'The Machine': A Boat Lift Mystery Solved?

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The operation of canal locks requires a large quantity of water, doubled when the waterway crosses a summit with lock flights descending in two directions. Water was a valuable commodity in an era when even the smallest streams could power a succession of mills, and there is no doubt that the supply problem was a severe constraint to the spread of the canal system, with many minds being exercised in finding a viable alternative method of moving boats from one level to another. Ideas for watersaving locks, vertical lifts, or inclined planes proliferated during the canal mania of the early 1790s, but all the lifts that were built at this time were experimental and failed to supplant the use of ordinary locks for sustained commercial operation.

The sites of most of these devices are well recorded, but speculation still surrounds that which is known to have been built for the use of the Ellesmere Canal, and this article aims to bring together the limited data concerning it and to assess the likely location.

Origins

A newspaper report of 1790 tells us that:

Mr Duncombe, Engineer to the intended canal between the Severn and the Dee, has invented a method of raising Boats of any tonnage to the highest summit whatever, and letting down the same without loss of water, with perfect safety and more expedition than by the common Water Locks now in use. What is more remarkable, a loaded or unloaded boat can come up while an unloaded one goes down ... and the whole is performed by a uniform unaccelerated motion.¹

The canal referred to is the Ellesmere scheme, the early history of which has been dealt with elsewhere.² John Duncombe, an engineer from Oswestry, carried out the initial surveys, but of his invention we know nothing more than the bare facts quoted above. It may have been an inclined plane or a vertical lift, but he clearly envisaged two counterbalanced cradles or caissons. Whether this proposal developed further, or influenced later events, is a matter for speculation.

Three years later, Letters Patent were granted for An Improved Method of Constructing Navigable Canals without the Use of Locks or Inclined Planes, and whereby most of the Objections to and Inconveniences arising from Canals are effectually removed.³

The patentees were Edward Rowland and Exuperius Pickering. Rowland lived at Plas Bennion and was a subscriber to the canal, sat for many years on the Committee, and owned land and collieries near Ruabon. Pickering similarly was involved with mining in the area. Both would have known Duncombe.

Description

The principle of the device as set out in the patent was straightforward. A 'cradle' or water-filled open caisson just large enough for a boat and with gates either end was supported on wood or iron pillars attached to an airtight 'diving chest' submerged in a well below. When a boat entered the caisson it displaced its own weight of water, so the load on the pillars was constant: the size of the diving chest was so arranged that its buoyancy equalled this load. The whole could then be easily moved up or down by a simple rack and pinion. Pulleys and counterweights could be added if needed to take some of the load and reduce the size of the diving chest.

The same principle was successfully used a century later for the much larger Henrichenburg and Rothensee lifts in Germany.

The model

In the Waterways Museum in Gloucester is a scale model boat lift which is clearly related to Rowland & Pickering's design. It appears to be of some age, and has both a diving chest and pulleys for counterweights, and is complete with a wooden narrow boat. There is an unusual arrangement of gates. Unfortunately the provenance is not known,⁴ and it is difficult to decide whether all the elements are original or whether there have been later changes.

It is clearly not a copy of the Ellesmere Canal lift, which had a much smaller rise; the best guess is that it was a demonstration model made around the time of the patent application to show the principle. The patent does refer to 'our models'.



The model in the Waterways Museum, Gloucester, said to be of Rowland and Pickering's lift. Because the mechanism is hydrostatically balanced, very little effort is needed to raise the caisson when the windlass handle is turned, the two vertical strings are wound onto the horizontal roller, and the caisson (which in the model contains a boat) is raised. The four pillars act as guides for the ascending caisson, with rollers minimising friction. The four wheels (one is hidden in the photograph) are optional; ropes attached to the caisson at one end could pass over these wheels to weights, which would reduce the size of the diving chest necessary. However, the patent states that balancing by weight had been found to cause greater friction in the model. The water in the canal is retained using a conventional mitre gate, as can be seen; there is a similar one at the upper level.

(Photograph: Howard Paddock)

The experimental lift

At an Ellesmere Canal Committee meeting on 4 December 1794 at which Rowland was present, it was minuted:

Ordered that Mr Telford do as soon as he conveniently can point out a place on the line of the Canal between Pontcysylltee and Chester for Messrs Rowland and Pickering to erect at their own expense a Machine for raising or lowering Canal Boats without locks and very little loss of water the said Messrs Rowland and Pickering referring themselves to the Committee to pay for the said Machine if it answers to their satisfaction and if not the undertakers to be at the whole expense.⁵

In addition to the formal record made by the clerk, we also have the slightly different version of the agreed arrangement in the notebook of a committee member who attended the meeting:

Ordered that Mr Telford point out a place (as soon as possible) between Cysyllte and Chester for Mr Rowland and Pickering to erect a machine for raising and lowering canal boats without a lock and with very little loss of water — Mr Rowlands to bear the whole expense of trying the experiment and if it answers will expect to be paid as shall be agreed upon at the meeting ... prior to his commencing the erection of his machine.⁶

Thomas Telford was the company's newlyappointed General Agent, and this direction must have caused him some difficulty, for the canal proposals in the area were in a very fluid state at that time. Clearly a suitable site must have been found to allow building to start fairly soon after, as we learn from a newspaper advertisement in May 1796 that:

The Patent Machine for raising and lowering Boats without Loss of Water (instead of Locks) is erected upon the line of the Ellesmere Canal, near Ruabon, in the County of Denbigh, and is in that State of Forwardness, that a trial has been made with success. The Proprietor will, for the Inspection of Engineers, have the Machine in Motion every Monday and Thursday Evenings, at four o'Clock. Letters for information addressed to the Patentees Messrs Rowland and Pickering, Ruabon, near Wrexham, North Wales, will be duly answered.⁷

It is likely to have caused considerable interest, and several engineers took the trouble to inspect it, but little record has survived. John Rennie wrote later that year to James Watt;

Having some branches of canal to execute from the Grand Trunk to the Potteries in Staffordshire where there will be a great difficulty in obtaining a sufficient supply of water — It occurs to the Proprietors that the machine of Rowland & Pickering might be adopted with advantage — they accordingly desired

me to examine it & report my opinion thereon — I went to Ruabon last week & saw the machine — but have not yet determined my report. I understand you have seen it & as my own opinion is not very favourable, you would greatly oblige me by saying what you think of it — the principle of it is certainly perfect — but it seems to me not only liable to be frequently out of order; but requires a nicety of adjustment which will be difficult to be done by the kind of men who are to use it.

It is rather more expensive than locks, & as it has four sets of gates to keep water tight its leakage will be greater, & as generally speaking the waste of water on canals is nearly double what is used for the passing of boats through the locks, the saving of water will not be so great an object as is generally imagined.⁸

Watt replied that he had not seen the machine working, and had reservations regarding its adoption



The lift at Rothensee (near Magdeburg) uses the same principle as in Rowland and Pickering's patent. It is shown in its raised position, with the diving chest just visble in the floation tank. (Photograph: Peter Brown. The lift ceased operation a few months after this photograph was taken in 2005.)

until properly tested.⁹ He thought the probable defects were the raising and lowering by racks, which he thought would be better achieved by letting water in or out of the caisson, the chances of expensive repairs to leakages in the trough and caisson, and the greater number of gates to open and shut. He did not think that gate leakage would be a problem as they were not so deep as locks and were hinged with leather at the bottom. [This may suggest the use of drop gates falling into the channel.] His assistant James Southern had been with him at the time, and a draft of his comments has survived:

To execute the principle well is a matter of considerable difficulty. In many situations it is not applicable on account of the necessary drain for the casson pit. Would become very expensive in above 15 or 18 feet lock and perhaps altogether ineligible. I think (but from slight consideration of the subject) — it may be advantageous in heights of 12 feet, & under as far as it is applicable. The leakages being the same in this & a common lock, (& I believe they would not be greater though there are more gates) its advantage may easily be ascertained when the daily number of tons locked up & down is given. If more tons descend than ascend through the lock, water will be raised equal to the difference of tons — & vice versa.

It is possible that William Chapman or one of his correspondents also saw the lift, as it is referred to in his 1797 book:

This plan, which possesses ingenuity, and is applicable in many instances, is now carried into execution on the Ellesmere Canal, near Ruabon in Denbighshire; on a fall of 12 feet, and for boats of 70 feet length, and seven feet width; and the whole is moved up and down by a rack and pinion towards each end of the machine.¹⁰

No more is heard of this device, and by the end of the century the Ellesmere Company had effectively abandoned any intention of continuing their waterway north of Pontcysyllte. However, the lift experiment was unfinished business, as recorded in two Ellesmere Canal Committee minutes in 1800:

Messrs Rowland and Pickering having applied to this Committee for a compensation for the expense of erecting their Patent Machine upon the Canal in the terms of the order of the Committee made 4th December 1794 It is Ordered that professional Men be consulted whether the Machine has been constructed in principle Materials and Execution so as to be likely to answer the purpose intended in its present situation and Mr Jessop and Mr Rennie having examined the Machine It is Ordered that Mr Potts do write to them desiring their opinion on the subject.¹¹

And:

Upon reading the several orders of this Committee

of the fourth day of December One thousand seven hundred and ninety four and the twenty fifth day of June last past relating to a machine proposed by Messrs Rowland and Pickering to be erected on the Ellesmere Canal for raising or lowering Boats without Locks and also the letter of Messrs Jessop and Rennie of the fourth day of August last as to the utility of the said Machine and Mr Pickering's letter to Mr Rowland of the twenty fifth Instant relating to the loss Messrs Rowland and Pickering had sustained by the erection of the said Machine It is Ordered by this Committee that the sum of Two hundred pounds be paid by this Company to Messrs Rowland and Pickering towards the loss they have sustained in erecting the said Machine It appearing to this Committee that a sum of eight hundred pounds and upwards has been expended by Messrs Rowland and Pickering in erecting such Machine and that after converting the materials of the said machine to any other purpose there will be a loss of four hundred pounds and upwards sustained by Messrs, Rowland and Pickering on that account.12

The payment was duly made,¹³ but the letters referred to have not survived, and there is no significant information amongst the Rennie Papers.¹⁴

Probable remains

As Charles Hadfield wrote:

Perhaps somewhere along the ghostly line its inexplicable remains still stand, waiting to be found.¹⁵

For a narrow canal the patentees estimated the total moving mass to be 50 tons, requiring a diving chest of 1,800 cubic feet in a well 10 feet wide and 45–48 feet long, and perhaps 20 feet deep, which would have to be carefully built in brick or stone with framing either side, reaching above to the height of the upper canal, to guide the moving part, and rollers to eliminate friction. 'Dogs or screw bolts' would be used to secure the caisson to the end of the upper or lower canal so that the appropriate gates could be safely opened.

Assuming that all timber and ironwork would have been recovered later, stone- or brickwork would be the most likely remains, together with evidence of the well which would still survive even if infilled.

The canal scheme

We can assume that the position of the lift was fixed in consultation with Telford early in 1795. Before trying to identify this location it is necessary to look at what route for the canal the company had in mind at that time.



Ellesmere Canal schemes, Cefn Mawr and Ruabon

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The project as approved in the 1792-3 parliamentary session¹⁶ was based on the alignment set out by John Duncombe which had originally been designed with a continuous summit level from Frankton to Wrexham, necessitating a long tunnel under Ruabon [A-B on the map]. However, by this time it is known that the company had already decided on major revision¹⁷, including the saving of expense by locking into and out of the Dee Valley to reduce the height of the river crossing as recommended by Jessop, and a higher level route for the northern part of the canal which would avoid the long tunnel. In doing so the company were constrained by their Act¹⁸, which prevented entry without consent on any lands of Sir Watkin Williams Wynn to the east of the turnpike road between Ruabon and Newbridge.19 This was the walled area of the extensive Wynnstay Park.

North of the Dee the revised route, as shown on the plans deposited in November 1793²⁰ for the 1794 Session [C–D–E–F–G–J], looped around Cefn Mawr climbing to the new summit level, keeping to the north-west of the turnpike by means of a deep cutting [F–G] near Plas Madoc. This application was not taken forward following Jessop's advice that further work needed to be done on the surveys.²¹

The cutting, whilst a significant improvement on the previous tunnel, would have involved the disposal of large quantities of surplus spoil and was an expense which it was desirable to avoid. The Chairman was asked by the Committee in January 1794 to apply to Sir Watkin's agent for consent to take the canal to the east of the road. Some progress must have been made, for at the July committee meeting Telford was given further instructions to approach him 'as it appears likely that such application will be favourably received'. The proposal then was for a deviation carrying the canal 'to the east of Wynnstay Park upon the banks of the River Dee without having any connection with the lands adjoining'. Whether this was intended to be east of the turnpike and roadside wall, or literally skirting right around the eastern limits of the Park, is not clear, but the latter would have been very circuitous and most unlikely. Telford produced a general plan of various Pontcysyllte to Chester routes at the August meeting, which unfortunately has not survived, and the Committee opted for the 'brown line' subject to Jessop's approval, as this would be 'the most eligible and will be attended with less expense than either of the other lines'.

From the above it may be inferred that at the critical time the position of the experimental lift was decided, Telford was in discussion with Sir Watkin Williams Wynn or his agent, and that a line through his Park to the east of the main road was in contemplation. Examination of a modern contour map suggests that a simple variation of the line [E–G], would have sufficed, but on this elevated slope it would have been an intrusive element in the landscape as viewed from Wynnstay Hall. The canal would have benefitted Sir Watkin, who owned considerable local mining and industrial interests, but it is understandable that he would wish to protect the amenity of the park which had only recently been landscaped with the assistance of Lancelot 'Capability' Brown.

We can speculate that a more acceptable solution, despite it being nearer to the Hall, would have been to continue the lowest level of the canal around Cefn Bychan and into the Park concealed in a small wooded valley [D–H], then locking up and following the lowest land to rejoin the earlier line at Ruabon [H–G].

There is no further mention in the records until July 1795 when Jessop reported on 'the different lines improvements and variations of the Canal and the different Branches thereof'.²² It is clear from this that the preferred line was now again west of the road, and not interfering with Wynnstay Park. The change of heart may have been associated with the concurrent decision to revert to a high level aqueduct at Pontcysyllte as the cutting spoil would be useable for the approach embankments, and there was also a desire to provide better access for the Acrefair Collieries as evidenced by Jessop's recommendation of a branch there from the summit level. The deviation [C–K–F–G–J, with the branch K–L] was authorised in 1796.²³

Location

According to the committee minute of December 1794 the lift was to be sited between Pontcysyllte and Chester, and all the written evidence refers to it being 'near Ruabon'. With these constraints it is possible to dismiss several possibilities:

Frankton: Tom Rolt suggested that the experiment took place at Frankton Locks in Shropshire, primarily on the fact that this was one of the earliest parts of the canal to be built.²⁴ Despite the appropriate topography and fall of the top lock, and the mystery of why a staircase pair was built when water was known to be in short supply, this location can be discounted as it is not between Pontcysyllte and Chester, and is many miles from Ruabon.

Fron Cysyllte: South of the Dee several locks were proposed, between Fron and the intended low level crossing of the river. This was just outside the 'between Pontcysyllte and Chester' criteria, in Llangollen Parish, and nearly three miles away from Ruabon, and is therefore an unlikely site. Any works here would be buried under the later canal embankment.

Wrexham: The long fall from the north end of the summit level to the Dee at Chester might be a candidate, save that the nearest possible location to Ruabon would have been over four miles away, and any reference would surely say 'near Wrexham'

This reduces the search to the length near Cefn Mawr where the canal needed to gain nearly 100ft in height from the proposed level of the Dee crossing to the summit — probably about 12 locks. This is all less than two miles from Ruabon and within that Parish. On the November 1793 alignment, most of the lockage would have been on William Mostyn Owen's Plas Kynaston Estate [East of point D on the map]. Owen was one of the original projectors, a shareholder and committee member, and would no doubt have been willing to facilitate the work even though no statuory authority was yet in place for a revised route. However, such a location, on the southern slope of Cefn Mawr, would have needed considerable earthwork to achieve an abrupt rise of 12 feet, and there is no cartographic evidence of this, nor is there any natural supply of water. Even at this early date the estate was riddled with mine workings, which would be an adverse factor in siting large and expensive structures that could easily be ruined by fairly minor ground movement.

Home Farm

If the Wynnstay Park route has been correctly identified, then a number of factors suggest the focus of attention should move to the area of the later Home Farm:

- There is a sharp rise in the ground as the likely canal route leaves the valley, which would involve four or five locks.
- The nearest main community is Ruabon Village, less than a mile away.
- The earliest Ordnance Survey of the area dated 1837²⁵ marks a smaller building on the site of the farm with the name 'Machine'. Whilst this may be coincidence, it is worthy of note that all the documentary evidence refers to the lift with this name.
- A supply of water was available from a small stream falling into the valley. An artificial pond



Site of 'The Machine', looking north, 2007 (Author)



Site of 'The Machine' (Base map Ordnance Survey 1911)

or reservoir was located just above the Machine and may initially have been fed by this stream, although the estate map appears to show a leat or culvert bringing water from the Afon Eitha above Ruabon, partly along the probable canal route [H-G]. By 1819 a length had been opened up to form the small ornamental lake which still exists, and a further small reservoir was later built above the first.

• An early 19th century map of the Wynnstay Estate²⁶ shows the same building and calls it 'Threshing Machine'.

The 'Machine' building, about 13ft x 52ft on a roughly north-south orientation, survived until comparatively recent times, and was the nucleus of a range of Victorian agricultural buildings which developed into the Wynnstay Estate Home Farm. Many of these survive, some in a derelict condition (and are worthy of further research and investigation in their own right).²⁷

Some of the stone work of the farm buildings appears to be recycled, and bears evidence of a previous use. It may, of course, have come from the old Hall, which was demolished after a major fire in 1858.

Speculation

If the 'Machine' was indeed the site of the lift experiment, removal would have left a large brick or stone chamber, with a supply of water, and it is conceivable that this would have formed the ideal site for the installation of a water-wheel powering threshing and other agricultural equipment. If the leat from Ruabon had not already been built, it may have been provided then to augment the supply.

Conclusions

It seems to have soon become clear, perhaps even before construction began, that the lift in its chosen location would not be needed by the canal, but it was nevertheless built and tested, and probably worked well enough — the company would not have met half the builders' loss had it been a failure. Set against that, they or others in the canal establishment were clearly not sufficiently impressed to arrange for its adoption elsewhere.

In regard to the site, only the emergence of firm documentary or archaeological evidence will settle the matter, but hopefully this article may narrow the field, and bring to light further information.²⁸

Notes and references

- 1. Derby Mercury, 6 May 1790. Quoted in RCHS Journal, March 1976, 20
- 2. Richard Dean, 'The Metamorphosis of the Ellesmere Canal', *RCHS Journal*, November 1985, 228
- 1 April 1794 (1794 No 1981), Construction of Navigable Canals
- The Waterways Trust advise that this model was donated to them by Southampton Museum who have no record of its source, but believe it had been with them at least since the 1920s.
- 5. National Archives, RAIL 827/1
- 6. John Knight's notebook: Shropshire Archives
- 7. Aris's Birmingham Gazette, 16 May 1796
- 19 August 1797. Birmingham City Archives, Boulton & Watt Collection
- 9. 25 August 1797. Letter in private hands
- W. Chapman, Observations on Various Systems of Canal Navigation, 1797, 9
- 11. National Archives, RAIL 827/2, 25 June 1800
- 12. National Archives, RAIL 827/2, 26 November 1800
- 13. Report to the General Assembly of the Ellesmere Canal Proprietors, 1805, 29
- National Library of Scotland advise that in Rennie's notebook for 1797 (MS 19857) there is a one-line note 'Messrs Rowland & Pickering Ruabon near Wrexham'.
- Charles Hadfield, Canals of the West Midlands, 1966, 174
- Cheshire Record Office, Plan of the Intended Canal ..., 1792, QDP1
- 17. National Archives, RAIL 827/4, 25 October 1792
- 18. 33 Geo 3, c91 (30 April 1793), s9



Recycled masonry at Home Farm (Photograph: Author)

- The southerly half of this length originally ran further east as marked on the map. The road was later realigned and the park extended.
- 20. Denbighshire Record Office, QSD/DC/2
- 21. National Archives, RAIL 827/1, 17 January 1794
- 22. Shropshire Archives, Knight Collection, 14 July 1795
- 23. 36 Geo 3, c96 (14 May 1796)
- 24. LTC Rolt, Thomas Telford, 53
- 25. One-inch Old Series Sheet 74NE (1837). The original 1819 survey drawing shows similar detail.
- Reproduced in T W Pritchard, *Remembering Ruabon* (2000), 50
- 27. The site is on private land with no public access.
- There are extensive collections of Wynnstay material in both the National Library of Wales and the Denbighshire Record Office