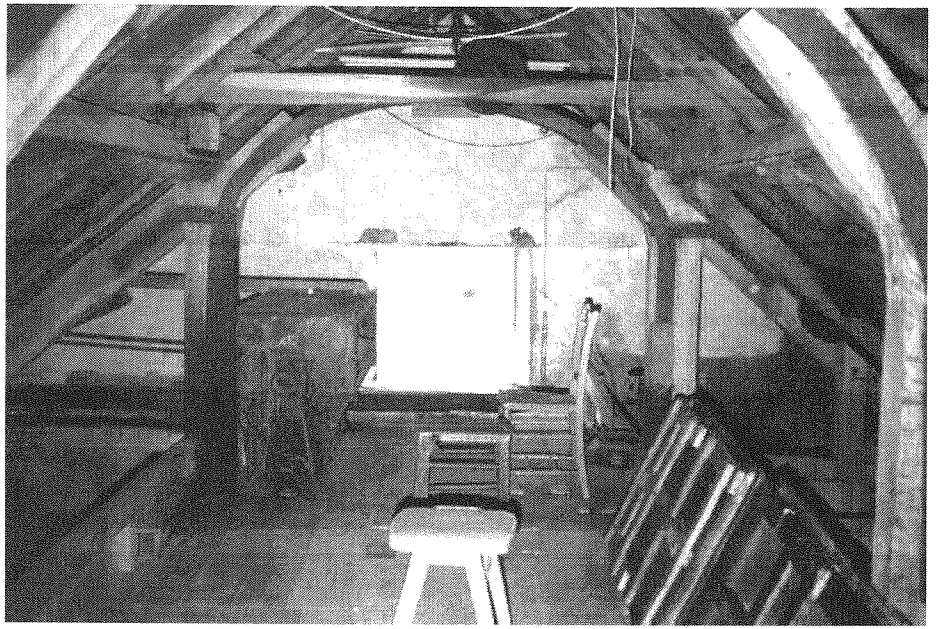


Figure 21. The top floor of the mill prior to the partitions being fitted, with the Armfield dressing and scalping machine on the left and the sack hoist pulleys on the right.

the Armfield dressing machine conveniently fitted just below the walkway. Therefore the alterations may have been made in 1892 for Aaron Davies. The dressing machine now stands behind very close fitting partitions and is difficult to view. The upper section is a scalper, fitted with a fixed wire mesh drum, about 4ft. long, and revolving brushes and was used to remove the larger bran particles from the meal. It was fed by an elevator of which only the head and driving pulley survive, now out of position. A screw at the bottom of the scalper carried the meal to the lower part of the machine, a silk reel about 9 feet 6 inches long which would have removed finer bran particles. This used to be surrounded by an outer wooden casing but this was destroyed in the alterations to this floor in c.2000.

The sack hoist is positioned above the millstones, just above the level of the bin floor. It is of the standard slack belt type with a short, heavily counterweighted operating lever which has been truncated. There was also a counter weighted ratchet to hold the lever in its working position. Between the two bins next to the hoist are the remains of the head of the grain elevator. Unfortunately all the spouts have long since been removed so it is not now obvious which bin fed the grain cleaner.

As in many mills, the floor between the bins was used as a repository for bits and pieces of equipment. This practice continued after conversion to a Youth Hostel and it was in these areas that the lengths of line shaft, two damsels, a few mill bills and other iron work were to be found. However, the most interesting find was part of a millstone dressing machine, presumably the one mentioned in the valuation of Edward Watkin's property in 1890. Once cleaned up this proved to be by J. B. Harris of Ottawa, Illinois, U.S.A. and probably dates from the 1870s. It is intended that this machine will provide the focus of a future article for "*Wind and Water Mills*".

Conclusion.

The Whitelaw turbine cost at least twice as much to purchase and install as the estimated cost of a waterwheel. However, it seems that there would have been much less difference in the overall cost of turbine driven machinery at about £228 and William Davies's estimate for a waterwheel and conventional upright shaft gearing at about £200 including workmanship. Even if it is difficult justify the choice of what must have seemed rather radical and unproven machinery on economic grounds, it appears that, after a poor start, the turbine may have required relatively little maintenance over its working life of about 75 years. Perhaps the true deciding factor was a need for the Earl of Powis to be seen to be just as forward thinking as his "nouveau riche" neighbour, John Naylor. Whatever the reason, the decision certainly seems to have influenced work elsewhere for this part of the county has had a greater number of turbine installations than anywhere else.

The survival of this fascinating machinery at Clun Mill is probably the result of the building being purchased by the Youth Hostel Association rather than being converted to a dwelling. However, the changing needs of its members have threatened the integrity of the machinery in recent years. It is sincerely hoped that the involvement of the Midland Mills Group has re-affirmed its importance and will ensure its survival without further alteration.

Acknowledgements.

I am very grateful to Kate Bonson, Tony Bonson, June Booth, Chris Carter, Trevor Griffiths, Ian Langford, Tony Perryer, Alan Stoyel and Sam Sweet, the other members of the Midland Mills Group working party who did so much to improve the appearance of the machinery in a very short time.

Particular thanks are due to:

Kate and Tony Bonson for their careful measured survey and the excellent set of drawings which resulted from it.

Figure 22. Some of the Midland Wind & Water Mills Group working party in February 2004 removing rubbish from the turbine pit. The open hatchway in the background is the entrance to the turbine compartment. From left to right: Tony Perryer, Kate Bonson, and Peter Ingle, manager of Clun Youth Hostel.

Chris Carter for making me aware of all the documentation in Shropshire Archives and sharing her particular knowledge of the mill.

Alan Stoyel for his detailed notes on many aspects of the building and its machinery plus helping with preparatory work for the mill trail and the grand re-opening of the Youth Hostel in May 2004.

Sam Sweet for his restoration work on the millstone dressing machine.

I am also very grateful to the former manager of Clun Youth Hostel, Peter Ingle, for his generous co-operation and assistance throughout but especially for his decision to contact the Midland Mills Group in September 2002 about the proposed alterations to the buildings.

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THE MODDERSHALL VALLEY WATERMILLS 40 YEARS ON

By Lawrence Helsby

Although having had only a general interest in watermills and windmills since my student days of 1960, a nostalgic trip to discover the present state of the Moddershall mills seemed to be worth making just that little bit of an effort, risking a B & B via the internet, and praying for a couple of days of decent weather.

As students at the then Stafford College of Technology in Tenterbanks, there were three of us in our final engineering year of a four-year sandwich course sponsored by the English Electric Group. Doug Legge from Stafford, Alec Rushton from Liverpool, and myself from Marconi's in Chelmsford. The project was to make an engineering study of the mills, but this had to be expanded to justify three students being involved. Hence our searches stretched into the history and development, such that we foraged amongst books and papers in several local libraries, and talked with people still in the mills, or who had worked in the industry. The final "publication" was reproduced on a Gestetner duplicator, with photographs glued into place in each of the dozen or so copies produced. No PCs, digital cameras, photocopiers or other reprographic equipment that is now available, hence once a "master skin" had been typed on a typewriter, it was almost impossible to make any corrections, whether simple typing or other errors, which we tried to keep to an absolute minimum. Now that such equipment is considered normal and reasonably priced, for my own satisfaction, I scanned my somewhat faded original copy of our 1961 thesis, and it was this that made me determined to return to the valley.

Having made it "up north" by midday, much quicker than anticipated, booked into my B & B, and made a quick visit to the Boar public house in Moddershall, my first disappointment was to find that the Boar Mill had long since gone. Although one person claimed that the mill wheel was still there underground, others intimated that it probably wasn't, or had completely rotted away by now. Driving down the road to the next mills, again Ochre mill was no longer in existence, although I struck it lucky in that Peter Plant there, had an A4 colour aerial photo taken in 1965, presumably just before demolition. This is an excellent record of the mill, all the buildings being quite distinct, even a parked car. The

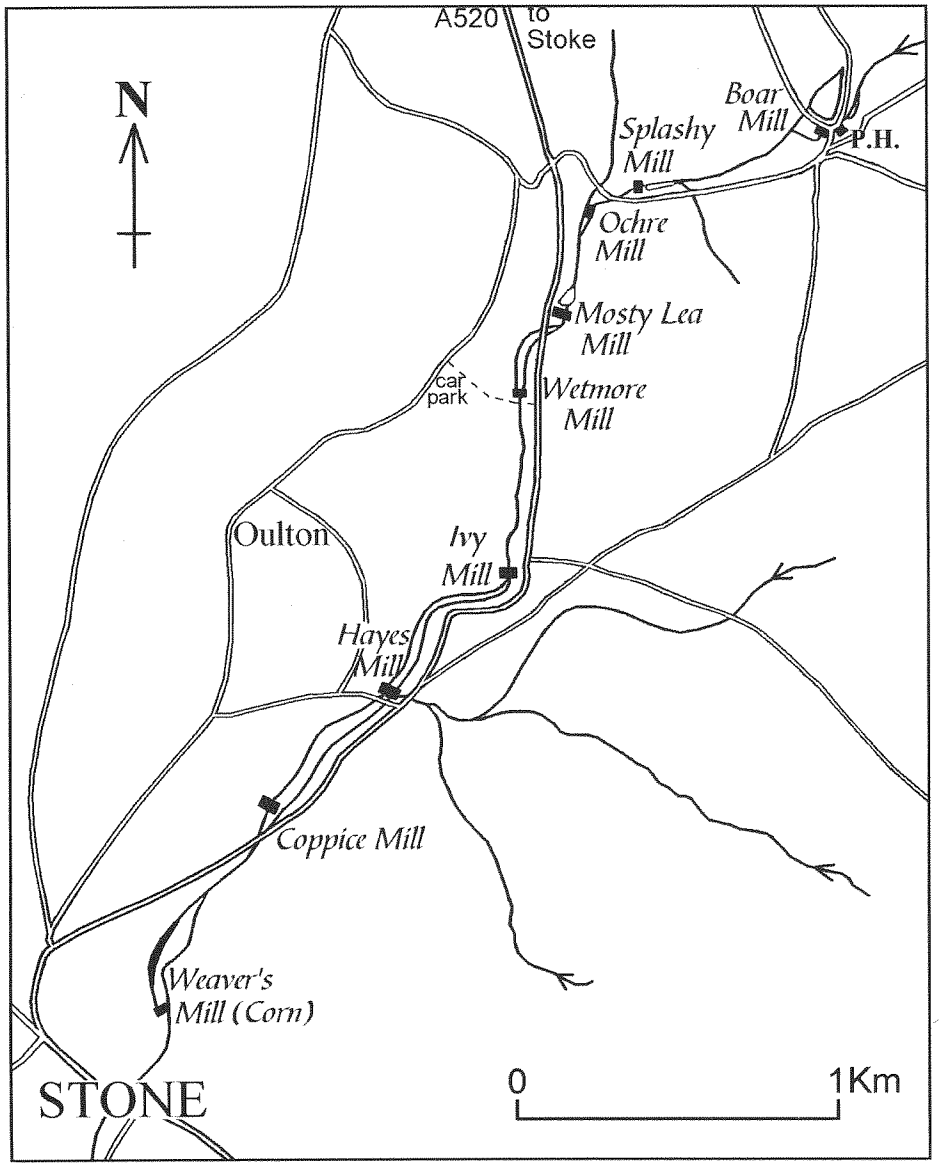

Figure 1. A map of the Moddershall Valley north-east of the town of Stone showing the locations some of the watermills sites on the course of the Scotch Brook.

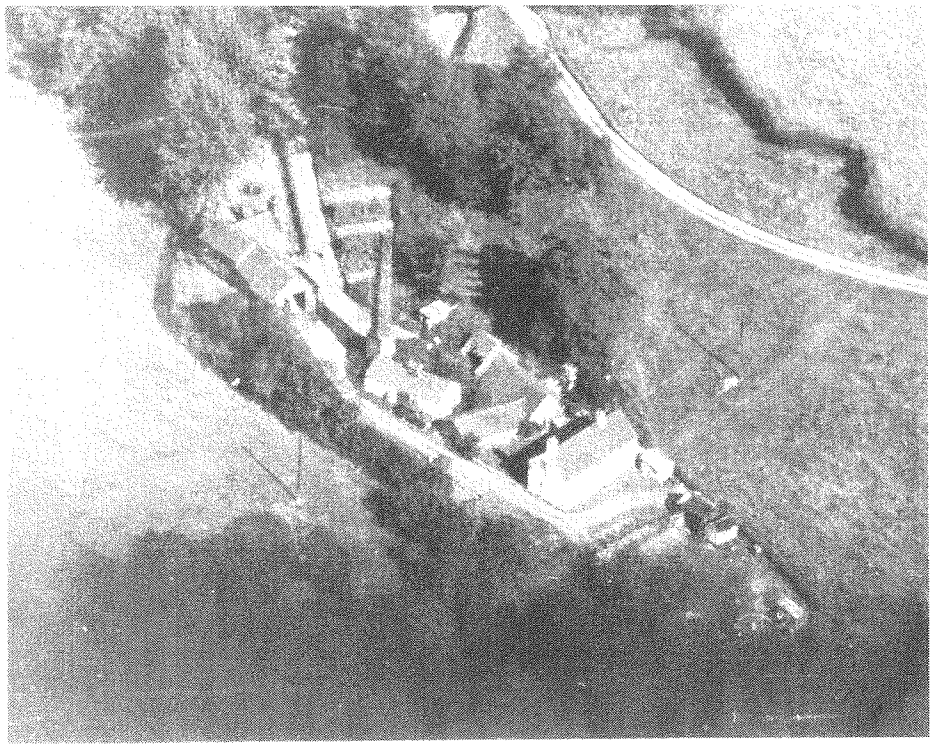

Figure 2. An aerial photograph of Ochre Mill taken in 1965 before the mill was demolished.

photograqph was purchased from a casual caller offering it for sale, and I wonder if the unknown photographer took other photos in the area. On the opposite side of the road is Splashy or Top mill. Originally, this was sometimes known as the Mill of Many Roofs, a very apt name in view of its construction, as the 1960 pen & ink sketch shows, but the right hand buildings have all gone, leaving the wheel exposed on the one remaining left hand building. A modern house now stands below the mill, and the landscaped gardens have transformed it into a "chocolate box" mill, complete with water cascading over the wheel. Unfortunately, I was unable to see inside the mill, and an application has been made to convert the last building into residential accommodation, so any remaining machinery will probably be scrapped.

Ivy Mill on the main Stone Road is still almost intact, although the machine room with the pit wheel and other drives is closed off for safety reasons. Mrs Hinchliffe took me on a tour, and the pans and other equipment are still there, with the top pan having been renovated, but the lower pan now showing signs

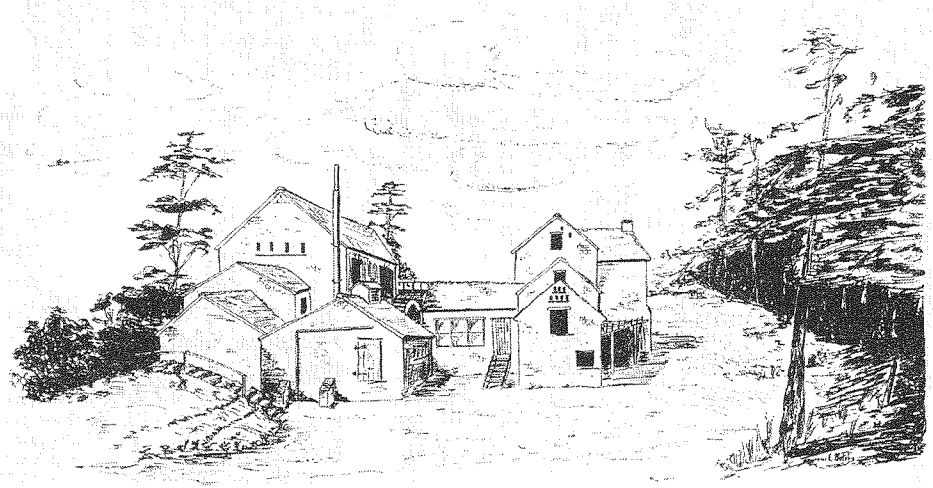

Figure 3. A sketch of Splashy Mill drawn in 1961 before the demolition of the buildings on the right hand side.

Figure 4. Splashy Mill as it can be seen today.

of its' age. Some repairs have been carried out to the waterwheel, but since these were not completely finished and the wheel not allowed to run, some of the timber is once more deteriorating. Where necessary, steel girders have replaced the original timber roof beams, and the kiln chimney has been pointed and capped. The pans are used as storage for items used in the current business carried on in the other mill buildings, and the original residence of Mr Hissey (1960) is now used as offices, and the old stables have been converted to provide a much larger living accommodation.

The following morning, an early visit to Coppice Mill, the one nearest to Stone, paid dividends, as I caught Tony Bonser about to leave for work. His son, Sam, took over as my guide, and Tony invited me back in the evening to "talk mills", and see some of his photographic collections extending back over many years prior to my own 1960s interest. The situation is very similar to that at Ivy mill, with the wheel having received some attention, and most of the 1960 equipment still present, and once again the pans used for storage. The water situation has seen a lot of hard work and money spent on it, to keep the dams and streams in good order, but must be an ongoing worry for all the mill owners. In the evening, Tony showed me the book by Barry Job, "*Watermills of the Moddershall Valley*", and I was able to delve into it whilst waiting for Barry to come and join us. I was delighted to meet him, and his book must be considered the definitive history of the Moddershall Mills, with all the references and sources of material fully detailed. Unfortunately, as students, we hadn't realised the importance of giving precise chapter and verse of our sources for future readers of the thesis, listing only the publications titles.

During my wait for the evening visit to Coppice Mill, I located Hayes Mill which is the same externally as during the 1960s, although as with Splashy Mill, the gardens have been pleasantly laid out to set off the buildings. I spent most of the day at Mostly Lea and Wetmore Mills. The latter is probably the same as in 1960, since all the machinery had been taken away even then, but the waterwheel was in good shape, and spinning merrily for visitors to see. The Mosty Lea mill is a sight for sore eyes. The external view is probably completely unchanged since my1960 sketch, and this is due to the "Friends of Mosty Lea" who have done an amazing job of pretty well completely restoring the mill into an almost working bone grinding mill. The wheel wasn't quite 100% successfully restored by contractors, as it catches slightly on the bottom, which has damaged some of the boards, resulting in an unbalanced wheel that catches in one place on each revolution. However, the pans are connected to the gearing and wheel, so that the sweeps can be seen rotating. There are no heavy blocks of chert, and one idea is to make some imitation blocks that can be swept over the paved beds, to show the complete grinding action. Floodlights have been installed in

Figure 5. A sketch of Mosty Lea Mill drawn in 1961.

the pit wheel room, so that access is easy for visitors, the mill being currently open on the first Wednesday of most months.

What of the future? Mosty Lea must be the one that must be maintained at least as a "working museum", and the working group should be given every encouragement possible. The mill is now advertised in the Midland Wind & Water Mills Group leaflet "*Windmills & Watermills in the Midlands*". Unfortunately, it is the one mill in the valley that has very poor access. Entry from the Stone Road is prohibited, and therefore a fairly long walk is involved down a long hill from a scout's car park, plus another long walk, albeit through very attractive woodland, to get first to Wetmore Mill, then, ending via a tunnel beneath the main A520 Longton Road, on to Mosty Lea. This makes it impossible for anyone who is not reasonably active to visit the mill, and hence means that there are unlikely to be many visitors, and certainly would discourage casual visitors who spot the mill sign from the main road. Further co-operation from the scouts would be needed to allow and provide parking areas, and probably extensive lobbying of the appropriate council planning department, for permission to construct a safe entry and exit from the rather narrow main road, this in turn requiring a fairly considerable amount of cash, possibly via a lottery grant. An on-site potter making and selling their own work, and persuading a local shop to open a salesroom of china and pottery might encourage visitors. This partial commercialisation seems to be the only way to keep such enterprises alive,

and is successful with corn mills. These of course do have the advantage that they can still mill their basic materials, and sell the products as flour, or as seen on a visit last year to Heatherslaw Mill in Northumberland, not far from Holy Island, bread baked on the premises and as scones and cakes in a small restaurant. I can thoroughly recommend their chocolate cake, in addition to the buttered scones! They are particularly lucky in that as well as the working undershot wheel and complete flour mill, there is a narrow gauge light railway starting from the other side of the mill stream, and running to Etal, a 3½-mile return journey, so that a family can have a pleasant day out, as well as the mill addict of the family spending time in the mill. For the Moddershall mills, there is the attraction of the Foxfield Light Railway giving a 5-mile return journey, only a short distance away, which could also act as an incentive for a family outing to the mills.

Ivy and Coppice are still capable of being completely restored, and with the help from another group of volunteers such as those at Mosty Lea, or another Mucky Mills Gang who made a significant attack on Clun Mill in Shropshire (see MMG Newsletter No.78), this could be achieved over time. The difficulty with these two mills is that both form family homes, and although a valley tour of three mills might be an attraction, invasion of the owner's privacy, and in the case of Ivy Mill also the running of a business, would probably prohibit such a method of financing any restoration.

I hope that Mill aficionados will forgive my general rather than strictly technical approach in this article, but should be able to see that despite some drastic deterioration that can take place over the span of 40 years, it is still possible to preserve what is still there, hopefully for at least another 40 years.

Acknowledgments

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TANSLEY WOOD MILL, MATLOCK
A DERBYSHIRE 'BUMP' MILL

by Alan Gifford

Introduction

It has long been recognised that the rapid growth of the textile industry throughout the late 18th and early 19th centuries contributed in no small manner to this country's development as an industrial nation. The textile industry of that period has left a significant mark in the architectural scene of the countryside, particularly notable in the north and east of Derbyshire. Even today this is, in many places, quite a dominant feature, both on the landscape and on the river systems.

Derbyshire played a key part in the changing economy of that period and new textile mills were built along much of the 60 miles of the River Derwent that flows through the county. The power provided by the river enabled imported materials, such as silk and cotton, to be spun and woven in previously unheard of quantities and at much greater speed than had been thought possible a few years previously.

Whilst the importance of some of the mills on the River Derwent[1] has recently been recognised by the awarding of 'World Heritage Status' by the United Nations Educational and Cultural Organisation (UNESCO), on its tributaries other less well known mills played an equally important part in raising the image of Great Britain in the eyes of the world. In addition they provided employment, especially for women and children, on a scale hitherto unknown in these areas. Such a location is at Tansley (see Figure 1), a small hamlet about one mile east of Matlock, which was changed for ever in 1783 by the building of what became known as 'Tansley Wood Mills' (SK 312600). This is, at least, part of the story of that mill.

The Early Factory System

The major landmark brought about by the silk and cotton industries, was the development of the 'factory system'. The first stage of this major change of industrial practice occurred in 1704 with the building of Thomas Cotchett's new silk mill in Derby, using the engineering skills of George Sorocold in its construction. This visionary project failed, however, probably due to poor management and lack of resources. A little later, in 1721, John and Thomas

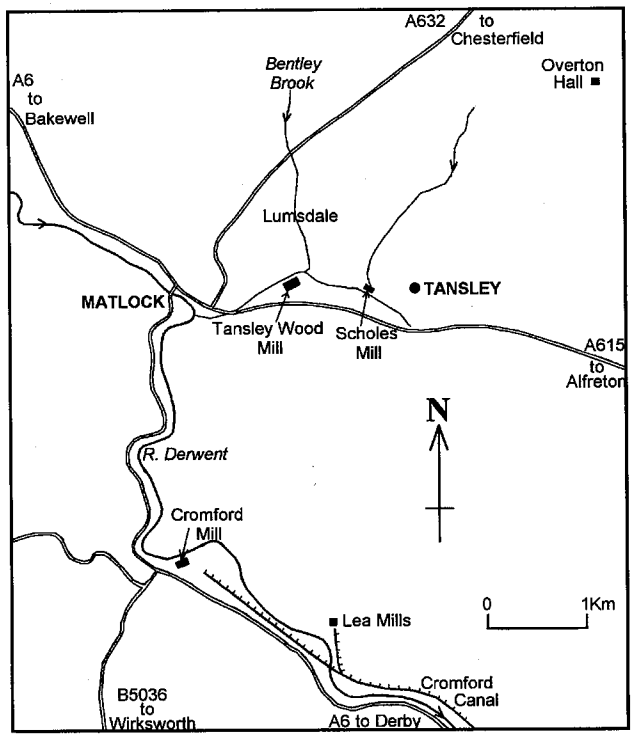

Figure 1. Map of the Matlock area of Derbyshire showing the location of Tansley Wood Mill.

Lombe built a new brick silk mill to produce silk thread, using part of Cochett's buildings, powered by a single undershot waterwheel about 21 feet in diameter and 6 feet wide. This five storey mill was manned by paid employees, including large numbers of women and children, who were required, for the first time ever, to work long and regular hours each day, a concept of employment virtually unheard of at the time.

In 1771, Richard Arkwright, after early experiences with a horse-powered cotton mill in Nottingham, decided to build a factory in the small village of Cromford some 15 miles north of Derby. This mill was powered by water from a lead mine sough and a small stream, rather than using the full power of the River Derwent. Arkwright also largely used the children and women workers, who could not be employed in lead mining, the main industry of the area at that time. Once again these employees were working pre-determined hours, on a regular basis - in a factory. Arkwright patented two of the basic machines used for spinning cotton and sold licences to other mill-owners, although many other mills used his concepts illegally.

Between 1781 and 1785 his right to these patents were finally annulled and the door was opened for many entrepreneurs, developers, and some out-and-out speculators, to build cotton spinning mills so as to cash in on an apparent bonanza, seen by some as licence to print money! As a result over 200 cotton mills were built in a matter of a few years.[2] It was in this climate that Tansley Wood Mill was built.

Tansley Wood Mill - Historical Background.

Peter Burdett's map of 1762/67 shows no evidence of a mill existing on the site chosen for this new mill. The nearest mill shown on the map at that time was a little way downstream, indicated by a mill symbol, which is believed to represent Matlock Mill, which had various uses over the years. Some distance upstream, in Lumsdale, a lead smelter was shown. It would appear that Tansley Wood mill was, therefore, probably a 'new build', rather than a conversion of an existing structure. After one of Arkwright's patents expired in 1783 work started immediately in building the new mill at Tansley, to produce spun cotton thread.

After a local landowner, Robert Banks-Hogkinson granted a lease in 1783, the first buildings on the site were erected by Messrs Osgathorpe and Prestwidge. The project failed however, when the owners were declared bankrupt, a not uncommon fate for mill owners of that era who exceeded their capability.

In 1792, a Miss Frances Willoughby acquired the balance of the 21 year lease. At the same time she also acquired the majority holding in a patent (No.1368) to make 'candlewick'. This patent, which had been taken out by Thomas Oldham and George Pestwick of Swanwick, Derbyshire, in 1783, was for a machine to spin candlewick from flax waste. Candlewick, or 'bump', as it was commonly known, was made up of fibres of flax or cotton waste, which were simply loosely twisted together to form threads. Initially this was used for the wicks of candles and oil lamps, etc., and huge quantities were used, since these forms of lighting predominated at the time. Much later the material found use for making bed coverings, and in modern times the major usage was for the production of 'candlewick' bedspreads, as they were known. The thread was also found to be suitable for weaving into a coarse bedsheet material and also for rough clothing. In 1794 Miss Willoughby entered in to a partnership with John Radford and soon after they leased a nearby house from Sir Joseph Banks.

Sir Joseph Banks (1743 - 1820) was a renowned botanist and explorer, who went with Captain Cook on the voyage to discover Australia. He lived in nearby Overton Hall and from time to time visited the mill site, recording his impressions in his diary.[3] In 1793 he recorded that the lease was for *'21 years'* and in 1794 he visited the *'Bump Mill'* at Tansley, noting the new works by Miss Willoughby, who had not taken up a proposal the previous year that she should purchase

the site. However, in 1800, Miss Willoughby and her partner, Mr. Radford, renewed the lease for another 21 years, at an annual rent of £42, payable on Lady Day.

Tansley Wood Mill was probably the mill referred to in 1807 by John Farey[4] as *'...a candlewick mill in Tansley'*, also noting it to be one of only four such mills in the county at that time. The other bump mills in the county identified by Farey were at New Brampton (Chesterfield) (SK 3670), Clowne (SK 4975), and at Kelstedge (Ashover) (SK 3363)

The mill is clearly marked on Sanderson's map of 1835, which is entitled *'Twenty Miles around Mansfield'*, being described as a 'Bump Mill'. Also there was a nearby cotton mill shown at Tansley, less than half a mile away. According to Frank Nixon,[5] this latter mill was built in about 1783, but its listed building citation states it was built some ten years later, in 1793. Certainly it was built for Samuel Unwin, of Sutton in Ashfield, and was known as 'Scholes Mill'.

In the 1840's, Tansley Wood Mill was owned by Thomas and Edward Radford, presumably sons of the John Radford referred to earlier. At that time the business was described as *'linen and cotton candlewick manufacturers'*. In 1851 an agreement over water rights made the last reference to making 'candlewick', at which time the site also included a bleach works. For a period from 1871, the mill was leased by G. & A. K. Baines, but In 1890 the Radford family leased the mill to Frederick Henry Drabble, a former wool spinning manager from Lea Mills, at Holloway near Cromford. Thereafter the mill was known as 'Drabbles Mill', a name it retains to the present day. Drabble added *'pulling and garnetting'* to the operations carried out on the site. 'Pulling' was part of the recovery of hosiery waste where the material was mechanically torn up to emerge looking like raw wool, whilst 'garnetting' further refined this product, removing cotton and other unwanted threads.

In 1912 Drabble purchased the mill outright and soon after, in 1920, bought the Tansley Wood estate, which is adjacent to the mill. 'Drabbles' became a limited company in 1914, still recovering hosiery waste, but also expanding further into dyeing and bleaching. The business continued to grow, but eventually, in keeping with many other British textile mills, found it was no longer competitive and ceased operations in July 1999.

The water supply for Tansley Wood Mill came from the Bentley Brook, which had already been well used by the numerous mills in the Lumsdale Valley, and was stored in two large mill ponds upstream of the mill building. The overall site expanded over the years to extend over some 40 acres.

The Mill Buildings

According to a plan published in 1802 for a proposed extension to the Cromford Canal, the first buildings which were erected by Osgathorpe and Prestwidge in 1873 appear to have been in the form of an 'L' shaped structure (see Figure 2). This original building was constructed using millstone grit. This three storey building is still recognisable, forming part of the Grade 2 listed buildings on the site. By the time of the 1845 tithe map the mill had been considerably extended and a number of other free-standing buildings have been added on the site, close to the original mill. These were all built in stone and had pantile roofs.

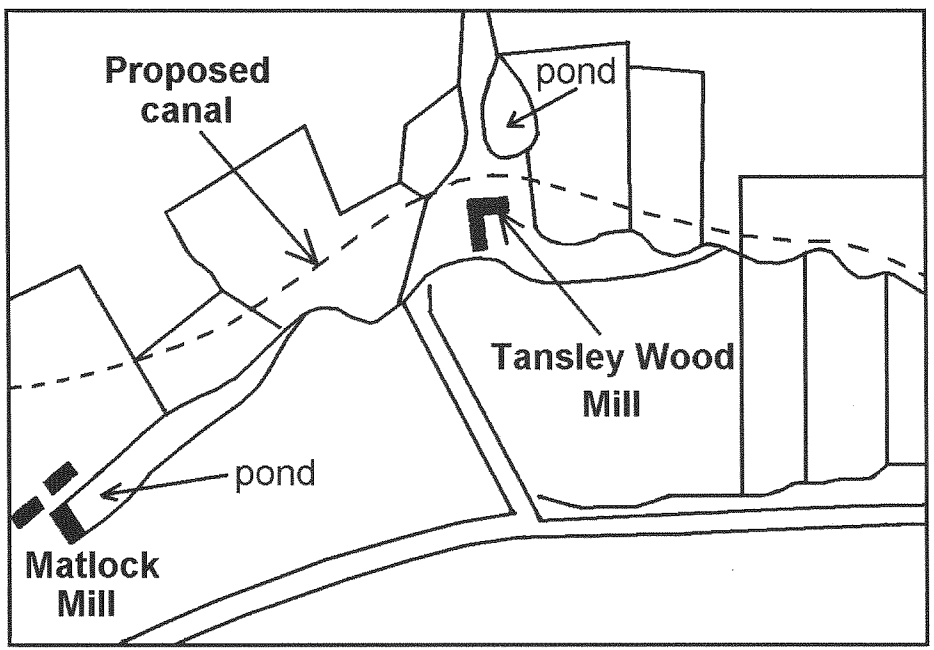

Figure 2. Map of the proposed extension to the Cromford Canal, 1802, showing Tansley Wood Mill as an 'L' shaped building.

An 1871 lease to G. & A. K. Baines shows that a bleach house and gasometer had been added, whilst there were also two large chimneys included, indicating steam power was used on the site by that time. The windows in many cases have been blocked off but a number of original iron frames, with either 4, 6, 16 or 32 light casements survive. There were a number of fire-places, since the spinning of cotton required a warm, humid atmosphere; this, coupled with the cotton dust created in the operations, must have made working conditions very

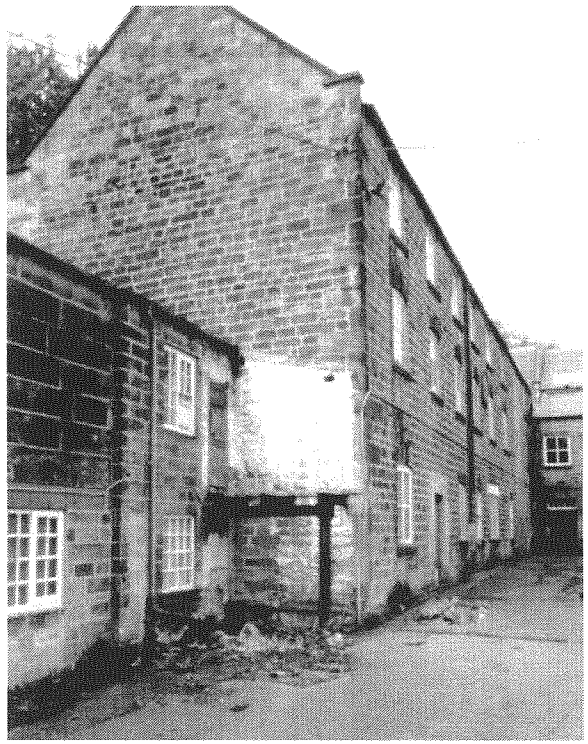

Figure 3. The west wing of the original mill, built in 1783 by Osgathorpe and Prestwidge. (2003)

unpleasant, a factor commented on in numerous mill inspections in the early 1800's as '*cause for concern for the health of the workers*'.

Apart from the listed buildings there are many un-listed buildings on the site, which were associated with bleaching, dyeing and drying processes, as well as garneting sheds and also a number of warehouses and stores. These buildings were often supplied with copious quantities of water to suit the processes involved. Although many of the early buildings are built of stone, in later years brick and steel framed roof structures appeared. The garneting sheds were small and discrete, since with amount of dust involved, they presented potentially explosive situations. They were generally built of stone and brick, with thin slate roofs.

Coupled with many overhead water and steam pipes the whole complex could best be described as jumbled-up and 'messy' by the time production ceased in 1999, but hidden within all this are important late 18th and early 19th century mill buildings.

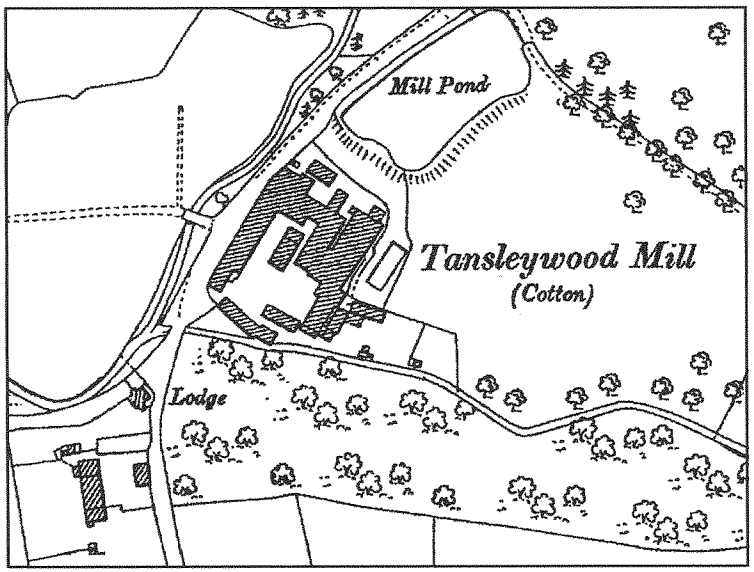

Figure 4. The 1897/8 edition of the 25 inch to 1 mile Ordnance Survey map showing the extent of Tansley Wood Mill and the location of the main mill pond.

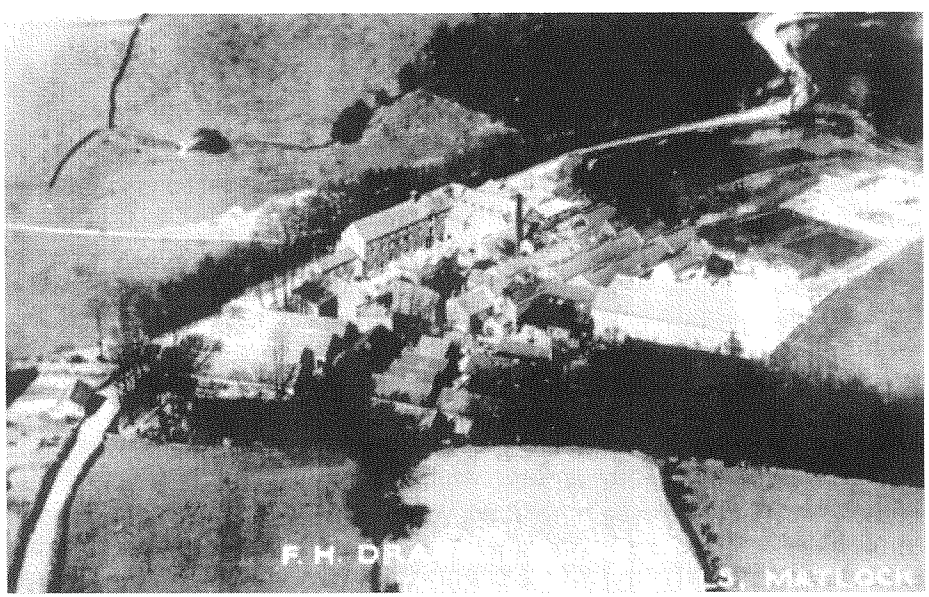

Figure 5. An aerial view of the mill owned by F. H. Drabblefrom 1927. Note the extent of the garneting and pulling sheds in the foreground.

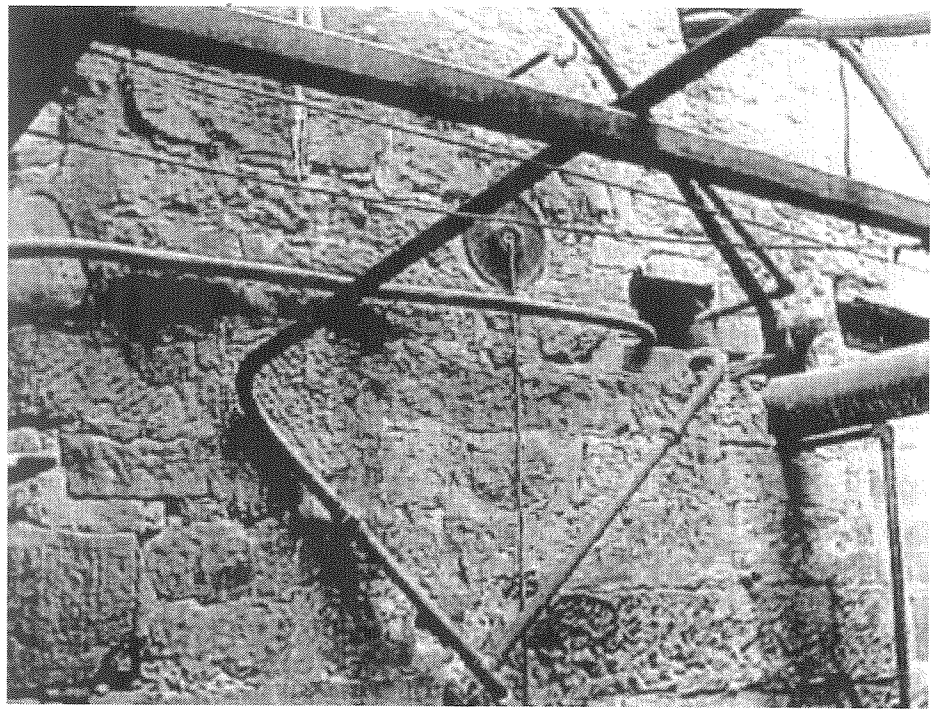

Figure 6. A typical section of pipework presently dominating the site. (2003)

The Power System

The power for the mill initially came from the waters of the Bentley Brook, which flows down the Lumsdale Valley, eventually becoming part of the River Derwent. There were two mill dams, both located immediately above the mill. The smaller, upper dam took the water from the brook via a weir and a culvert under the road but is presently heavily silted up and overgrown with vegetation. The larger, lower dam was fed from the brook by another weir and leat and could also be topped up from the upper dam. This lower mill pool has stone walls and has also silted up over the years. The water feed into the mill, certainly in the 1870s, was through a large diameter, riveted, overhead iron pipe, clearly visible on a painting of the mill from that time.

There was an internal wheel pit, to the eastern end of the north wing of the old buildings, which originally had a waterwheel, probably breast shot, which was about 24 feet in diameter and 4 feet wide. There had obviously been a significant demand for more power because at some time this wheel had been replaced, in the same location, by a 33 feet diameter wheel, which was 7 feet

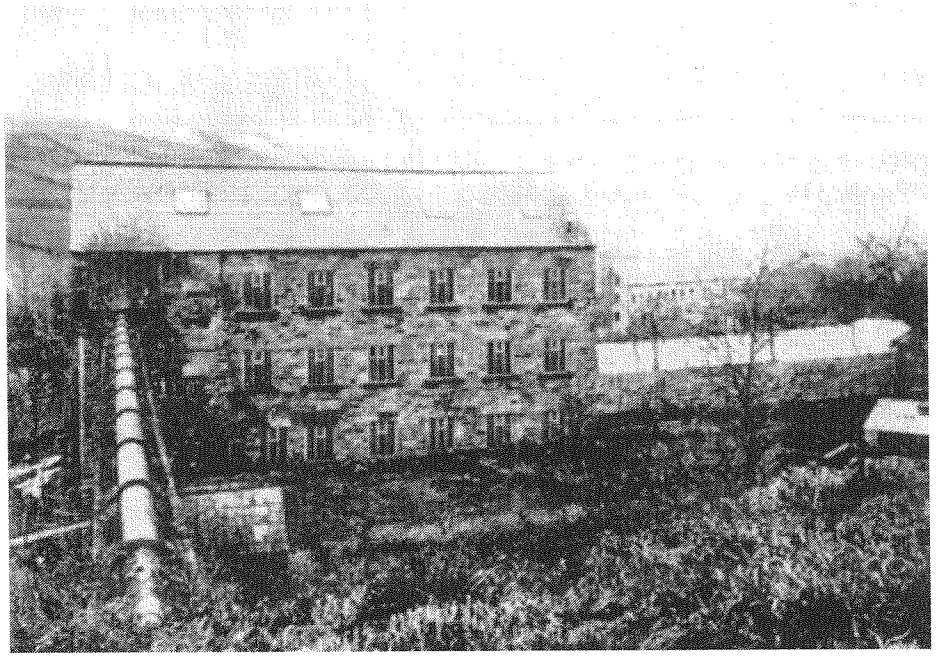

Figure 7. The nearby Scoles Mill in 1893 showing a similar water feed pipe to that at Tansley Wood Mill.

wide. The huge changes to the stonework and mountings in making such a major change of wheel size must have had a most disruptive effect on production in the mill. There is no evidence as to the construction details of the waterwheels or when the change-over took place. The earlier wheel could well have been made of wood but the replacement may well have been a suspension type iron wheel, since these were in use in the area from 1811.[6]

All floors of the original mill complex appear to have been served by line shafting and the drive to the upper floors appears to have been by means of rope drives, contained in a rope race shaft, rather than by upright shafting such as was employed at Belper North Mill.

The waterwheels were later either supplemented, or replaced, by a 'Francis Spiral' single discharge water turbine, supplied in 1914 by James Gordon & Co., of London. It was mounted vertically and generated 40 h.p. from a head of 36 feet. The drive from the turbine was by conventional steel shafting.

The power supply was further supplemented, presumably before 1871, by a single cylinder horizontal steam engine, which would have probably developed around 120 h.p., the steam being provided from horizontal Lancashire boilers.

The Future

Only part of the story of Tansley Wood Mill has been told so far. Presently the site lies semi-derelict, with much excess vegetation and contamination. Many of the later buildings are of little historic value but the core, listed buildings are basically sound and could be saved and, whilst perhaps not of national value, they certainly add to the region's textile heritage. There is little doubt that by clearing the site of the extraneous, relatively modern buildings and the mass of ugly pipework, etc., which litters the site, the original cotton/bump mill stone structures could be preserved and restored to their former glory, even if only in their external appearance. Various proposals for the development of the site, including restoration of the old buildings and watercourses, have been submitted for development but have failed to receive planning approval. To date it seems that the planners prefer a derelict site - maybe time will tell!

Acknowledgements

The author would like to thank Mr. Bob Pearson, of Pearson Management, Froggatt, Derbyshire, who commissioned an extensive study to support planning applications for the development of the Tansley Wood site, and who gave his permission to access this valuable information. This article is essentially based on this study, which was carried out by a team from the Manchester University Archeological Unit comprising Dr. Peter Arrowsmith, Dr. Michael Nevell, Ian Hradil and Steve Stockley, which also used some survey data provided by the Arkwright Society. Thanks are also extended to Robin Clarke for his assistance in compiling this article.

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CANDLEWICK

By Robin Clarke

Candlewick is one of those terms which is used to cover several different meanings, often ill-defined. Two main strands can be unravelled, the first being wicks for candles and other lighting apparatus, the second being bedspreads.

Candlewick was originally just that, wicks for candles. There are records of cotton wool being used as a material for this purpose in the archives of Bolton Priory in Wharfedale, Yorkshire, as early as 1298. However, common usage of cotton in this way dates from the mid 18th century onwards. An account of the manufacturing of candlewick is buried in the article on the Manufacture of Cotton in Abraham Rees's Cyclopaedia. This article was originally published in 1812, although the complete encyclopaedia did not emerge until 1819-20. One of the authors of this article was James Thomson, who was manager of a calico printing works at Church near Accrington and later had his own company at Primrose Mills outside Clitheroe. His co-author was John Farey junior, who was also responsible for the account in the Cyclopaedia of Strutt's mills at Belper and that on the steam engine. Their article stated:-

> "Candlewick cotton is a very loose coarse thread, made from the cheapest and most inferior kind of cotton: being only intended for the wick of candles, no great care is used in the manufacturing. A great deal of candlewick is made from tow [strictly short fibres of flax or hemp] which is bleached and makes an article something like the cotton in appearance but by no means equal to it in quality. This is known by the cant term [i.e. current stock phrase] of "bump", and many large mills are employed in spinning it. The cotton candlewick is known by the name of Turkey which is made from Smyrna or other cheap inferior kinds of cotton. It is generally about 10½ to 11 hanks per lb. and sent off to market to be wound in large balls. [A hank is 840yards long]
>
> Oxford candlewick is made from inferior cotton, about seven hanks to the pound. Wiltshire candlewick is made from waste cotton about No 7. [i.e. seven hanks to the pound]
>
> These articles are spun without the care requisite for yarn or twist: they are generally spun on mules, and in some mills for coarse goods they do not take the trouble to form them into rovings at all, but spin the candlewick at once from the slivers, as prepared by the drawing frame."

The sliver is a continuous ribbon, about one inch in diameter, of loose untwisted cotton fibres lying parallel to each other. It is produced by the carding engine which consists of two closely spaced cylinders revolving in opposite directions under a dome. The surface of each cylinder and the inside of the dome are covered in wire cards made of leather with short projecting teeth or

wires, inclined in the opposite direction to that of its revolving cylinder. In practice two carding engines are used; the first producing a "lap" of fifteen to twenty thicknesses, each the circumference of the cylinder; the second machine, the finishing carder, produces a thick roll by passing the lap through a funnel, which is then drawn off through rollers.

The sliver is next passed to the drawing frame where it passes through a succession of rollers. Each set of rollers revolves at inreasing speeds and as the sliver passes from the slower rollers to the faster ones it is stretched out to four times its original length. Several strands are then combined into one, with all the fibres parallel. At the same time a slight twist is given to the strand, about 2 – 3 turns per inch. This strand, now in a condition and of sufficient strength to be spun into yarn, is called a roving.

When raw cotton arrives at the mill the bales are passed through an opening machine, or "devil". A flue connected to the machine leads to an upper chamber where small pieces of waste cotton are deposited on its floor. They are carried by the air-flow generated by the rapid revolution of the opposing cylinders of the devil. A narrow return flue produces a strong current of air over the cotton being treated. The deposited waste is manufactured into candlewick, sometimes as the sole constituent, sometimes mixed with inferior grades of cotton.

Thomson and Farey give the amount of cotton imported into Great Britain in 1787 as 22,600,000 lbs, of which 80% came from three areas: British West India 6.6 million lbs, from French and Spanish settlements 6 million lbs, and from Smyrna and Turkey 5.7 million lbs. The latter, comprising 25.2% of imports, was the usual grade for candlewick. In the same year production of candlewick amounted to 1.5 million lbs, i.e. 6.6%, compared to 6 million lbs of fustians (26.5%), and 11.6 million lbs of calicoes and muslins (51.4%).

Candles were not only used for domestic illumination but also as a source of light in factories, mines, lighthouses, public buildings and churches. In the 18th century candles provided virtually all the domestic and industrial lighting.

One early factory that was lit by candles was that of William Marshall, a flax spinner at Water Lane, Holbeck, Leeds. He built two mills in the 1790s that were initially lit by tallow candles. These two mills provided a floor space of about 38,000 square feet that needed to be illuminated for 400 hours per year.

Miners often provided their own candles but sometimes they were provided by the mine owner, as at Ecton in Staffordshire, where the "candle & powder account" still exists in the Duke of Devonshire's archive. In a 12 month period from September 1785 to August 1786 12,540 candles were supplied (at cost price) to around 75 miners working at the Ecton Copper Mine. A report on mines in Cornwall written by Nicholas Ennor in 1854, estimated that each miner used 2 lbs. of candles a week, or 100 lbs per year. There were 16,000 men and boys working underground at this time. At 6d per lb the annual cost of candles was £40,000. A report on coal mining in South Staffordshire by W. Farr, published at

the same period only commented that the candles were "*small, about 16 to the pound, carried about fixed in a bit of soft clay or stuck to the sides of the roadways and working places*." No estimate of the total cost was given.

Smeaton's Eddystone Lighthouse, completed in 1759, was lit originally by 24 tallow candles, each weighing 0.4 lb. and producing 2.8 candle power. The candles were consumed at the rate of 3.4 lb. an hour. A specimen of these candles can be seen on display at Trinity House. These candles were eventually replaced by oil lamps. In Liverpool as early as 1763 oil lamps that had flat wicks were used in a lighthouse. A great improvement was introduced by Argand in 1783 using a circular wick and a central chimney to produce an enhanced updraft, thereby ensuring a higher degree of combustion. This basic design was then continually improved.

At first just a few strands of cotton were used in the making of a candle, so the light provided was poor. The ideal wick is made from a good quality, long staple cotton, spun into a coarse loose thread with little twist. In practice, inferior grades, unsuitable for fine spinning, were used. The performance of the wick was improved by introducing plaited wicks, first patented by Cambaceresa in 1820. The plaiting ensures that the end of the wick bends over as the candle burns so that it is consumed by the flame's outer mantle. Complete combustion was aided by soaking the wick in a solution of an oxidising agent such as ammonium nitrate or potassium nitrate. This increased the light output and made snuffing unnecessary.

Town gas for lighting was used in industrial premises from the early 19th century and later in the home. Incandescent gas mantles were introduced and used widely from 1880 onwards. The mantle, originally made of cotton, was replaced by one made of collodion (soluble gun cotton). It was soaked in a mixture of rare earth solutions, mainly those of ceria, thoria and zirconia, to increase the degree of illumination.

The death knell for the use of some form of cotton in providing illumination came with the development of electric lighting early in the 20th century. Although electric lighting was quickly introduced into the larger cities its appearance in the smaller towns and the countryside was much slower. During the period 1919-31 the average household candle production was 40,000 tons a year, however this had dropped by 1948 to only 19,000 tons. In 2000 the output of candles had risen to 37,467 metric tons. Today candles are still used for illumination in the forced rhubard sheds around Leeds and Wakefield.

The other usage of the term "candlewick" as defined by the Oxford English Dictionary is a "*soft material, usually cotton yarn, used to produce a tufted surface, or a material embroidered with tufts of this yarn.*" A dialect term "bump" was used for a very coarse wool or yarn in Derbyshire, South and West Yorkshire and Westmorland, but not in North Yorkshire or Nottinghamshire. The dictionary states that the term "candlewick" was first used to describe a bedspread in the 1930 catalogue of the Chicago store, Sears & Roebuck. This does seem to be

very late. Certainly, there were several types of woven bedspreads to which the term "candlewick" was applied from the late 18th century onwards. All were woven on a wide handloom using thick white cotton, the "wicking", and had a formal geometrical design. These were also popular in North America in the period 1820-40. The effect was achieved in three main ways, namely, by tufting, by knotting, and by couching.

In the tufting method the wicking is worked through the base material using long running stitches. The stitches are raised above the surface by passing the loop over a small twig, or wire, or even the wing bone of a turkey. The "twig" is then removed and the stitch cut. The piece is then washed. The strands from the cut stitch shrink so that they stand out as a single puffy dot - the "popcorn" effect. Earlier examples are known of bedspreads made using similar techniques. One variety were called "caddows" or "Bolton quilts", after the town in Lancashire where they were made. However the loops were not cut. Examples can be seen at the museums in Bolton and in Ottawa, Canada.

The knotted bedspread was decorated with stitches such as French knots or bullion stitches using different thicknesses of wicking and numbers of strands. Other stitches were sometimes used such as satin stitch, cut or uncut; backstitch; stem stitch and outline stitch. The reverse sides of these bedspreads are a confusion of knots and threads.

For the couching type of bedspread the wicking was laid on top of the base material, usually in straight lines, which were sewn down at intervals with fine thread. Linen, rather than cotton was used at first. Bedspreads with five different weights of wicking are known. Details and straight lines were usually a single strand. Complicated designs used many yards of wicking resulting in a heavy bedspread.

To complicate matters even further many embroidered candlewick bedspreads are based on a ribbed foundation. This effect is produced by using candlewick warp threads at regular intervals in the weaving. This is one source of the confusion arising from the term "woven candlewick". Woven candlewick has a smooth reverse side as its distinguishing feature. The loom was threaded with fine white cotton and the weft shuttle contained the roving. Selected loops of the roving were picked up from the flat web by sliding a long slender stick – the "reed" – through them. While the reed held the loops up the weaver stepped on the loom treadle so that the harness rose and fell and the loop was encircled and held firmly by the warp. The reed was then pulled out, transferred to the next row of loops, and the whole process repeated. The raised loops gave the bedspread its familiar "bump" appearance. Sometimes a weaver would use two reeds of different diameters to create both deep and shallow pile on the same bedspread.

Twentieth century machine made versions have kept the shearing of the loops but discarded the embroidered designs. Such bedspreads are still made - in England, according to the label.

THE MILLS ON THE HOPTON BROOK

By David Poyner

Hopton Brook is a tributary of the River Rea (see Figure 1). It may be considered to start from the junction of Wellings Brook and Crumpsbrook, two small streams that rise from the marshy ground of Catherton Common on the east flank of the Titterstone Clee Hill. It flows some 6 miles through the ancient Shropshire parishes of Cleobury Mortimer, Hopton Wafers, Milson and Neen Sollers. It falls approximately 450 feet during the course of its descent, although two-thirds of this occurs during the first 2½ miles, prior to its entry into Milson. The most significant tributary joins in Milson. This is a brook formed from two small streams that flow from Hints and Coreley on the south-east flank of the Clee. Modern OS maps call the more northerly of these two streams "*Mill Brook*". However, the first series OS map uses this as a synonym for Hopton Brook and instead calls the tributary Hopper Brook.

The industrial archaeology of Hopton Brook was first recognised by L. C. Lloyd in his pioneering study of Shropshire paper mills; further useful work was done by A. H. Shorter. The late Ken Goodman in his Ph.D. thesis drew attention to the use of the stream to power iron works. Most recently, Tim Booth summarised information about all known mills in his publication on water mills on the Rea.[1] This article attempts to build on the work of Booth and is primarily based on field surveys conducted in 2003-4, supplemented by documentary work, particularly in the archives of Hopton Court. It is not imagined that the present study will be the last word on mills on this brook; however, it suggests the histories of some mills need to be revised and has revealed the existence of a number of new sites. The mills will be considering geographically, working upstream from the confluence of Hopton Brook with the Rea.

Sturt Mill (SO 654712).

As pointed out by the previous workers, the earliest reference to Sturt Mill is in an excise notice of 1816 when the paper maker was Henry Harris (who also features in Milson). In 1825 the mill was offered for sale; the occupiers were Joseph and Henry Harris who still had 16 years of a lease at 50 guineas p.a. to run. However in 1830 it was advertised to let; it included "*overshot wheel, capable engine, stuff chests, vats, pots, two drying rooms, store rooms and all other*

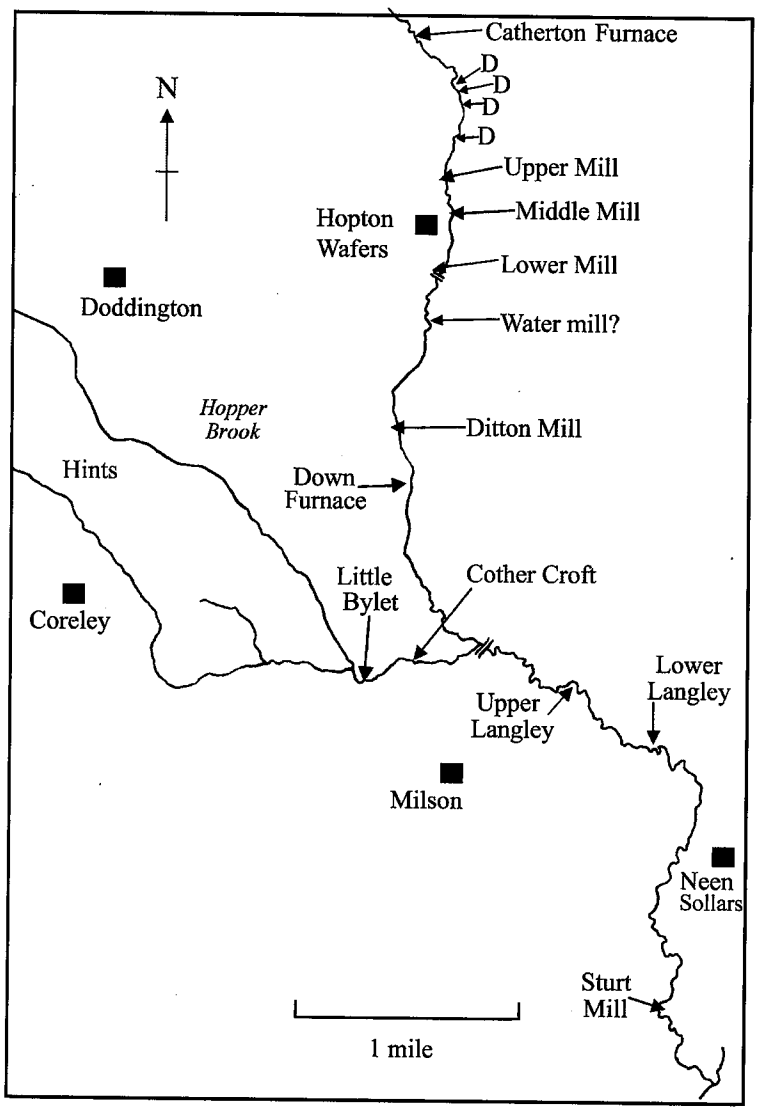

Figure 1. Hopton Brook and its main tributaries.

necessities for making brown paper".[2] It is likely that paper making ceased at this time. The mill is shown as an L-shaped building on the Milson tithe map of c.1840 next to two smaller structures. There is no suggestion on the map that it was used for anything at this date. However, by the time of the first series 1:2500 O.S. map in 1882 (see Figure 2), it was a corn mill, although now reduced to a

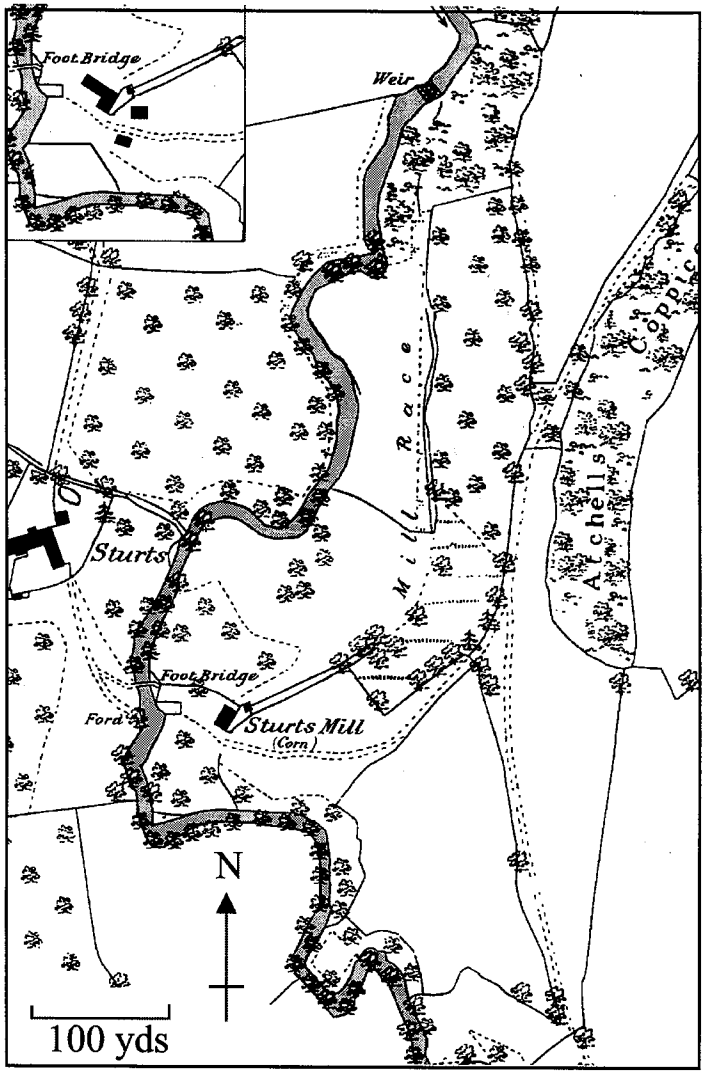

Figure 2. Sturt Mill. Main map; 1882/3 first Series O.S. 1:2500 map showing the mill. Inset, mill as it appears on the Neen Sollars tithe map.

simple square plan and with the adjoining buildings gone. Corn milling stopped around c.1910. Booth concluded that there had been an 18 feet diameter wheel that drove two pairs of stones via a lineshaft. The simplest interpretation is that the mill was built at the start of the 19th century as a paper mill and had a working life as a paper and corn mill of about 100 years.

The Mills of Milson.

The precise history of the mill sites in Milson remains unclear and so it appears best to treat the various mills collectively. The presence of a medieval mill in Milson can be inferred from the assessment of Richard "*the miller*" (le moliner) in the 1327 Lay Subsidy. The next documentary references are in the papers of Mytton family who held a scattered estate in the parish that they obtained via marriage. In 1589 Humphrey and Henry Bury sold to George Bishop a water mill and messuage in Milson, in the occupation of Richard and Margery Lewis.[3] It is tempting to assume this was on Hopton Brook or one of its tributaries, although some of the land associated with the sale was in the south of the parish, bordering Trapnell Brook that feeds directly into the Rea. A fine of 1651 mentions two water mills in the parish, in the possession of Richard Hunt.[4] Hunt had obtained some of his land from the Bishop family and when he died his widow Elizabeth married Henry Mytton. It seems that Henry gained at least some interest in her Milson estate. In 1661 he let a corn mill and other land to John Nash, reserving (amongst other things) the rights to fish pools.[5] In 1685, as part of the conditions of a bond between Mytton and Thomas Oseland of Hints, Oseland promised "*not to divert from the corn mill, now in the occupation of Francis Nash, the stream that runs between Hints and the said mill, except in times of great flood*".[6] In 1691, the Mytton estate in Milson was leased to Sebastian Legas of Dudnell in Cleobury Mortimer, excepting the water corn mill and a moiety of the fish from the mill pond.[7] Finally in this series of documents is an agreement between Elizabeth Mytton, widow of Henry and Henry Mytton junior, their son, dated 1705.[8] This includes a corn mill and a blade mill, both late in the tenure of Francis Nash. (A blade mill is a grinding mill, where scythes were sharpened via water power.) The mills were to be devised to a cousin of the family, Elizabeth Kinnersley. Exactly what Elizabeth did with these is not known; they are not mentioned again in the Mytton papers although the family retained its Milson estate until the 19th century. Either the mills did not revert to the Mytton family or they were quickly closed and abandoned.

The Mytton family estate owned land along the course of Hopper Brook. This is the most likely area in Milson where they could have owned water mills. As Hopper Brook rises in Hints, it makes sense with the 1685 bond between Mytton and Oseland. It has not been possible to investigate this land, but in 1765 it included a field called "*Little Bylet*" (SO 633734; see Figure 1) where the two streams from Coreley and Hints joined.[9] The name is consistent with proximity to a mill site. A little east of this is Cother Croft. This field was included in the 1661 lease of the corn mill and lands from Mytton to Nash. It is close to Hopper Brook, but from at least 1765, separated from it by a narrow strip of land (SO 636737). Conceivably this strip might have been the site of the mill, once owned by the Mytton's but later sold on. How closely the blade and corn mills

were related to each other is uncertain. The practical problem of having a grinding mill, with a constant shower of sparks next to a mill full of an explosive dust from corn suggests that there would have to be some physical separation.

At about the same time that Francis Nash held his corn and blade mills from Henry Mytton, the Shepheard family of Bitterly seem to have established a paper mill in the parish. Lloyd repeats a suggestion of H. E. Forrest that Richard Shepheard founded the mill before his death in 1659. The mill passed to his son John and then to John's son-in-law Richard Browne in 1728. In 1741 there was an agreement between a Richard Wilkes, plantiff and Ralph and Mary Saunders over the conveyance of land, building and a paper mill in Milson, presumably this one.[10] Lloyd records references to John Watsall (1733), "*paper maker*", Charles Nash (1760), "*paperman*" and John Nash senior (1774), "*formerly a papermaker*". Shorter records that in 1785 Elizabeth Hardman, paper-maker of Milson was made bankrupt. In 1816 Henry Harris was a papermaker at Milson although the next year Hugh Davies paid excise duty.[11] Although the mill is still shown on the published first series O.S. map of 1831, it is unlikely that it worked long after this, perhaps finishing at the same time as Sturt Mill. The first series O.S. map of 1835 marks a paper mill near Lower Langley Farm (SO 652731; see Figure 3). The simplest explanation is that this is Shepheard's 17th century paper mill (as suggested by Lloyd). It is not shown on the tithe map of 1840, presumably because it had gone out of work and been demolished. However, the field in which it stood is called "Paper Mill piece". Contemporary aerial photographs show a leat heading in this direction, across the field. The

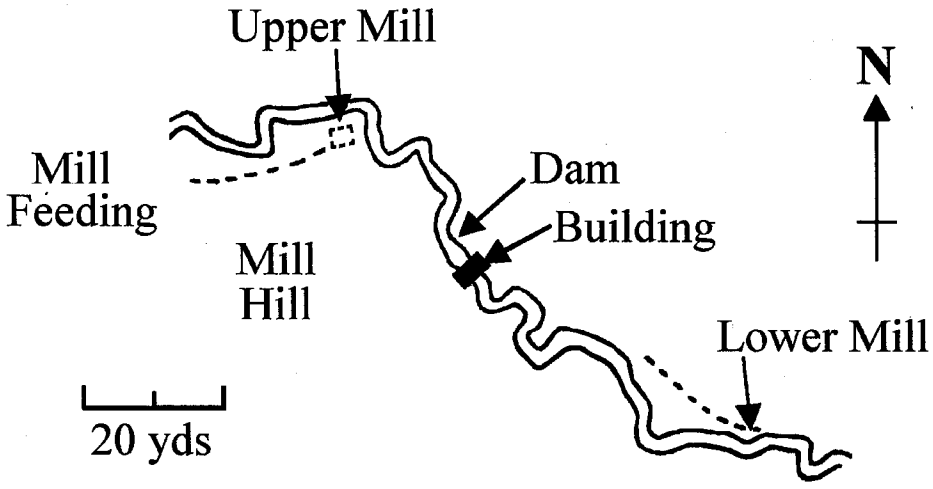

Figure 3. Langley Upper and Lower mills. Map based on field evidence, tithe and first series 1inch : 1 mile O.S. maps.

remains of a masonry dam can be seen upstream from this (SO 649733); it must have fed the leat. In 1937, Lloyd was able to identify remains of the mill itself; it has not been possible to investigate the site in the current project.

Interestingly the Milson tithe map marks a small building across the brook a little below the remains of the dam (see Figure 3). There are fragmentary remains of a brick wall in the bank of the stream at this point. Its function is unknown. The tithe map also records "*Millbrook Meadow*" and "*Mill Hill*" as field names, further upstream, near Upper Langley Farm. Above these are "*Mill Hopyard*", "*Mill Feeding Coppice*" and "*Mill Fielding*". Today traces of a leat can be seen crossing Mill Hill, probably originating in Mill Feeding and leading to a pit for an over- or breast-shot wheel in Millbrook Meadow (SO 647735; see Figure 3). This mill at Upper Langley is very poorly documented. "Mill Hill" is first recorded as a name in 1665, when it was sold with other land to John Shepheard (the paper mill owner) by Ursula Vaughan and associates.[12] The Mytton family owned land near Mill Hill, although by 1765, this did not adjoin the brook.[13] Thus the mill seems to have been in existence by the mid 17th century and gone out of use by the early 19th century. It could have been the Mytton blade mill which passed out of the family, it could have been Shepheard's paper mill (in which case the origin of Lower Langley becomes unclear) or it could have had another owner completely.

In summary, the documentary evidence points to three distinct mills in Milson at the end of the 17th century; a corn mill and a blade mill, both owned by the Mytton family and a paper mill on land of the Shepheard family. By the 19th century, there was a paper mill at Langley Lower Mill and this was probably the mill owned by the Shepheard's. The Mytton corn mill was probably somewhere on Hopper Brook. The history of Upper Langley mill remains to be established but it is a plausible candidate for the blade mill.

Coreley

The main waterway through Coreley is the Cornbrook. However, there is evidence that some use was made of Hopper Brook or another tributary of Hopton Brook. In 1662, one John Richards of Hints was granted liberty "*to turn the water at Broad Meadow style and use the wear (sic) which George Shepherd shall erect there ... to water the meadow called Between the Meadows, leaving sufficient water at all times for George Shepherd*".[14] The rest of the land in this deed is in the east of Coreley, adjacent to Milson and on the tithe map there is a Broad Meadow close to Hopper Brook. Richards was clearly working a water meadow; it is not clear if George Shepherd's weir was also for water meadows or a mill.

Down Furnace (SO 636748) and Ditton Mill (SO 635752)

Hopton Brook leaves Milson at Haybridge to enter Earls Ditton. Today the latter is divided between Hopton Wafers and Cleobury with the brook as the boundary, but originally it was a township that was considered as part of Cleobury; it extended from the brook to the summit of the Clee Hill. In the Middle Ages it was part of the Mortimer holdings and then the Earls of Arundell; in the 16th century it passed to Sir Roland Hayward and subsequently became part of the Craven family estate. By the 17th century two waterpowered establishments were present; a blast furnace by Down Farm and a corn mill just on the boundary with Hopton Wafers.

There is only one documentary reference to Down Furnace. This is the 1691 lease of the Mytton estate in Milson to Sebastian Legas.[15] It contains an clause "*that if he Sebastian Legas shall finally ... relinquish and forbeare his employment at Downe Furnace in the said county or if he Sebastian Legas shall place and settle himself and his family at any farme whereon he shall lay out by way of fine for lives or years the sum of £100*" he could end the lease, giving due notice. Dr Peter King, who first appreciated the significance of the reference, has noted that in 1662 the ironstone on the Craven lands was going to Andrew Hill,[16] who worked a furnace at Tilsop, several miles to the west of Down. Thus it seems unlikely that the furnace at Down could have existed at this date. However, in 1664 the coal and ironstone was leased to Richard Walker, ironmaster at Bringewood.[17] Whilst Walker probably took this lease to secure a supply of ore to Bringewood, it would have opened the way for him to construct another furnace nearer his mines. In 1690 the coal and ironstone mines on the Craven estate passed to Job Walker, of Bringewood and Bouldon furnaces.[18] Job went bankrupt in about 1695; Down was not amongst his possessions at that time.[19] In 1698 Earls Ditton was leased to Richard Knight, ironmaster, who also took over Bringewood. Knight granted parts of the coalworks to Andrew Hill of Tislop and also Matthew Baldwin of Farlow.[20] Baldwin had lived in the area for some years prior to this. Dr King has concluded that Down was probably built by either Richard or Job Walker after 1664; latterly it may have been sublet, perhaps to Baldwin. It had closed by 1715 as it is not mentioned in Hulme's list of ironworks.

Local parish registers offer opportunities for further speculation about the furnace. Sebastian Legas was living in Diddlebury (perhaps working at Bouldon Furnace) in 1688, having married Ann Littleton in Brimfield, Herefordshire (near Bringewood furnace) the year before. However in 1690 he baptised a child in Cleobury Mortimer and he features in Milson registers from 1692-6; he was churchwarden in 1694. It may be that Walker was responsible for the movement of Legas from Diddlebury/Bouldon to Down and that his disappearance from the registers in 1696 coincides with the closure of the furnace. This however is pure speculation. Cleobury Mortimer registers in 1682 record John Price

"*mettleman*". This term is consistent with a founder at a blast furnace or his assistant. It could also apply to a forgeworker and there was a forge in Cleobury. However, in all other cases, men employed there are called "*forgeman*" in the registers; indeed this is the term used to describe Price himself two years earlier.

The site of the furnace is obvious (see Figure 4). A shallow weir just below Ditton Mill must have served to direct water into the leat. This ran south for about 350 yards, parallel to Hopton Brook. It then must have worked a breast- or over-shot wheel, having gained a head of roughly 10 - 15 feet. A short tail race lead back to the brook. Faint traces of coursed masonry mark the furnace itself.

Down Furnace appears to have been a relatively short-lived venture, operating at the end of the 17th century. By contrast, Ditton Mill has seen a

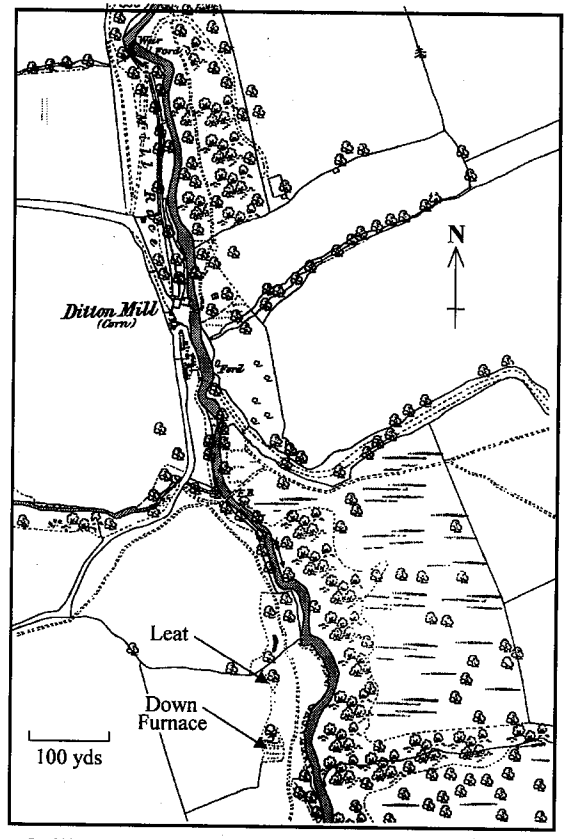

Figure 4. Ditton Mill and Down Furnace. Base map is 1882/3 1st Series OS 1:2500 map showing Ditton mill. The site of Down Furnace has also been indicated.

much longer history. However, for the most part it is not much better documented than its ephemeral neighbour. The first references to it come from the Cleobury Mortimer registers. This gives us a list of millers: William Allen, 1622; Thomas Price, 1623-5; Thomas Crundall, 1632; Richard Pugh, 1655-63 and James Meredith, 1681. The origins of the mill are unknown. The first lease that survives is from 1740, when Lord Craven leased it to Richard Dorsett of Detton for 21 years at £10 p.a., together with Detton Farm for £101 - 10 - 0.[21]

Nothing is known of the arrangements of the mill in the 17th century. However, in 1783 it was leased by Thomas Botfield from Lord Craven and Botfield recorded its valuation, carried out by Edward Rawlings on 27th May.[22] This included; a dressing mill and hoppers (£5 - 0 - 0); a French and a Welsh stone, making a pair (£12 - 0 - 0); a pair of grey "Flints" (£5 - 5 - 0) and a pair of Derbyshire stones (£4 - 0 - 0). The hoppers and hopper frames to serve the three pairs of stones was valued at £3 - 0 - 0. Botfield noted that French stones should be about 4 feet 4 inches in diameter and that Thomas Chine of Tewskbury would sell these at £30 for 5 feet diameter and £26 for 4 feet 6 inches. He also noted the name of a millwright, namely Cartwright, of Womborn.

Little further can be added to the account of the mill provided in Booth.[23] As noted there, the dismantled gearing remains outside the building, now a house. This shows that some modernisation was carried out in the 19th century, with the installation of an iron pitwheel and wallower by George Turton; presumably the wheel was also replaced. However its shaft and most of the other gearing and shafts were wood. The mill retained three pairs of stones; two pairs driven conventionally and the third by a bevel wheel engaging on the pitwheel.

The Mills of Hopton Wafers.

The most intensely worked part of Hopton Brook is the section that runs through Hopton Wafers. A field survey has recorded at least eight mill or dam sites. An important documentary source for the mills in Hopton is an abstract of title of Joseph Oldham to the Hopton Court estate.[24] Although not dated, Oldham held the estate from 1770 to 1779. The document starts with the marriage settlement of Dorothy Kennet in 1686, who married Richard Hyde, owner of the estate. This reserved "*three water corn girst mills in Hopton...*" to the use of Dorothy for her natural life, whilst "*paper mills and blade mills*" were to the use of the heirs of Richard and Dorothy. In 1708, the marriage settlement between Richard Hyde and Sarah Charlett refers to "*three water corn mills under one roof, two messuages, tenements and paper mills and all those messuages and tenements, scythe mills and fulling mills*" in the estate. A recovery of the same year lists two water corn mills, two scythe mills, two paper mills and two fulling mills, whilst one of 1744 includes three water corn mills, two scythe mills, two

paper mills and one fulling mill. The lists of mills in this document can be read in various ways, but at least four distinct mill sites are implied. Equating these with the mill sites found by field work is a challenging exercise.

The first mill site in the parish is at SO 638759. This was recorded by the Royal Commission of Historic Monuments.[25] An obvious leat provides a head of about 10 feet for a wheel; the water would have discharged almost immediately into the brook. The start of the leat is now obscure. A rectangular set of foundations probably marks the site of the mill. There is a smaller set of square foundations adjacent to this, set next to a shallow circular pit, of unknown function. The mill is not marked on the tithe map of 1839 (although the land is called "*Mill Ground*" and it is close to "*Mill Meadow*" and "*Mill Field*") and so had presumably been demolished by then. Indeed the mill is not shown on any known earlier map, including the 1815 preliminary O.S. drawings which is normally a good guide to mills working at that date. Thus it is likely this is the site of a mill that went out of existence by the start of the 19th century. A probable documentary reference is an advert in Berrow's Worcester Journal, 24th March 1774, for a set of water corn mills in Hopton Wafers. This was quoted by Booth where it was suggested to be Ditton Mill; however, Ditton was not in Hopton Wafers at that date. It is tempting to equate this to the "*three corn mills under one roof*" belonging to the Hyde family in 1680.[26] Indeed, the history of the site can probably be taken back further for in 1669 Hercules Hide was in possession of a "*Mill Farm*" and lands including Mill Hill and Mill Meadow.

Above the presumed corn mill are the sites of the Lower, Middle and Upper paper mills. They are clearly shown on the O.S. preliminary drawings as well as the tithe map and were documented by Lloyd in his articles. Lloyd based his account partly on published sources and also on the recollections of a nonagenarian resident of Hopton Wafers, Edwin Caldwell. He first noted paper making in 1723 when Sarah Hyde, wife of Richard, was killed in a paper mill. However, in 1669 Hide owned "*those papermills erected on two pastures called the Old Hamsalls*". This wording is consistent with the presence of the two mills mentioned in 1708 and 1744.[27] In the inventory attached to his will of 1720, Richard Hyde owned a stock of rags for paper making worth £152, implying that he worked the mills directly.[28] Lloyd quotes Beriah Botfield, writing in 1858, to show how in 1756 Mary Hyde leased the paper mills to Oldham; the latter went into partnership with Thomas Compson who became his brother-in-law. Documents at Hopton Court broadly confirm this. In 1762 Mary sold to Oldham the Upper Mill and the revision of the Middle Mill, held and occupied by Oldham under a 99 year lease. In 1770 Hyde sold the Lower Mill and the chief rent of the Middle Mill to Oldham. In 1771 Oldham sold to Thomas Compson the paper house "*formerly in the occupation of Edward Nicholls, late in the holding of George Newall and Richard Hyde*" and finally in the possession of Compson.

Edward Nichols, papermaker, is recorded in Hopton Wafers in 1743.[29] Thus first through lease and then purchase, Oldham gained control of the Hopton paper mills. Prior to Oldham, in 1744, there were only two mills; by 1762 there were three. It may be significant that in 1762 the Upper and Middle mills were sold to Oldham whereas the Lower Mill was not sold until 1770; perhaps the Upper and Middle mills were the original paper mills. Caldwell, in his recollections, recorded that it was the Upper Mill where Mary Hide was killed in 1723.

Lloyd noted how Oldham sold Hopton Court estate to John Hale of Bewdley in 1779 but Hale appeared not to have made paper, presumably leasing out the mills. The Hopton Court papers support this, for the Hale family leased a paper mill for a year to Henry Manning in 1801. The mill sold by Oldham to Compson in 1771 remained in Compson's hands until his death in 1808, when it was sold to Thomas Botfield in the following year. None the less, in 1803, Thomas Botfield entered into partnership with William and Beriah his two brothers, to make paper at the Upper, Middle and Lower mills in Hopton; presumably he had a lease on Compson's mill and probably purchased the other mills from the Hale family. The terms of the partnership were favourable to Thomas, for he was to be paid £200 p.a. as rent for the mills and if the profits from the partnership fell below 5% of the capital invested in the business, he could end the lease.[30]

The Botfield partnership agreement was for 21 years and in agreement with this, Lloyd (quoting Caldwell) states that the mills were taken over by three brothers, Richard, William and Henry Nichols in 1824. Caldwell claimed that Upper Mill was burnt down in 1826 and never rebuilt. However, Lloyd subsequently noted that in 1823 the Shropshire Quarter Sessions granted Thomas Botfield a rebate on duty he had paid on paper destroyed by fire. Thus the fire appears to have taken place at the end of Botfield's period of working the mills and may even have been why the mills were subsequently taken over by the Nichol brothers. It also seems certain that the Upper Mill was rebuilt; it is shown intact on the 1839 tithe map and was also included in a lease to the Nichols. According to Caldwell, Richard Nichols was never any more than a sleeping partner and when the lease for all three mills was renewed in 1838, it was only to William and Henry. The rents were £65 p.a. for the Upper Mill, £60 p.a. for the Middle Mill and £50 p.a. for the Lower Mill. However, shortly after this William and Henry became unable to pay. The mills were closed by 1841 as no paper workers are recorded in the census and in 1844 the brothers formally gave up their lease and all machinery in the mills.[31]

Lloyd was able to find little trace of the mills in 1936; however, his visit was in July and it appears he probably missed evidence due to summer growth. There are remains of the dam and the first few yards of the leat for the Lower

Mill at SO 639763 (see Figure 5). There are no surface remains of the mill itself, but a stone bridge (noted by Lloyd; SO 639762) across a minor tributary of Hopton Brook survives and gave access to the mill. The tithe map clearly shows a single pool and the main mill building. The Middle Mill (SO 639766) is harder

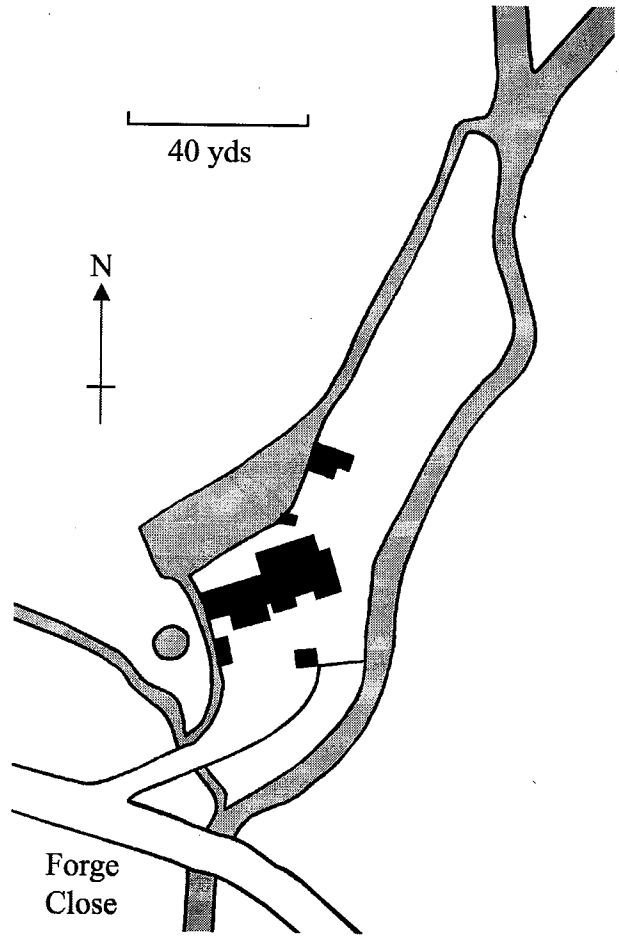

Figure 5. Lower Mill, Hopton Wafers. Based on tithe map of 1839.

to interpret (see Figure 6). The site was partly truncated in c.1850, when the road was diverted away from Hopton Court to run over the north end of the mill. Soil and rubble has also been dumped over the mill and in the pool. However, it is possible that if this were removed, there would be good survival of foundations. The tithe map shows upper and lower storage pools. The main mill was clearly at the lowest level but a building below the upper pond may have also housed

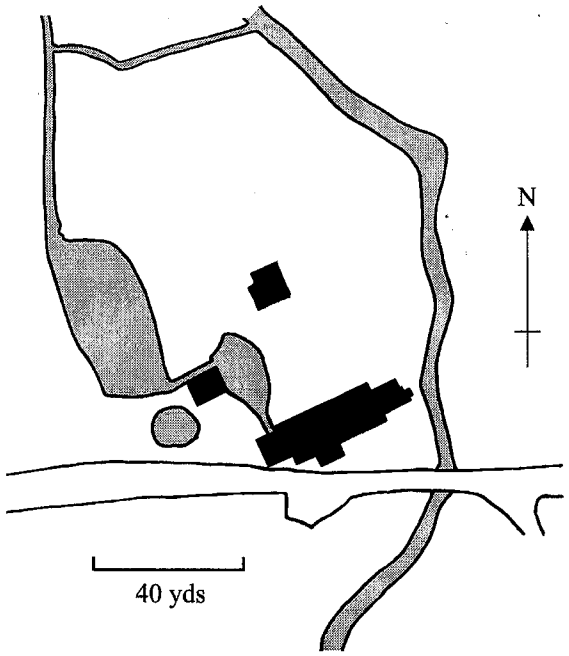

Figure 6. Middle Mill, Hopton Wafers. Based on tithe map of 1839.

a wheel. The leat leading to the upper pool is well-preserved, as are the lower course of the dam. The Upper Mill (SO 639768) is the best preserved site (see Figures 7 and 8). By the brookside is a substantial stone retaining wall about 10 feet high with a possible wheel-pit at its north end. Beyond this are a series of platforms and hollows. These can be interpreted in the light of the tithe map. The retaining wall supported a mill associated with the wheel pit. Behind it was a small holding pond to feed the wheel. There was then a second mill building whose wheel pit can also be identified. Finally was a larger holding pond fed by the leat from the brook. The small holding pond was also fed by a branch from this leat. To the south were other buildings whose sites are marked by slight hollows. The leat can be followed north to a dam (SO 640772). Thus certainly the Upper Mill and perhaps also the Middle Mill had two distinct mill buildings with wheels. A limestone quarry and kiln are found next to the Upper Mill; they probably post-date it.

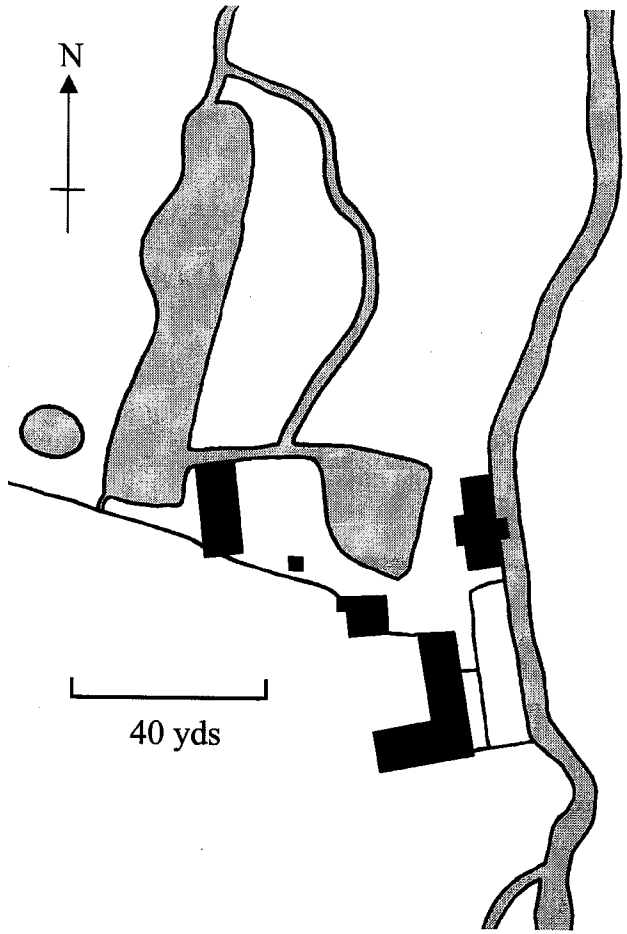

Figure 7. Upper Mill, Hopton Wafers. Based on tithe map of 1839.

The corn and paper mills of Hopton Wafers can be located relatively easily. The blade and fulling mills mentioned in the various 17th and 18th century documents are harder to place. Partly this is because of the nature of the documents; they are essentially copies of copies. Not only is there the chance of transcription errors but there is also the possibility of formulaic phrases being used which reflected a reality long gone when they were copied. In fines and recoveries, it was only important not to understate the extent of the property; a single mill that had seen several uses could easily find itself described as though it was two distinct enterprises, still in operation. It is difficult to even hazard a guess as to the location of the one or two fulling mills. Was this a single mill with

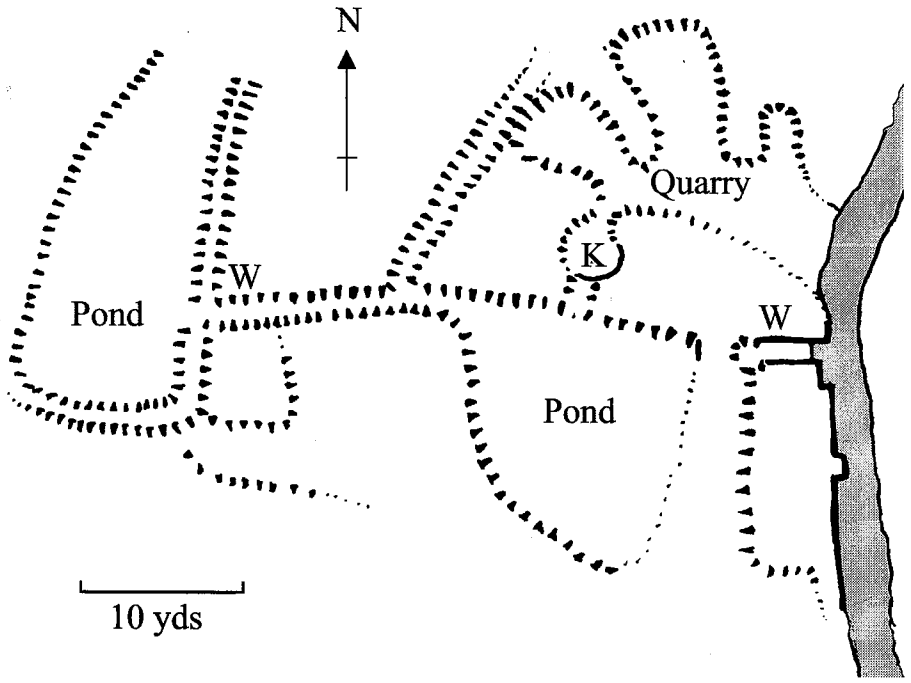

Figure 8. Upper Mill, Hopton Wafers. Current remains. W = Wheelpit, K = Lime kiln. (The site of the southern buidings was not surveyed.)

two wheels or two distinct mills? The most economical explanation is that it was on the site of one of the paper mills and was subsequently converted. Fulling mills proliferated in the Middle Ages and subsequently declined as cloth making became concentrated in particular regions. None the less, a fulling mill did survive on the Rea at Wrickton, Stottesdon in the 18th century, providing some context for the Hopton examples.[32]

A little more can be deduced about the blade mills. By 1674 Hercules Hide owned a blade mill which he leased to a William Hughes. From at least 1669 there was a "*Forge Close*" in Hopton. A map of 1819 shows that this was just south of the Lower Paper Mill, immediately below the bridge which the 18th century Ludlow-Cleobury turnpike uses to cross the brook.[33] A forge is a site where the brittle cast iron from a furnace is turned into malleable iron by a complicated remelting and hammering process (requiring water power). This creates slag; however, there is no significant evidence of slag at this site or downstream, suggesting that if it worked as a conventional forge, it left no trace (but see below). It is possible that the field takes its name from the mill that later

became the Lower Paper Mill and prior to that it was a blade mill. In 1682, in a grant of land in the possession of a Widow Harris to Richard Baldwyn, Hercules Hyde reserved "*one blade mill and warehouse then standing or being on a close called the Mill Close*".[34] If Mill Close was near the water corn mill, this would fit with the blade mill on the site of the Lower Mill. The reference to the warehouse might also be significant; by the time of the tithe map, Forge Close was called Warehouse Meadow. There is independent evidence of a scythe-making industry in Hopton until the early 18th century, for in 1711 Richard Tolley, scythesmith, made his will. It seems likely that the industry ceased by the middle of the 18th century and the mill(s) were converted to paper manufacture.

It would be unwise to exclude the possibility that Forge Close once was the site of a forge. The absence of significant amounts of slag is not impossible, as it might be almost completely removed for use in road making. With a number of furnaces operating around the Clee Hill (Down, Tilsop and Catherton; see below), a forge might have seemed an attractive proposition, albeit it would have to work in competition with forges at Cleobury. A failed forge could be converted to a blade mill.

Upstream of Upper Paper Mill, the valley of Hopton Brook is marked by a series of dams and former water courses. The dams are at SO 639772, SO 640775, SO 639786 and SO 639787 (see Figure 1). Above the first of these is what looks like a water channel, but it is far above the present course of the brook. The middle two dams are stone. Only the final dam is shown on any map; it is on the first series O.S. preliminary drawing and the tithe map, where it is seen to be the source of the leat for the Upper Mill. This dam is by far the biggest of all those on the brook. Above it is another straight gully that looks like it was once a water channel but there is no sign of any dam associated with it. There are suggestions of leats leading from all of the other dams. The large dam is the only one that features in the documentary record; in 1664 Hercules Hyde sold land in Hopton and Cleobury to William Pountney of Heath Hills, Cleobury "*excepting to Hyde free liberty of egress and regress from one pond and one weir in the premises, with liberty of digging on the east side of the pond to mend the weir and to draw and to fish the pond at all times*". The large dam is close to Heath Hill and is between Cleobury and Hopton and so is almost certainly the structure reserved in this lease.[35]

Whilst the role of the large pond, to serve the Upper Mill, is clear, the function of the other three ponds, between it and the Upper Mill is less certain. They may relate to earlier phases of the history of the Upper Mill or they may have been holding ponds, to store water for the other mills downstream. None-the-less, it cannot be excluded that they might have been associated with mills that have now disappeared; this can only be resolved by more fieldwork.

Catherton Furnace

Above the Big Pool, Hopton Brook eventually enters Catherton; originally part of Earls Ditton or Doddington but later incorporated into Cleobury Mortimer. These upper reaches of the brook were the subject of particular scrutiny by Goodman.[36] In about 1540 the antiquarian John Leland visited the area. He wrote *"There be some blo shoppes to make yren apon the ripes or banks of Mylbroke, comynge out of Caderton Clee or Casset Wood"*.[37]

Goodman considered that this best fitted the description of Hopton Brook just below Knowle Wood, near Heath Hills. Most workers had considered that Leland was describing water-powered bloomeries to make iron. In this process the iron ore is heated to a sufficient temperature to liquify the slag but the iron itself remains in the solid state, as a spongy mass. This is then consolidated into a bar (or bloom) by hammering. In a powered bloomery either (or both) the bellows and the hammer would be worked by water. Goodman's thesis was that a *"blo shop"* was a blast furnace. These were first introduced into England at the end of the 15th century, but by 1540 they had yet to move out of the Weald, the chief iron-making district of the day. Goodman was rewarded in his searches by a large quantity of blast furnace slag by Hopton Brook just below Heath Hills, at SO 638777. This was from a charcoal blast furnace.

In spite of the presence of slag, some have been unconvinced of Goodman's claim for a 16th century date for the furnace,[38] pointing out that the slag could have come from a 17th century furnace. Furthermore, the exact site of the furnace remained unidentified. The current survey has been able to locate the furnace (see Figure 9). The bridge (used to transport ore and charcoal into the top of the furnace) survives as a fragmentary course of masonry, built into the east bank of the valley, about 200 yards from the current course of the brook. Nothing can be seen of the furnace structure itself but it would have been immediately beyond the bridge. To the north of the furnace, faint traces of a building platform can be seen; perhaps a charcoal barn. The furnace would have been blown by water-powered bellows. Just to the north of the furnace, very slight traces of a leat can be seen, contouring round the hill. These become progressively clearer until just to the north of the proposed charcoal barn the leat runs on an obvious ledge cut above the brook. After a few more yards it ends. There is no trace of a dam; it may have been washed away or the leat may have been extended a few more yards via wooden launders into the brook. A scatter of late 17th century pottery and a clay pipe were noted around the furnace; no earlier pottery could be seen. The furnace itself can be dated via the will of William Edwards of Heath Hills, Cleobury Mortimer. This was made August 20th, 1643: in it, Edwards is described as *"founder"*. This must mean that he worked at the furnace, on the casting floor. In all probability the Richard Maddockes *"fownder at the furnace"*

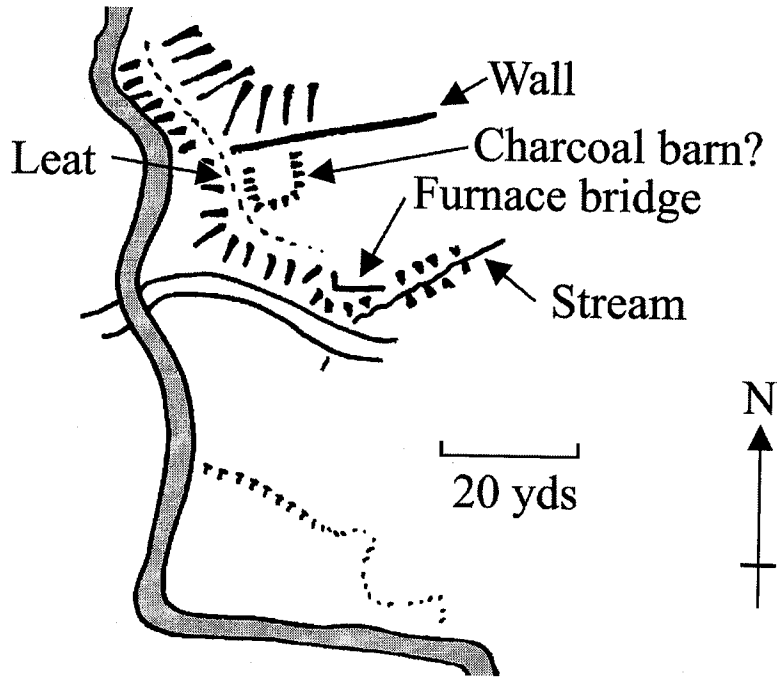

Figure 9. Catherton Furnace. Current remains.

who baptised a daughter at Cleobury in 1633/4, also worked at Catherton. The owner of the furnace is unknown; it stood on land belonging to Sir Francis Lacon who also had interests in south-east Shropshire but it may have been sub-let to another party; perhaps one of the Blounts or the Walkers, local ironmasters of this date. Thus the documentary evidence points to the furnace working in the second quarter of the 17th century; there is no documentary or field evidence to support an earlier date.

Conclusions

Hopton Brook has been an important power source from at least medieval times to the 20th century. This survey has identified a minimum of 11 waterpowered sites. Only three of these can be shown to have originated as corn mills, although others may later have been converted to corn milling. The Clee Hill area is not good quality arable land and so there would have been relatively little call for corn milling. Consequently the sites were predominantly industrial, with five paper mills leading the way. Taken with the two paper mills found on the Rea near Cleobury Mortimer, it can be seen that this was one of the chief paper-making regions in Shropshire in the 18th and early 19th centuries.

However, prior to paper making, it was the iron industry that dominated the brook, particularly in the 17th century, with two blast furnaces and at least two blade mills. As with the paper manufacture, Hopton brook was at the centre of a larger concentration of industry. From the late 16th century there were two furnaces and two forges in Cleobury, a blade mill in Neen Savage as well as another furnace at Tilsop. Whilst not all of these were particularly long-lived, they show the importance of iron production and working in this area in the Early Modern period. It is possible to identify 13 scythe smiths working in Cleobury and Hopton from wills and parish registers from the late 16th to the early 18th centuries; this was an important local specialty. Clee Hill iron was considered to be of good quality and this may explain why it was favoured by these craftsmen. It was only when charcoal iron smelting moved away from the Hill in the 18th century that the metal trades ceased. For a period, the area may have rivaled the North Worcestershire and Staffordshire scythe makers. However, the demise of metal working allowed paper manufacture to establish itself; the area was dynamic and could produce new water-power-based industries. Possibly the fulling mills in Hopton point to a period prior to the blast furnaces, where the cloth trade was as important as the early iron industry with its bloomeries.

Much remains to be discovered about the mills of Hopton Brook. A particular challenge is for the medieval period. Only one medieval mill has so far been established. However, in c.1540, Leland called the brook "*Mylbroke*". Where were these mills and what were they used for? The survey also found no trace of Leland's "*blo shoppes*"; these bloomeries require identification. The sites of mills both in Milson and Hopton Wafers still need to be established. In particular in Hopton it is uncertain whether the known mill sites can account for all the documented mills. The functions of the dams in the parish is also an outstanding problem. Fortunately there is good survival of remains along most of the brook; the archaeological potential is high. It is also likely that more documents remain to be discovered; for example, no serious attempt has been made to investigate medieval sources.

A further site visit to the upper part of the brook was made by myself and Tim Booth on 29th December, 2004. Two hydraulic rams were noted in-situ at Hopton Court at SO 639764 and SO 640764. A modern concrete weir, at SO 639765, includes remains of an older, stone structure. The retaining wall at the Upper Mill may include work of more than one phase, with a possible extension at its northern end next to the putative wheelpit. The site has had a complicated history. A piece of bloomery slag was also found in the bed of the brook, immediately upstream of the retaining wall.

It is hoped that this article may inspire further work on the mills of this brook.

Acknowledgements

I am grateful to Dr Peter King for comments on this article, many discussions on iron working and allowing me access to his unpublished data. I would like to thank Mr Chris Woodward of Hopton Court for allowing me access to his land and to the documents in his collection.Dr. David Higgins and Mr. David Barker, Stoke-on-Trent City Museums, advised on the dating of artefacts from Catherton Furnace.

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