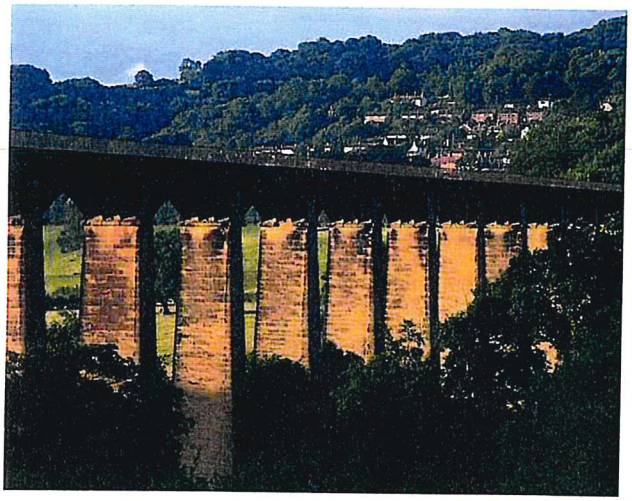
101202

British Waterways
Dyfrffyrdd Prydain



PONTCYSYLLTE AQUEDUCT REFURBISHMENT

APPLICATION FOR SCHEDULED MONUMENT CONSENT: SUPPORTING INFORMATION

Appendix 1
Historical Research Report

JULY 2003

Contents **Page**

FINAL REPORT

Report on the Documentary Sources for the history of Pontcysyllte Aqueduct, with particular reference to the ironwork of the Aqueduct

Introduction

There is a considerable body of documentary evidence for the building and maintenance of the Aqueduct at Pontcysyllte, which have been used extensively in previous historical accounts, most notably, those of Sir Alexander Gibb, L.T.C. Rolt, Charles Hadfield and R. Quenby.1

Of primary importance are the surviving records of the Ellesmere Canal Company, under whose auspices the aqueduct was constructed between 1792 and 1805. The original minute books of the Ellesmere and Chester Canal Company (covering the years 1791-1813) are held at the Shropshire Records Centre, but microfilm copies are available for consultation at the Public Record Office (PRO Class RAIL 827). The Shropshire Record Office also holds an incomplete series of reports to the proprietors of the Ellesmere Canal Company, made by William Jessop and Thomas Telford, the two principal engineers engaged in overseeing the construction of the Ellesmere Canal.

Also of importance are collections of letters written by or to the engineers responsible for the design, construction and subsequent repair of the aqueduct, principally Thomas Telford, William Jessop and William Hazeldine. These letters are dispersed among various archives and libraries, including the Shropshire Record Centre, the Ironbridge Gorge Museum Trust, the National Library of Scotland and the Institute of Civil Engineers. An extensive collection of copies of correspondence and other papers relating to Pontcysyllte Aqueduct was assembled by Sir Alexander Gibb, in the course of writing his biography of Thomas Telford, and can be found in Box 73 of the Gibb Collection at the Institute of Civil Engineers in London. These include draft estimates for completion of the masonry and ironwork of the aqueduct at Pontcysyllte, the originals of which no longer survive. The Institute also holds a large collection of personal papers of Thomas Telford, including an important inspection report of the ironwork at Pontcysyllte Aqueduct, taken in 1818.

The records of the Ellesmere and Chester Canal Company, including minute books and reports, are largely held at the Public Record Office (PRO Class RAIL 826). The later records of the Shropshire Union Canal, formed in 1846, are mostly kept at the Public Record Office (PRO Class RAIL 623) and the British Waterways Museum at Ellesmere Port. There are also important collections of plans, drawings and illustrations of Pontcysllte Aqueduct at the British Waterways Archives, the Shropshire Record Office (including a book of drawings and engravings belonging to William Hazeldine (1763-1840) responsible for the design of the iron trough at Pontcysyllte), the Institute of Civil Engineers and the Science Museum Library.

1 Valuable older accounts of Telford's work on the Ellesmere Canal, including the construction of Pontcysyllte Aqueduct, may be found in Sir Alexander Gibb, *The Story of Telford* (London 1936), L.T.C. Rolt, *Thomas Telford* (Harmondsworth 1958, rev ed. 1985). Of particular importance are the studies of Charles Hadfield (C. Hadfield and A.W. Skempton, *William Jessop Engineer* (Newton Abbot 1979), C. Hadfield, *Thomas Telford's temptation* (Baldwin 1993).) and R. Quenby, *Thomas Telford's Aqueducts on the Shropshire Union Canal* (Shrewsbury 1992).

History of the Construction of Pontcysyllte Aqueduct 1792-1805

The proposal to build an aqueduct at Pontcysyllte was first made in August 1792 by the experienced engineer William Jessop, who had been appointed as Engineer to the Ellesmere Canal Company a year earlier, to decide which was the most convenient route to build a canal to link the Mersey by what was later called Ellesmere Port to the Dee at Chester and the Severn at Shrewsbury.2 There was much controversy about the preferred line between Chester and Shrewsbury, one group advocating a hilly route west of the Dee, to serve the Wrexham collieries, the Bersham/Brymbo ironworks and the Ruabon and Chirk coal fields, which would cross the Dee and Ceiriog valleys to reach Shrewsbury, while another group proposed a route east of the Dee, using part of the Chester Canal, to Ellesmere and Shrewsbury, with branches to Ruabon and Bersham, but not serving the Wrexham and Chirk collieries.3

Jessop recommended the western route, proposing a line across the Wirral from the Mersey to the Dee, and then east of Pulford and Trevalyn to Wrexham, by a 4,607 yard tunnel to Ruabon to cross the Dee at Pontcysyllte, then by a 1,235 yard tunnel at Chirk to cross the River Ceiriog at Pontfaen, and then via Frankton, Weston and a 476 yard tunnel to the Severn at Shrewsbury. 'The most striking difficulties' (as Jessop pointed out) would be 'the great Tunnel and the Aqueduct at Pontcysyltee'. Jessop estimated that it would cost £35,000 to cross the river at the canal's summit level, requiring the construction of an aqueduct 'one hundred and twenty six feet in height above the river and nine hundred and seventy yards in length'. However, Jessop claimed that the aqueduct could be built for the significantly reduced sum of £21,286, 'by reducing it twenty four feet in height and ascending and descending by locks', and providing 'an engine to be worked by the River Dee to raise the water from the level so depressed to the Summit Level'.

Jessop's plan was accepted by the Committee of the Ellesmere Canal Company on 10 September 1792, although the Committee requested that Jessop should reconsider the line at Ruabon to avoid a tunnel if possible. On 17 August 1793, a few months after the Act to build the Ellesmere Canal was passed on 30 April of that year, the Committee ordered William Turner, a local architect from Whitchurch, to draw up plans and estimates for the construction of the proposed aqueducts at Pontcysyllte and Pontfaen.

As William Jessop was busy on other canal projects, and unable to supervise directly the planning and construction of the Ellesmere Canal, the Committee decided to appoint another engineer to oversee the undertaking. Surprisingly, the Committee did not appoint Turner to the post, but instead hired Thomas Telford as 'General Agent, Surveyor, Engineer, Architect and Overlooker of the Works' on 23 September 1793.

By January 1794, William Turner had submitted plans for the building of the aqueduct at Pontcysyllte. Turner's design envisaged a three-arched masonry structure of 70-75 ft in height (50 feet lower than originally proposed by Jessop) approached by a series of locks. The Committee adopted Turner's plan, 'with such alterations therein as Mr Jessop shall communicate to Mr Telford, and that Mr Telford do prepare a specification and proper sections and working drawings, to enable workmen to give in estimates for

2 Jessop's report of 23 Aug 1792 is in the Minutes of the Sub-Committee of the Ellesmere Canal Company (PRO RAIL 827/4).
3 For a lucid account of the controversy, see C. Hadfield , William Jessop Engineer (Newton Abbot 1979), pp.139-41.

erecting the said aqueduct.'4

However, only two weeks after the Committee's adoption of Turner's design, Telford reported that 'he is not sufficiently prepared to enable him to advertise for proposals for erecting the Aqueduct at Pontcysyltee. And that he wishes to consult Mr Jessop on various points relating to it.' Subsequently, at a later committee meeting on 31 March, it was ordered that 'the plans, drawings and sections of the intended Aqueduct at Pontcysyltee produced to this Committee by Mr Telford and which have been settled and approved by Mr Jessop be adopted. And that Mr Telford do forthwith prepare a particular description and specification for the erection of the said aqueduct'.

These two puzzling entries in the Committee minutes are of critical importance, and have generated considerable controversy among historians. It would appear that Telford needed more time to consult with Jessop concerning modifications to Turner's proposed design for the aqueduct, and that between January and March 1794, he drew up plans and sections (possibly including a model) to illustrate his revised design for the aqueduct at Pontcysyllte. What was the nature of Telford's revised design for Pontcysyllte and did Telford conceive the revolutionary idea of an iron aqueduct at this time?

Unfortunately, the plans, drawings and specifications submitted by Telford to the Ellesmere Canal Company have not survived. However, two drawings have survived, preserved in a sketchbook of engineering drawings belonging to William Reynolds, the noted engineer and ironfounder (a close colleague and friend of Telford's), which may represent rough drafts of designs for Pontcysyllte Aqueduct.5 The first drawing of a proposed aqueduct at Pontcysyllte (dated April 1794) made by John Duncombe, one of the surveyors on the Ellesmere Canal project, consists of a massive two tier stone aqueduct 125 ft high. The second drawing, signed 'March 1794. Thomas Telford', depicts an aqueduct of about 95ft height above a river, consisting of an iron trough on four iron piers which support three arches, the central one being 110 feet span.

However, while Telford may have considered building an iron aqueduct at Pontcysyllte as early as March 1794, we cannot assume that the drawing in Reynolds' sketchbook formed the basis of the design he submitted to the Ellesmere Canal Company on 31 March. As the noted canal historian Charles Hadfield pointed out, 'no mention is made in the minutes of such a revolutionary concept' and there is no mention in the minutes for 1794 of an approach to ironmasters to supply iron for the aqueduct.6 In fact, the only contractor for work on Pontcysyllte mentioned in the minutes for that year is a Lancashire mason James Varley of Colne, whose tender was accepted by the Committee on 26 May 1794, 'having proposed to undertake the building of the Aqueduct at Pontcysyllte upon more reasonable terms than any other person'. This would seem to imply that the design for the Pontcysyllte Aqueduct drawn up by Telford and accepted by the Committee in March 1794 remained that of a masonry aqueduct, presumably a modified version of William Turner's proposals.

The construction of the aqueduct seems to have proceeded slowly during 1794 and 1795. On 17 July 1795 Telford reported to Rowland Hunt, the Secretary of the Ellesmere Canal Company, that 'the foundation for one of the piers of the great aqueduct was

4 Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1) 17 January 1794.
5 William Reynolds Sketchbook (1793-96) is held in the Library of the Science Museum. Duncombe's drawing is No.1 in the sketchbook, Telford's drawing is No.110.
6 C.Hadfield, William Jessop Engineer (Newton Abbot 1979),p.143.

brought to its proper level when I was there last night, and as it is considerably below the bed of the river, it is very desirable to have the masonry begun as soon as possible.' He further remarks that, 'for the present, I have directed that every preparation should be made but no stones shall be laid without further orders. Some extra pumping etc will arise from this temporary suspension but it is certainly of much consequence to the general spirit of the undertaking.' 7

This 'temporary suspension' in the building of Pontcysylltee was occasioned by a fundamental revision of the design of the aqueduct, first outlined in William Jessop's report to the Ellesmere Canal Company on 14 July 1795.8 Jessop's report states that 'it had been proposed to save expense in the Aqueduct at Pontcysylte to reduce the height 50 feet and descend and ascend by locks, but in due consideration I must now recommend to the Committee to make this saving by adopting an iron aqueduct at the full height originally intended which on correcting the levels appears to be 125 feet above the surface of the water of the River Dee'. The revisions proposed in Jessop's report were finally accepted by the Committee on 7 August 1795, when the minutes state that 'the recommendation of Mr Jessop in that respect shall be adopted and the General Surveyor and Agent to the Company is hereby directed to proceed in the said works conformably thereto'. .

Historians have long speculated as to who should be given credit for conceiving the idea of a high level aqueduct with an iron trough at Pontcysyllte. It should not be forgotten that Jessop had originally proposed building a 125ft high aqueduct at Pontcysyllte in August 1792, but this was a masonry structure, not of iron. However, there is good reason to believe that it was Telford who originated the idea of building an iron trough supported on masonry piers. The evidence of Telford's design for an iron aqueduct in Reynolds' sketchbook, dated March 1794, shows that he had already considered the use of iron, at a time when he was drawing up plans and specifications for Pontcysyllte. Moreover, in March 1795, Telford and William Reynolds submitted a proposal for building an iron aqueduct at Longdon on Tern on the Shrewsbury Canal, consisting of an iron trough 186ft long in four spans supported by cast iron pillars, 16ft high above the river Tern. 9

In his autobiography, Telford claims credit for the idea of an iron aqueduct at Pontcysyllte, and directly connects it with the design of the Longdon aqueduct. Telford remarks that 'I had about that time carried the Shrewsbury canal by a cast iron trough at about 16 feet above the level of the ground and finding this practicable, it occurred to me, as there was hard sandstone adjacent to Pont y Cysylte, that no very serious difficulty could occur in building a number of square pillars, of sufficient dimensions to support a cast iron trough, with ribs under it for the canal.'10 Telford further states that 'after due consultation (presumably with Jessop), I caused a model to be made of two piers, a set or compartment of ribs, the canal trough, the towing path and side railing, with all the flinches, their nuts and screws and jointing complete'. This model, built by one William Smith at a cost of £46 15s 10d, is preserved in the Stoke Bruerne Museum. It would appear that Telford's design of the aqueduct at this stage consisted of eight piers, which was increased to nine (by Jessop's recommendation) and later increased

7 National Library of Scotland MSS 19972 f.83

8 Shropshire Record Centre Deed no.15025

9 C. Hadfield, William Jessop Engineer (Newton Abbot 1979), p.145. Shrewsbury Canal Minute Book 14 April 1795

10 J. Rickman (ed.) Life of Thomas Telford (1838) pp.41-46

to nineteen arches supported upon eighteen piers.

However, while Telford may have originated the idea of an iron aqueduct at Pontcysyllte, there is evidence that Jessop contributed significantly to the design. In a letter dated 26 July from William Jessop to Telford, he expresses some reservations about the proposed design, remarking that 'in looking forward to the time when we shall be laying the iron trough on the piers, I foresee some difficulties that appear to me formidable- In the first place I see the men giddy and terrified in laying stones with such an immense depth underneath them with only a space of 6 feet wide and 10 feet long to stand upon, and the same want of room will hardly allow space for the beams and scaffolding while the iron work is putting together.'11

Jessop recommended an extra pier and a wider trough to ease the difficulties, advising that 'in order to reduce the weight of the iron, or the parts of it, it will be better to have the openings narrow by adding another pier, so as to have 8 openings of 52 feet from centre to centre instead of 60 feet. In the next place I would have the piers 7 feet wide at the top instead of 6 feet, and make them about 2 feet more in the other dimensions.' In an interesting postscript, he also mentions that he has spoken to Samuel Moore, Secretary of the Royal Society of Arts, 'who has promised to have a premium proposed by the Society of Arts for a competition for *coating iron*.' However, it appears that no competition actually took place, as there is no record of it in the published transactions of the Society.

Work on Pontcysyllte seems to have proceeded slowly between 1796 and 1799, undoubtedly caused by the financial constraints imposed by rising inflation as a result of the war with France. Considerable alterations continued to be made to the design of the aqueduct during these years, as appears from a letter of Telford, dated October 1796, to Matthew Davidson, the overseer of works at Pontcysyllte Aqueduct, enclosing a 'geometrical drawing of Pontcysyllte', in which he remarks that 'I have left the foundations to be put in on the spot, and according to the depth, the number of piers are likewise undetermined'.12 Matthew Davidson also appears to have made a very important contribution to the final design of the aqueduct, providing Telford with a drawing of the structure in 1796; it is worth noting that Telford himself refers to Pontcysyllte as 'Davidson's famous aqueduct, which is almost reckoned among the Wonders of Wales' in a letter of 1797.13

Work on the construction of Pontcysyllte appears to have resumed in late 1799. In his report of 27 Nov 1799, Telford states that 'as soon as the season will permit that the masonry be taken in hand, I have recommended that the Abutments and remaining portion of the piers of Pontcysylte Aqueduct should be begun upon'.14 On the same day, the remaining masonry work of the aqueduct was advertised to be let by contract. Just over two months later, on 5 February 1800, the tender of John Simpson, a noted mason from Shrewsbury was accepted, 'having offered to execute the square Masonry at one shilling and two pence per cube foot and the rubble works at four shillings and nine pence per cube yard', according to the specifications drawn up by Thomas Telford. Simpson's estimate, and Telford's written specifications for the construction of the remaining masonry of the aqueduct, survive in typescript copies in the Gibb Collection

11 Institute of Civil Engineers Library: Gibb Collection Box 80 (6).
12 Ironbridge Gorge Museum Trust.
13 Ironbridge Gorge Museum Trust.
14 Shropshire Record Centre Deed no 15036.

at the Library of the Institute of Civil Engineers.15 The final design of the aqueduct consisted of nineteen arches, each of 45 ft span, carried upon eighteen piers, double the number proposed in the revised Telford/Jessop design of July 1795.

However, at the same time as work recommenced on the masonry work of Pontcysyllte, several major obstacles arose, not only to hinder the construction of the aqueduct, but also to make the whole undertaking seem like 'a great white Elephant'. In accordance with William Jessop's report of 24 January 1800, it was decided by the Ellesmere Canal Company that it was 'wholly unadvisable to execute a canal between Pontcysyllte and Chester (as was originally intended)□especially since the extensive opening of the collieries between Hawarden and Flint which will communicate by Railway with the Dee, so as to deliver coal at a much less price at Chester than formerly'.16

The route from Pontcysyllte to Chester having been abandoned, Jessop now considered the problem of 'how to deliver coal at the least expense, from the Ruabon Collieries, into the Basin on the South side of the Dee at Pont Cysylte'. In his report, Jessop proposed building a railway from the Ruabon collieries to the aqueduct, arguing that 'if there were to be a canal there must still be Railways from the collieries, and that, with the lockage, the expence would at least be double the cost of a Railway, it appears that the latter is most advisable.' He then went on to consider the question of whether, 'if a Railway should be so far determined on, whether it should be continued over the columns intended for the Aqueduct, or whether the Aqueduct should be completed to communicate with the Railway on the north side of the river'. Jessop preferred continuing the railway over the piers of the aqueduct, estimating that it would take an extra year and additional expenditure of £8400 to complete the aqueduct as a canal.

Jessop made further important recommendations about the completion of the aqueduct structure, advising that, 'in the execution of the columns, I would recommend, that in what remains to be done, they should be built, and be composed of stones well worked to two feet in bed, and be connected one side with the other, at every six feet in height, by two pieces of oak (dovetailed a little on the underside) principally for the purpose of internal scaffolding. The courses thus put together, will be less liable to false bearings than if they were solid: it will save five or six hundred pounds in the expense; and what to me appears most material, it will afford safety to the workman.'

Jessop further recommended that 'instead of wing walls connected with the abutments at the end of the embankments, it will save some expense, and perhaps have a better appearance, if the abutment, built of rough masonry, and connected by bond timbers, with a counterfort about 12 feet in length, and 7 feet in thickness, be buried in the slope of the earth, terminating the embankment; the earth, so sloping, will bury near a half of the next column, which half may of course, be built of rough masonry'

All of Jessop's structural recommendations seem to have been carried out, but his suggestion that the piers of Pontcysyllte aqueduct be used to carry a railway was finally rejected in favour of a canal. After lengthy consultation, it was finally decided on 25 November 1801 by the Ellesmere Canal Company, 'on considering the different estimates of the expence of making a canal or railway across the Aqueduct at

15 Institute of Civil Engineers: Gibb Collection Box 73
16 Shropshire Record Centre Deed No. 15037 (Copy in the Hadfield Papers in the Institute of Civil Engineers Lib.)

Pontcysyltee and receiving the opinions of the Engineers of this Company on the subject', that it would be 'for the interest of this Company to make a Canal across the said Aqueduct in preference to a Railway'.17

The decision having being taken to use the aqueduct as a canal instead as a railway, and the completion of the remaining masonry work being well underway, plans for the construction of the iron trough of the aqueduct finally began to take concrete shape. As early as February 1797, the Committee of the Ellesmere Canal Company had spoken to the leading Shropshire ironmasters William Reynolds (who had already collaborated with Telford on the Longdon aqueduct) and John Wilkinson, to enquire on what terms they 'will either jointly or individually agree to furnish the iron work for Pontcysyltee and fix up and complete the same'.18 And on 28 June of the same year, advertisements were inserted in the Shrewsbury, Birmingham and London papers 'for proposals to be sent to Mr Telford the General Agent of this Company for proposals for executing the iron work at Pontcysyltee according to the plans and dimensions to be left with Mr Telford.'

However, because of the uncertainty over whether Pontcysyllte would be used as a canal or a railway bridge, it was not until March 1802 that the final design of the iron trough was settled on and a contract formally offered to the leading iron-founder William Hazeldine for executing the iron-work at Pontcysyllte according to the conditions and specifications drawn up and signed by Hazeldine himself. The cast iron was to be supplied from his nearby foundry at Plas Kynaston, at the north end of Pontcysyllte.19

Hazeldine had been involved in work for the Ellesmere Canal Company since 1796, when he had been engaged to work on the Chirk aqueduct project. Indeed, a letter from William Wilkinson (brother of John Wilkinson) to James Watt, dated 1800, mentions that the Ellesmere Canal Company had already accepted an offer from Hazeldine to supply the iron for the aqueduct over the Dee at £10 10s per ton and screws at 6d per lb, which was significantly cheaper than the terms offered by the iron-founder John Wilkinson (£13 10s per ton and screws at 8d per lb).20

By 1804, the masonry piers of the aqueduct had been completed, and construction of the iron trough at Pontcysyllte was well underway. In his report of 28 Nov 1804, Telford states that 'the ironwork of the Trough-Part of the Aqueduct of Pontcysylte over nine arches, is now put up, being nearly one half of the whole length, many plates now being cast and brought to the bank at the North end of the Aqueduct'. He confidently asserted that 'there is a reason to expect that the whole of the Trough part will be completed about midsummer next□the workmen being familiar with the operations of putting the plates together- and the operations of the foundry being in a very regular train and well supplied with metal'. 21 The aqueduct of Pontcysyllte was finally opened with much ceremony on 26 November 1805.22

17 Minutes of the Committee of the Ellesmere Canal Company 25 Nov 1801 (PRO RAIL 827/2)
18 Minutes of the Committee of the Ellesmere Canal Company 10 Feb 1797 (PRO RAIL 827/2)
19 Minutes of the Committee of the Ellesmere Canal Company 17 Mar 1802 (PRO RAIL 827/2)
20 Quoted in R.Quenby, *Thomas Telford's Aqueducts on the Shropshire Union Canal* (Shrewsbury 1992), p.62.
21 Shropshire Record Centre 212/Box 366 Bridgewater Papers: Bundle of correspondence and papers re. holdings on the Ellesmere Canal.
22 A copy of the report of Thomas Telford to the General Assembly of the Ellesmere Canal Proprietors on the opening of the Pontcysyllte Aqueduct is in the Library of the Institute of Civil Engineers (Gibb

History of the Maintenance of Pontcysyllte Aqueduct
1/ 1805-1900

Although the aqueduct at Pontcysyllte was finally opened in November 1805, the minutes of the Committee of the Ellesmere Canal Company (which became the Ellesmere and Chester Canal Company in 1813), indicate that building work on the aqueduct continued sporadically into the 1820s. In November 1806 Telford was ordered to give directions for the construction of two graving docks at the north end of Pontcysyllte Aqueduct and for the building of small houses at the wharf of Pontcysyllte 'to accommodate persons who superintend the shipping of coals at the said wharf'.

On 25 November 1807, it was reported to the Committee that 'the difficult works upon the Water Line from Pontcysylte to Llantisilio were 'nearly completed' and a 'bank tenter' was appointed with responsibility for the maintenance of the Pontcysyllte aqueduct. At the same time, the Committee also ordered that 'the Acqueduct at Pontcysylte be painted at a proper season in the manner pointed out by Mr Telford's report of this day'. Unfortunately, this particular report of Telford's, recommending the painting of the aqueduct (evidently meaning the ironwork) has not survived.23

However, it appears that Telford's recommendation to paint the ironwork of the aqueduct had still not been carried out six years later, for in another report of 5 January 1813, he advised that 'that the Iron work at Pontcysylte Aqueduct should receive a proper coating to preserve it from the actions of the Atmosphere'. On 19 July 1813, the Committee appear finally to have acted on Telford's recommendation, ordering that 'such part of it, as now wants such coating, be immediately done, either with coal tar, or such other coating as may be thought proper and effectual and attended with the least expense'.24

The sheer scale of the ironwork to be coated at Pontcysyllte, and the considerable time and cost which such a task would take, may well be the reason why the Committee's order of 1807 was not carried out earlier. This is hinted at in the statement of the Committee that 'if the whole of the Aqueduct cannot be coated in the present year, then, that such part only as most requires it be done the present year, and the remainder as early as possible in the ensuing year.' The surviving minutes and reports of the Ellesmere and Chester Canal Company make no further reference to the painting of the Aqueduct at Pontcysyllte, which suggests that the Committee's order of July 1813 was carried out. However various building works and repairs continued to be carried out to the aqueduct until the 1820s. In his report to the Committee of 27 August 1821, Telford stated that he found the Aqueduct 'to be in the most perfect state; excellent wing walls have been erected to secure the banks, at the north abutment, and an effectual cure as been made of the troublesome and expensive leakage through this bank'.25

The problem of differential settlement of piers and abutments appears to have been a

Collection Box 73)
23 Minutes of the Committee of the Ellesmere Canal Company 25 Nov 1807 (PRO RAIL 827/3)
24 Minutes of the Committee of the Ellesmere Canal Company 19 July 1813 (PRO RAIL 827/3)
25 Shropshire Record Centre 212/Box 366 Bridgewater Papers: Bundle of correspondence and papers re. holdings on the Ellesmere Canal)

particular cause of 'much trouble and vexation' at both Pontcysyllte and Chirk aqueducts. In April 1818, Telford wrote to George Moncrieff, the Secretary of the Edinburgh and Glasgow Union Canal Company, concerning plans for the building of an iron trough aqueduct at Slateford. Telford discusses the problem of differential settlement of piers, remarking that 'even with the best sort of gravel at Pontcysylte and Chirk managed in the most careful manner, tho sinking has not yet, after 12 years, entirely left off; we have had much trouble and vexation and some accidents'.26

Shortly afterwards, on 1 May 1818, Telford wrote to James Thomson, the general manager of works at Slateford Aqueduct, telling him to visit the iron smelting works of William Hazeldine (responsible for making the iron trough of Pontcysyllte) at Calcott and Hazeldine's iron foundry and forge at Shrewsbury, and then to examine the aqueduct at Pontcysyllte and learn the details of the ironwork there, and compare it with the drawings for the proposed aqueduct at Slateford.27

James Thomson's inspection report on Pontcysyllte aqueduct,dated 8 May 1818, is the earliest detailed account we have of the ironwork of the aqueduct.28 Thomson commented that 'the whole of the iron work is in as good condition as when completed, and without the least appearance of a drop of water having passed at any part'. He paid particular attention to the material used to secure the joints of the iron trough, stating that 'the jointing is done with very coarse flannel in the state it comes from the loom, cut into pieces to suit the flanges and well covered with white lead of the usual consistency for jointing, and more or less of these pieces are put in according to the inequality of the joints which come together. They are also cut a little narrower than the flange so as to leave a space on both sides to be caulked firmly up with good hemp rolled in tar, and being well caulked and pitched over'. Frustratingly, Thomson does not mention whether the ironwork of the aqueduct had been painted or not, but this may simply be because the coating of the ironwork was not part of his brief, as specified in Telford's letter of 1 May.

There is little evidence of significant repairs to the aqueduct at Pontcysyllte until the mid 1860s, when detailed inspections were made of both Chirk and Pontcysyllte aqueducts by William Baker, an engineer working for the Shropshire Union Railway and Canal Company. Both aqueducts seem to have been in a relatively good state of repair, although both had certain faults in the masonry and ironwork in need of urgent attention. In his report on Pontcysyllte, dated 9th August 1866, Baker reported that, 'after carefully examining the whole of this magnificent structure', he found 'every part of it in a thorough state of repair, with the exception of the South Abutment, and Southerly Pier, and the arch between these'. Baker described the faults in detail, stating that 'the face stones of the south abutment from the springing of the arch to the underside of the trough (a height of about 9 feet) have in some places slightly moved forward, and in others have pressed against the iron ribs, causing the stone to chip away; the iron ribs are in several places broken, showing that an undue pressure is acting upon them; there is also a considerable quantity of water finding its way through the masonry.' 29

Having examined the aqueduct and hearing the evidence of the foremen and workmen

26 Institute of Civil Engineers: Edinburgh and Glasgow Union Canal Papers no.264
27 Institute of Civil Engineers: Edinburgh and Glasgow Union Canal Papers no.308
28 Institute of Civil Engineers: Edinburgh and Glasgow Union Canal Papers no.306
29 British Waterways Archives Ref. WM 75/90 A copy is given in the Appendiz to the Minutes of the Executive Committee of the Shropshire Union Canal and Railway Company (PRO RAIL 623/14).

on the spot, Baker ascertained that the cause of the movement in the stone work, and the fractures in the iron, 'proceeded from the swelling of the material at the back of the abutment, and wing walls, caused I have no doubt, by a leakage between the end of the trough and the embankment'. To remedy these faults, he recommended that 'the material at the back of the abutment be removed, the abutment strengthened, and a water tight joint made by puddle or otherwise, at the end of the trough, in doing which, it may be found advantageous to slightly lengthen the trough itself.
Baker further recommended that 'the broken joints of the iron ribs should be fished (strengthened by supports) or repaired by some simple method', at a cost not exceeding £300 or £400 (the final cost amounted to £396).

Baker also made some curious observations regarding the painting of the ironwork of Pontcysyllte, remarking that 'the iron work of the aqueduct does not appear to have been painted since its erection 70 years ago, some oxidation has taken place but not to the extent that I could recommend your incurring the cost of repairing at present'. It is not clear whether he means that the ironwork had remained unpainted since the completion of aqueduct in 1805, or whether it had not received a fresh coating since that time. If the ironwork had been completely unpainted since its erection, this would seem to imply that the orders of the Committee in 1813 to paint the aqueduct had been ignored. However this seems improbable, and one cannot doubt that an engineer of the calibre of Thomas Telford would have reiterated his recommendation that the ironwork be painted in later reports, had it not been done.

Twenty years later, in 1886, another survey was taken of Pontcysyllte aqueduct, this time by an engineer named George Jebb, who recommended that the whole structure needed to be scraped and painted at a cost of £500.30 Jebb's recommendation was accepted by the Executive Committee of the Shropshire Union Railway and Canal Company on 24 March 1886, and a staff of painters was hired from the Britannia Tubes company of Bangor to undertake the work. Unfortunately, the 1886 order does not specify what type of coating was to be used, merely stating that the 'least expensive materials' were to be employed.

Although the Committee's order does not explicitly refer to the repainting of the aqueduct, the fact that the structure was to be scraped (suggesting the removal of the original coating) and painted strongly suggests that this was indeed the case. If this interpretation is correct, then this order provides concrete evidence that the aqueduct was painted at some point before 1886. No further references have been found in the minutes of the Ellesmere and Chester Canal Company or the Shropshire Union to the painting of Pontcysyllte Aqueduct between 1813 and 1886.

While the evidence is not entirely conclusive, there are good reasons to believe that the ironwork of Pontcysyllte Aqueduct may well have been painted, at least in some part, in about 1813 (probably using coal tar as the coating material) and that the structure was not repainted for another 75 years, until 1886, when the original coating was scraped off and repainted. It is possible that the painting of the aqueduct may not have been

30 Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/22 no.16585). This entry is quoted by Quenby, who states that the Aqueduct needed to be *scraped and pointed*,. However, after careful examination of the original document, this seems to be a misreading, especially in view of the fact that the entry is clearly entitled 'Painting of Pontcysyllte Ordered', and no mention is made of other workmen being contracted for the work, apart from painters.

completed in 1813, owing to the sheer scale of the work and the cost involved, this may be the reason why no reference is made to it in Thomson's inspection report of 1818.

2/ 1900 to present

There are only a few documented references to the maintenance of Pontcysyllte Aqueduct during the first half of the twentieth century. In December 1914, a slight landslip occurred in the embankment at the north-east end of the aqueduct, causing an old leakage to break out. Repairs were carried out to the embankment a month later, which involved emptying the canal, repairing and rebuilding the walls, and installing some stone drains in the embankment where the slip occurred.31

In January 1923, the Shropshire Union Canal Company was amalgamated with the London, Midland and Scottish Railway Company, which subsequently assumed responsibility for the maintenance of Pontcysyllte. The minutes of the works committee of the London, Midland and Scottish Railway Company contain very few references to repairs or other works carried out to the aqueduct. On 28 October 1936, the LMS accepted a tender from W.G. Beaumont & Sons for the tarring of Pontcysyllte Aqueduct, at a cost of £397.32 Unfortunately the tender does not supply very much detail about the nature of the work done, and omits to mention whether the external and internal elevations of the aqueduct trough were coated. Nevertheless, this is an important reference, as it provides definite evidence that coal tar was used as a coating for the aqueduct (although, as mentioned above, it was recommended by Telford as early as 1813).

During the 1950s and early 1960s, extensive repairs were carried out to the trough sides, which occasioned the temporary closure of the aqueduct towpath. The original cast iron buckle plates were replaced by trench sheet pile sections spanning between the cast-iron legs in the waterway, and a new steel angle was bolted to the top of the east trough wall plate. The cast iron standards supporting the trough, which had corroded badly, were replaced by new ones, while the iron parapet railing adjacent to the towpath was also replaced by a replica of Hazeldine's original.33 In 1965, the outside elevation of the trough wall plates and outer arched girders was repainted with 'Wailes Dove Bitumastic Super Service Black Solution'.34

In 1975, a routine inspection of the aqueduct revealed that the masonry of the south abutment had spawled, and, more seriously, the two internal cast-iron arched girders supporting the southernmost span of the aqueduct had failed, while the two external girders had buckled badly. It was concluded that 'none of the four cast iron arches was carrying any substantial load and that the trough itself was spanning from pillar to abutment'.35 A detailed engineering survey was carried out, which showed that these

31 PRO RAIL 623/27 (24 Feb 1915); RAIL 623/29 (14 April 1915)
32 PRO RAIL 418/97 no.4188 (28 Oct 1915)
33 R.Quenby, *Thomas Telford's Aqueducts on the Shropshire Union Canal* (Shrewsbury 1992), p.113. C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989) Part 1 Introduction
34 C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989) Part 1 Introduction.
35 Report of Damage to Pontcysyllte Aqueduct by B.P Haskins, Area Engineer, dated 17 June 1975, printed in C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup

problems were caused by a slight shift in the south abutment. The British Waterways Board took immediate action to remedy the problems identified in the 1975 survey, closing the aqueduct and draining the water out using the gigantic 'plug' in the trough to reduce the weight on the tank. The southernmost span was supported in a timber truss while the abutment was shored up and the original cast iron girders replaced with new steel ones. Further repairs carried out to the aqueduct included the installation of 'fish plates' and a tie bar at the springing point at the north abutment. The consultant engineers responsible for the work, Husbands Consulting Engineers, who had previously restored the Britannia Bridge, apparently believed that 'had they not stepped in to take emergency action, the piers might have collapsed one after another like dominoes'.[36]

In 1988, British Waterways commissioned Arup Associates to undertake a detailed engineering assessment and preliminary inspection of Pontcysyllte Aqueduct.[37] No major defects were discovered, although it was recommended that remedial works should be carried out to the south embankment, which was moving around the abutment and adjacent pier, causing damage to those structures. The supporting masonry elements were described as being in good condition, although 'isolated areas show initial signs of deterioration.' It was further concluded that the ironwork of the trough and the arched girders supporting it are in good condition except for bolt corrosion in two places along the length of the aqueduct. Regarding the condition of the surface coating of the aqueduct trough, the Arup report noted that 'the bitumastic compound used in 1965 for the exterior elevations is still performing well'. However, a report written prior to British Waterways' proposed refurbishment of the aqueduct in 2001 concluded that the life span of the existing paintwork had expired and that the structure required repainting. It was recommended that 'a modern, long life paint protection system is applied, with the maximum life to first maintenance of approximately 30 years'.[38]

Conclusion

Although the documentary evidence for the painting of Pontcysyllte Aqueduct during the nineteenth century is inconclusive, it is the author's opinion that the iron trough was painted in 1813, in accordance with Telford's recommendation and the order of the Committee of the Ellesmere Canal Company. The coating originally used was probably coal tar, as recommended by Telford himself. We have definite evidence that the aqueduct was repainted in 1886, so it must have been painted at some point previously, in spite of the observation in the inspection report of 1866 that 'the iron work of the aqueduct does not appear to have been painted since its erection 70 years ago'. Although we do not know what type of coating was used to paint the structure in 1886, the fact that the 'least expensive material' was recommended, suggests that it may well

Associates- Wrexham 1989)

35 R.Quenby, *Thomas Telford's Aqueducts on the Shropshire Union Canal* (Shrewsbury 1992), pp.113-16.

36 C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989)

[38] S.B. Dennis, Report on the Trial Refurbishment of Pontcysyllte Aqueduct (British Waterways 2001)

have been coal tar. Coal tar is definitely known to have been used to paint the aqueduct in 1936, though it is not known whether the external and internal elevations were both painted. The repainting of the external elevation of the trough in 1965 with 'Wailes Dove Bitumastic Super Service Black Solution' appears to have been the first time that a bitumastic application was used at Pontcysyllte.

FINAL COMPENDIUM

Chronological List of Documentary References to building works at Pontcysyllte Aqueduct

1792-1922

1792 (23 August) *Minutes of the Sub-Committee of the Ellesmere Canal Company (PRO RAIL 827/4)*

Report of William Jessop to the Ellesmere Canal Committee concerning the proposed line for the Ellesmere Canal.

On the cursory view of the country between the Mersey and the Severn which I took the last year when it was a question whether a line on the Eastern or Western side of the River Dee would be most desirable it appeared to me that the Western line would be best...The Main Canal from Chester will commence at the River Dee opposite the Chester Canal Basin, and will proceed in a direct line over flat meadows to Leach Hall and by Belgrave and to the East of Trevallen to Darland Green. From thence it will ascend to Burras and Wrexham and crossing the valley at Birsham will go to Havodbuch and Newhall to Rhuabon and then going underground four thousand six hundred yards will cross the Dee at Pontcysyltee and passing under the Bron Lime works and by Chirk and under ground by a tunnel one thousand two hundred and thirty six yards will cross the Ceriogg at Pontfair by Ewescot Mill, Wern, Wigmoor under Saint Martins by Kentley, Maesterwm Bridge, Francton Common, Hordley between Bagley and Shade Oak to Weston Lulling field where it will pass underground four hundred and seventy six yards, from thence over the Birth Common and between Baschurch and Eyton to Walford and from thence over Seaton Heath and to Bagley Bridge and Shrewsbury.

The most striking difficulties are the Great Tunnel and the Aqueduct at Pontcysyltee, to cross the latter at the summit level would be thirty five thousand pounds as it would be one hundred and twenty six feet in height above the river and nine hundred and seventy yards in length. But by reducing it twenty four feet in height and ascending and descending by locks, it will be done for seventeen thousand four hundred and six pounds and adding two thousand eight hundred and eighty pounds for the extra locks and one thousand pounds for an engine to be worked by the River Dee to raise the water from the level so depressed to the Summit Level the whole expense will be twenty one thousand two hundred and eighty six pounds.

1793 (23 September) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Appointment of Thomas Telford as 'General Agent, Surveyor, Engineer, Architect and Overlooker of the Works...to make reports to superintend the cutting, forming and making the Canal and taking up and seeing to the due observance of the Levels thereof to make the drawings and submit such drawings to the consideration and correction of Mr William Jessop..His engagement to extend to all architecture and engineering business to the drawing, forming and directing the making of the bridges, aqueducts, tunnels, locks, buildings, reservoirs, wharfs and other works.'

1794 (17 January) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Ordered that the plan of the aqueduct at Pontcysyltee with three arches as prepared by Mr William Turner of Whitchurch architect shall be adopted by this Committee with such alterations therein as Mr Jessop shall communicate to Mr Thomas Telford, the general surveyor and agent to this Company, and that Mr Telford do prepare a specification and proper sections and working drawings, to enable workmen to give estimates for erecting the said aqueduct, and that two copies of such specification sections and working drawings be prepared and one part thereof deposited with Mr Telford at Shrewsbury and the other part thereof with the clerk to the Committee at Chester and that advertisements be inserted in the Shrewsbury, Chester and Birmingham papers giving notice when the same are so deposited and that persons willing to undertake the execution of the said aqueduct may send their estimates sealed up to Mr Telford and to the clerk to the Committee within two months next after the publication of each advertisement.

1794 (31 January) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Mr Telford having stated to this Committee that he is not sufficient prepared to enable him to advertise for proposals for erecting the aqueduct at Pontcysyltee and that he wishes to consult Mr Jessop upon various points relating to it. It is ordered that the advertisement be postponed until such time as Mr Telford shall have consulted Mr Jessop upon the subject and that Mr Telford have credit on Messrs Eyton and Company the bankers for one hundred pounds to enable him to prosecute the said work at Pontcysylte.

1794 (21 February) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Ordered that Matthew Davidson of Shrewsbury be appointed Inspector of the works carrying on at Pontcysyltee and the Llanymynech Branch and also the future works at Chirk valley and in that neighbourhood and that he reside at Chirk and be allowed the salary of one hundred pounds per annum to commence at such time as Mr Telford shall think proper to engage him.

1794 (31 March) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Ordered that the plans, drawings and sections of the intended aqueduct at Pontcysyltee produced to this Committee by Mr Telford and which have been settled and approved by Mr Jessop be adopted and Mr Telford do forthwith prepare a particular description and specification for the erection of the said aqueduct and that advertisements be inserted in the Chester, Shrewsbury, Liverpool, Manchester, Birmingham and some of the London newspapers for proposals to be delivered sealed up to Mr Telford or to Messrs Petts and Leeke on or before Saturday the twenty fourth day of May next it being proposed that this Committee shall meet on Monday the twenty sixth day of May next to open and take the said proposals into consideration and to treat with any person or persons proposing to undertake the said work and that in such advertisement it shall be notified that the person or persons with whom the Committee may agree to execute the said work will be expected to produce sufficient security for the due performance of their contracts.

1794 (26 May) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

James Varley of Colne in the county of Lancaster mason having proposed to undertake the building of the Aqueduct at Pontcysyltee upon more reasonable terms that any other persons who have delivered proposals to this Committee or their Surveyor for that purpose. It is hereby ordered that the said James Varley shall be contracted with pursuant to his proposal as now adapted to the specification and particular sections, plan and dimensions lately advertized to be left with the Clerk and Agent to this Company for inspection and which has now been signed and subscribed by the said James Varley and the General Agent and Surveyor to this Company is to enter into a contract with the said James Varley accordingly.

1795 (21 March) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Ordered that an accurate account shall be taken and laid before this Committee at their next meeting of the stone raised and work done by James Varley the contractor for building the aqueduct at Pontcysyltee and that he be required pursuant to the terms of his agreement to produce sufficient sureties at the next meeting of this Committee to join with him in a bond in the penalty of five thousand pounds or upwards for the due performance and execution of his contract.

1795 (14 July) *Copy of William Jessop's Report on the Ellesmere Canal (Shropshire Record Centre Deed no.15025*)

The Surveys which have been made of the proposed variations from the lines of canal already authorized by the act of Parliament appear to have been done with much care and critical attention, and in looking over the lines and comparing the several sections I have not found cause for hesitation in the choice, nor much occasion to suggest amendments in those which I have to recommend.

Beginning at the River Dee at the point formerly proposed, the lines instead of pointing in a straight direction to Hope will pass a little circuitously to Pulford, on this course there will be a considerable length of deep cutting which cannot be totally avoided without very great lengthening the line, but I think it adviseable yet to resurvey this part to find some lower and shorter passage through the rib of high ground.

From Pulford there will be very little difficulty up the Gresford Valley to Poolmouth compared with the original line, nor indeed any material obstruction between this point and the aqueduct at Pontcysylte except the deep cutting on the outside of the wall at Wynstay.

From Plas Kynaston Quarry the chain of locks should be gradual and be disposed in regular distances to near the Aqueduct, and for the accommodation of the Acrefair Collieries there should be a collateral branch from the summit level.

It had been proposed to save expence in the Aqueduct at Pontcysyllte to reduce the height 50 ft and descend and ascend by locks, but in due consideration I must now recommend to the Committee to make this saving by adopting an Iron Aqueduct at the full height originally intended which on correcting the levels appears to be 125 feet above the surface of the water of the River Dee.

The advantages that will attend the preservation of this level are too obvious to need explanation. The arches or rather openings of the aqueduct may be seven of 50 feet each, the remainder may be raised by an embankment, and this embankment will be formed by earth to be boated from the cutting between the Dee and the Chirk valley- as few hands can be employed in this mode of working, and it will of course take much time in the execution, no time should be lost in beginning it.

It was originally proposed to cross the Chirk valley a little above Chirk Bridge, but from an objection by the owner of the land, the line was altered to cross at Pontfain, it would still be very advisable to adopt the first idea, and if instead of an embankment of earth, which would shut up a view of the valley, it be crossed by an iron aqueduct I should hope the objection might be removed as instead of an obstruction it would be a romantic feature in the view and avoid damage to much of the meadows and the plantations on the banks of the valley, and miss a very expensive and hazardous part of the line on the steep banks on the south side.

As there is reason to expect a considerable trade on the canal before water can be brought from the reservoir over the great Aqueduct, it will be necessary to take in part of Morlass River, until now I had not been informed that near the source of the Dee there is an extensive lake called Bala Pool, this has suggested an idea that at a small expence water in lieu of the Morlass may be given to the Dee by using this pool as a Reservoir either by making provision for drawing off 6 inches in depth of this pool, or by raising it 6 inches or by both, and this I apprehend may be done without any possible injury to any property.

The line to Whitchurch as now projected, is very much improved, it was in the first survey thought necessary to descend by locks, it is now found that it may be extended on one level not only to Whitchurch, but also by a branch passing near Wem and Prees to a point on the London Road 4 miles south of Whitchurch, and considering the general irregularity of the country the ground chosen is uncommonly favourable.

When power is obtained it will be very advisable to execute part of this line immediately, as it will certainly be very productive.

As in application to Parliament objections which are unforseeen frequently arrive while the Bill is pending. I think it adviseable to bring in distinct bills for the main line and for the Whitchurch line, and to proceed on the former first, lest local objections to one should impede the progress of the other, and it would cause very little difference in the expence.

Respecting the line for connecting the Whitchurch Branch with the Chester Canals, as it could be of no possible use until water could be brought to it by the execution of the main line and the Whitchurch branch, I think it would be very premature to take any steps towards this object at present and more especially as I have reason to believe that from the line as now proposed a much more eligible connection might be made, that any hitherto surveyed; but time and change of circumstances will probably throw lights upon this subject, that it cannot be well foreseen and such as it would be idle to predict.

Shrewsbury July 14 1795 W Jessop

1795 (17 July) *Letter of Thomas Telford to Rowland Hunt (National Library of Scotland MSS 19972 f.83)*

The foundation for one of the piers of the great aqueduct was brought to its proper level when I was there last night, and as it is considerably below the bed of the river, it is very desirable to have the masonry begun as soon as possible. For the present, I have directed that every preparation should be made but no stones shall be laid without further orders. Some extra pumping etc will arise from this temporary suspension but it is certainly of much consequence to the general spirit of the undertaking.

I have had an interview with Mr Archdeacon Travis and Mr Massey Taylor respecting the termination of the Canal at Chester and although everything is in a favourable train, yet to bring the business to any conclusion, will require my attendance here till Tuesday next, and it is very necessary to have the plan finally arranged in order to enable us to bring the passage boat near to Chester before the bad weather sets in. This being the case, I shall be able to wait on Mr Kynaston and you on Sunday, but I have directed that Mr Davidson shall come over to Boratton on Sunday, and he will follow your instructions with respect to every application necessary to be made, as to the attendance at the foundation laying. As soon as the day is determined on, the contractors should have notice to prepare.

The business of the passage boat is increasing, every person is pleased with it, and the Eastham Coach is nearly deserted, the Market carts are expiring and I am taking measures, that will prove a severe blow to the land carriage to and from Manchester to Chester etc.

1795 (26 July) *Letter of William Jessop to Thomas Telford concerning the construction of the iron trough at Pontcysyllte (Institute of Civil Engineers Library: Gibb Collection Box 80 (6))*

In looking forward to the time when we shall be laying the iron trough on the piers I foresee some difficulties that appear to be formidable. In the first place I see the men giddy and terrified in laying stones with such an immense depth underneath them with only a space of 6 feet wide and 10 feet long to stand upon, and the same want of room will hardly allow space for the beams and scaffolding while the iron work is putting together.

I therefore think in the first, that in order to reduce the weight of the iron, or the parts of it, it will be better to have the openings narrow by adding another pier, so as to have 8 openings of 52 feet from centre to centre instead of 60 feet. In the next place I would have the piers 7 feet wide at the top instead of 6 feet, and make them about 2 feet more in the other dimensions.

I hope you will not have proceeded with the other foundations till you received this.

And I begin to think it may be better to have the canal 9 feet wide and 5 feet deep as was first intended.

I have spoken to Mr Moore, who has promised to have a premium proposed by the Society of Arts for a competition for coating iron.

I shall go thro Chester in the Mail Coach on Thursday coming on my way to Holyhead and I have hardly a chance of seeing you.

1795 (Nov) *Notebook of John Knight(Shropshire Record Centre Deed No. 15030)*

Copy of Jessops Report as to the Lanymynach and Oswestry Branches and Thanet Water

Mr Jessop in his letter to Mr Turner dated Nov 1795 announces that he has received a letter from Mr Hunt on the subject of the plans and estimates to be made and prepared by Jn Tun (?) If the upper line from Lanymynach had been executed it would have been the summit there on the eastern side and would have taken in the Thanet Water, by which means there would have been a very ample supply of water, so that the boats might have looked down to an aqueduct of about 50 feet high, which might have been executed with stone, which is much more durable than iron and at an expense of £20000 less than the iron and stone now to be executed, and a large supply of water would have been obt(ained) for the supply of the line from Pontcysylte to Hadley Whitchurch Prees and Shrewsbury- This was the line recommended by Jessop and Dadford in their award.

But instead of which line the lower one is executed, which is about 60 feet below the level of the intended aqueduct at Pontcysylte so that there is a large waste of water from the ground line

NB- The only reason that appears- It went near Mr Mostyn Owens at the Woodhouse the Revd Mr Lloyds Osleston estates and is a boundary line to Mr Lloyds estates

1795 (28 October) *Ellesmere Canal Company Summary statement of accounts (Shropshire Record Centre Deed No.15033)*

The following statement of the payments made on account of the Ellesmere canal company, having been examined and approved of by the General Committee, and having been laid before the General assembly, held at the Royal Oak, in Ellesmere on Wednesday 28th day of October 1795, was likewise approved of by the said assembly and ordered to be printed and copies delivered to such proprietors as may apply for the same to Mr Telford, the General Agent to this company

On account of work carrying on under contract

Pontcysylltu - £2006 9s 7d.

1795 (21 October) *Report on the Ellesmere Canal Navigation by Thomas Telford (Shropshire Record Centre Deed No.15035)*

Ellesmere Canal Navigation

Although the term for the completion of the Wirral Line of the Canal does not expire till Christmas next, the Committee, being desirous of rendering it productive to the Company as soon as possible, embraced the first opportunity the state of the works afforded, for opening the Navigation, and have accordingly established a Passage boat, by which there has been a regular conveyance along that line since the 1st day of July last. The earnings of that boat, up to the 19th instant, amount to £394.li

Boats have likewise been provided for the conveyance of heavy goods, and a very considerable quantity carried by the Canal, to and from the present Chester Fair, but the account of the earnings of the boats is not yet made up. From this short specimen, and from the inquiries and proposals, which have been made from various quarters, respecting the conveyance of goods etc on the Wirral Line, there is every reason to expect that the

tonnage on that part of the Canal will much exceed the amount hitherto stated to the proprietors.

By an arrangement which has taken place between the Ellesmere and the Chester Canal Companies, and the Dean and Chapter of Chester, the Wirral Line of the Ellesmere Canal is supplied with water from the Chester Canal, on the Summit level, which provides a material advantage, without any additional expence to any of the parties.

The whole of the Llanymynech Branch is now cut, and the communication with the Montgomeryshire Canal is forming, in order that the progress of the Ellesmere Canal in that quarter may be in equal forwardness with the operations of the Montgomeryshire Canal Company.
That part of the main line which proceeds from the Llanymynech Branch, towards Chirk, is now cutting, for the purpose of approaching the Rhuabon Collieries, and the Slate Quarries in that neighbourhood; and the contractors with the company are also employed in cutting a part of the main line, which extends from the Llanymynech Branch into the neighbourhood of Cockshut and Baschurch, about five miles whereof, in length, are already completed.

The Aqueduct at Pontcysylty is carrying on with all the dispatch that a work of that magnitude will admit of.

Shrewsbury October 21, 1795.

1796 (October 10) *Extract from Letter from Telford to Matthew Davidson concerning drawings for Pontcysyllte Aqueduct (Ironbridge Gorge Museum Trust)*

'I have here sent you the geometrical drawing of Pontcysyllte. I have left the foundations to be put in on the spot, and according to the depth- the number of piers are likewise undetermined.'

1796 *Extract from letter from Telford to Matthew Davidson (Ironbridge Gorge Museum Trust)*

'I have daily expected expected your drawing of the iron aqueduct and was anxious to have it before the meeting of the Committee, which is to be held on the 13th.'

1797 (10 Feb) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/2)*

Ordered to enquire upon what terms Mr John Wilkinson and Mr William Reynolds will either jointly or individually agree to furnish the Iron Work for Pontcysyltee and fix up and compleat the same.

1797 (June 28) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/2)*

Ordered that an advertizement shall be inserted in the Shrewsbury and Birmingham and one of the London papers for proposals to be sent to Mr Telford the General Agent of this Company for proposals for executing the iron work at Pontcysyltee according to the plans and dimensions to be left with Mr Telford.

1799 (27 Nov) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/1)*

Ordered that the remaining Masons work at Pontcysyltee be immediately advertized to be let by contract at the next meeting of this Committee.

1799 (27 Nov) *Report of Thomas Telford to the General Assembly of Ellesmere Canal Proprietors (Shropshire Record Centre Deed no 15036)*

There are now upwards of forty five miles of the canal completed, of which there are now in Cheshire 9; Denbighshire 3 Shropshire 33 - 45.

The parts which are in hand are, The Aqueduct, Tunnel, Deep Cutting, and Embankments, which lie between Chirk Bank and Pont Cysylte.

There are also in hand a short tunnel, under the Shrewsbury and Whitchurch Roads near to Ellesmere, and a portion of the Canal which leads from Ellesmere on the Road to Wem. All the Arches of the Aqueduct at Chirk are now completed, and the spandrels and wing walls, with the preparations to receive the bottom, will be ready early in the Spring; proposals for the Iron Plates, which are to form the bottom, have been received, and they will be provided and laid early next Summer. The Tunnel and Deep Cutting at the North End of the Aqueduct, are also proceeding rapidly. The Canal which proceeds from the Irish Road along the South Bank of the Dee has all been lined, and in the course of this winter, stuff will be conveyed in boats from the deep cutting near Chirk, to the Embankment at Pontcysyllte. As soon as the season will permit that the masonry be taken in hand, I have recommended that the Abutments and remaining portion of the piers of Pontcysylte Aqueduct should be begun upon; by which means, by the canal is carried towards Wem and Whitchurch, the Lime and Coal Works, in the neighbourhood of Chirk and Ruabon, will be enabled to send their produce there by water conveyance. A fire engine has been erected at Ellesmere Port, which can supply that part of the Canal with a lockful of water per hour. A graving dock is now nearly completed at Chester, which is a convenience very much wanted for the trade there, as formerly there were no means of repairing the flats, but at Liverpool or Runcorn, and in those Graving Docks it was next to impossible to get a birth.

Preparations are also making to extend the Warehouses at Chester, the present being found too confined for the increasing trade there.

In the course of this year, although the works we have had on hand have been of a troublesome and difficult nature, viz. Aqueducts, Tunnels and Deep Cuttings, yet we have been hitherto successful, and we have had no accidents, nor have any parts of these great works shewn the least symptom of giving way. Even from the effects of this unusually tempestuous season (with the exception of two culverts, which taken together have cost no more than £100) we have kept altogether clear. When this circumstance is compared with the consequences from the failures of other canals, during the same season, it may surely be admitted as a proof, that the works are equally substantial, and equally well attended to- The Trade upon the portions of the Canal which have been rendered navigable, is quite equal to what could have been expected upon new Canals. The produce of the Passage Boat (notwithstanding the season has been much against that mode of travelling, and has almost wholly prevented bathing) is yet more than, in the same time, during any preceding year. This may be seen by the Tonnage Journal.

The tonnage upon heavy goods is also increasing, and will still increase as flats can be provided to supply the demand, eleven flats are now regular traders to Liverpool and Manchester, and upon the River Dee; and four other flats are now on the stocks, which are also intended for this trade, and a very considerable degree of competition is now arising in the summer.

In Shropshire, the exertions which have been made in opening Lime Stone Quarries and building Lime Kilns, in various parts of the country, and the readiness with which upwards of twenty distinct carriers have embarked in the Coal and Lime business, promise a supply equal to the demand of the country. And considering that it has just been on the opening of the Canal, when the works have scarcely been completed, and all the roads and connections with the different wharfs imperfect, the consumption has been far from inconsiderable: The navigation has not been fairly worked in this quarter of the country much above one year, and the amount of the tonnage, at a very low rate, is upwards of £1700 which with the rents of houses and boats built by the Company, will amount to about £2000 from the lines in Shropshire.

Upon the while, the Committee are justified in assuring the General Assembly that the works are proceeding as rapidly as prudence will admit, and that the trade upon the canal promises to answer the expectations of its original promoters.

I am gentlemen with much respect, your very humble servant. Thomas Telford

Ellesmere November 27 1799

PS. This report was made at the General Assembly, when it was ordered to be printed. It was also ordered that the works at Pont Cysylte Aqueduct which have for some time been suspended to expedite those at Chirk, be proceeded with as soon as the weather will permit in the Spring.

1800 (24 January) *Report of William Jessop to the Proprietors of the Ellesmere Canal Company (Institute of Civil Engineers: Hadfield Papers)*

On our way to Pont Cysylte, I saw the cut Branch to Brumbo: it is doubtful whether it can be made useful, until an extension can be made to Holt: and that is a subject which, I apprehend, does not immediately demand consideration. When the works more immediately necessary are executed, they will tend very much to narrow the field of speculation, and bring the objects, which it may have in view, more distinctly under the eye.

As the many obstacles thrown in the way of the original intension, and the change of circumstances which have taken place since the obtaining of the Act, have shown it to be wholly unadvisable to execute a canal between Pont Cysylte and Chester, and especially since the extensive opening of the collieries between Hawarden and Flint, which will communicate by Railway with the Dee, so as to deliver coal at a much les price at Chester than formerly - the great object for immediate consideration is, how to deliver coal at the least expence, from the Rhuabon Collieries, into the Bason on the South side of the Dee at Pont Cysylte.

On a survey which has been made from several Collieries to Pont Cysylte it appears, that a Railway might be laid down, on a declivity of a quarter of an inch, in a yard in length, which is as good an inclination for the purpose as could be desired; but, to preserve accurately this regular declivity, it would require some circuity in the line, some extra expence in embankment and deep cutting, and probably some deviation from the line authorised by the Act, in parts where it might be objected to.

I would recommend, that some latitude be taken in varying the declivity, so that it would be no where less than one-eighth of an inch in a yard, nor greater than half inch in a yard: by this means, it is probable that the line may be brought within the limits of the parliamentary line, in those parts where objections might be made to a deviation, and some difficulties in the execution may be lessened or avoided.

So circumstanced, and confiding that if there were to be a canal there must still be Railways from the collieries, and that, with the lockage, the expence would at least be double the cost of a Railway, it appears that the latter is most advisable.

It is next to be considered, if a Railway should be so far determined on, whether it should be continued over the columns intended for the Aqueduct, or whether the Aqueduct should be completed to communicate with the Railway on the north side of the river: and this question involves two material consideration – the time in execution, and the expence.

The time required to execute the Aqueduct would, probably, be a year more than would be required to do the Railway, and this would necessarily occasion some considerable loss in the Tolls. – The cost of an Aqueduct, on a pretty accurate calculation, would be about 8400l. more than that of a Railway, including, in the latter, about 500l. expence, for conveying the water from the north to the south side, by elm pipes.

If at any time hereafter the increasing prosperity of the country, a great increase of

population a discovery of more valuable mines, or other unforeseen circumstances, might make it desirable to have Navigable communication, the Iron ribs necessary for the Railway, and the railing, might become part of that which is necessary for an Aqueduct. – as there will be no obstacles to create concussion like that of a heavy carriage moving over a pavement, the motion of a train of wagons will be nearly as smooth as that of a boat moving over water, and by connecting them by chains of any length that apprehension may suggest, there weight may be almost equally dispersed over any given length of the Bridge, until experience may create confidence.

In the execution of the columns, I would recommend, that in what remains to be done, they should be built, and be composed of stones well worked to two feet in bed, and be connected one side with the other, at every six feet in height, by two pieces of oak (dovetailed a little on the underside) principally for the purpose of internal scaffolding. The courses thus put together, will be less liable to false bearings than if they were solid: it will save five or six hundred pounds in the expence; and what to me appears most material, it will afford safety to the workman.

Instead of wing walls connected with the abutments at the end of the embankments, it will save some expence, and perhaps have a better appearance, if the abutment, built of rough masonry, and connected by bond timbers, with a counterfort about 12 feet in length, and 7 feet in thickness, be buried in the slope of the earth, terminating the embankment; the earth, so sloping, will bury near a half of the next column, which half may of course, be built of rough masonry. The whole of the sides of the embankment should be planted, which in time, would become not only ornamental, but profitable.

I cannot leave Pont Cysylte without saying that the columns, without any exception, are executed in a more masterly manner than any thing of the kind that I have before seen.

As there are now about 30 miles of canal completed in Shropshire, and three in Denbighshire, which, if a sufficient supply of coal could be obtained, would immediately become productive of a very considerable income; this supply cannot be fully obtained until the canal be opened as far as Pont Cysylte; and as little more than a mile, now under execution, is wanting to make the canal so far complete, this obviously requires to be carried on with vigour. In this mile is comprehended, the deep cutting through Chirk, the Tunnel connected with it (which will be about 500 yards in length) the Chirk Aqueduct, the canal on Chirk bank, and the Bridge on the Chirk Road: these works are now n considerable progress, but it will take about twelve months to complete them.

The masonry of Chirk Aqueduct is very perfect. I have no reason to recommend any deviation from the design, except that I think the uniting the iron plates by screw-bolts, unnecessary: if any sensible contraction or expansion should happen by change of temperature, they might possibly be injurious.

Of the Bridge in Chirk Road there will be no reason to complain; the road will rather be improved by it.

Next to the part above-mentioned, the extension from Ellesmere to Hampton Bank, will tend considerably to increase the trade, and this will probably be completed within six months; and by the time that the canal may be opened to Pont cysylte, this Branch may be extended to within four miles of Whitchurch and of Prees.

The works so far completed, will nearly give full scope to the consumption of coal and lime in a country where no other can come in competition with it. Further extensions will, no doubt, enlarge the consumption; but, towards Shrewsbury, though the lime will command a market, the coal will be met by that from the Shrewsbury canal. It would, at present, be premature to say, when the extension from Wefton to Shrewsbury, or from Whitchurch to Nantwich, should commence, perhaps the principal object of these extensions will be, their relation to the Commercial Connection between Shropshire, Montgomeryshire, and Liverpool.

I have now only to submit to the committee, that it will be proper to cause surveys to be made for Lines of Railways towards Oswestry , and the collieries there, and to the Porthywaen Lime Rocks, for the purpose of ascertaining and comparing the expence of executing any part of such Railways, with the utility to be derived from them.

1800 (5 February) *Estimate of John Simpson for completing the masonry of Pontcysyllte Aqueduct (Institute of Civil Engineers Gibb Collection Box 73)*

Particulars of Pontcysylte

For compleating Pontcyssyltau aqueduct agreeable to Mr Telford's Report and annexed drawings
Square masonry at per foot cube one shilling and two pence exclusive of the labour to making and shifting scaffolding and moving crane. Rubble work in the abutments for labour and mortar including scaffolding and crane 4s 9d per yard cube, and any stone which may be wanted to compleat the abutments over and above those which are now lying on the ground which are the property of the Company to be provided for at a fair valuation according to the different places they may be wanted for.

Or if more agreeable to the Committee the whole of the above work to be left to a fair valuation as it finished at the end of each season

Signed John Simpson

1800 (Feb 5) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/2)*

Proposals from different persons having been delivered to this meeting in pursuance of public advertizement for compleating the Pillars and abutments at Pontcysyltee and John Simpson of Shrewsbury Mason having offered to execute the square Masonry at one shilling and two pence per cube foot and the rubble works at four shillings and nine pence per cube yard upon the terms mentioned in the specification now produced and in his written proposal and this being the most adviseable offer for the Committee to accept. It is ordered that the said John Simpson shall be contracted with for executing the said work on the terms above mentioned according to his said proposal and the said specification to both of which and also to this order he is to subscribe his name.

1801 (Nov 25) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/2)*

On considering the different estimates of the expence of making a canal or railway

across the Aqueduct at Pontcysyltee and receiving the opinions of the Engineers of this Company on the subject it is the opinion of this Committee that it will be for the interest of this Company to make a canal across the said Aqueduct in preference to a Railway and it is therefore ordered that the General Agent to this Company do make out the necessary drawings and specifications for making and compleating a Canal across the said Aqueduct and do advertize for proposals for m persons willing to undertake the same to be sent to him or to Mr Potts the Clerk to this Company at the end of two months from the time of the same being advertised, in order that such proposals may be laid before this Committee at their first meeting after the same shall have been received. And it is further ordered that the Banks of the Canal at each end of the said intended Aqueduct shall be formed in such manner as to be adapted to such Aqueduct when compleated.

1801 (25 Nov) *Report to the General Assembly of Ellesmere Canal Proprietors (Shropshire Record Centre Deed no. 15038)*

During the present year there has been a considerable progress made in the works of the Ellesmere Canal Company, especially in those of the greatest magnitude and difficulty.

The Chirk Aqueduct, which is seven hundred feet in length, and seventy feet high, is now compleated.- This aqueduct is different in its construction from any hitherto built:- there is no earth or puddle made use of; the waterway is formed with a cast iron bottom, and square masonry on the sides; the spandrels of the arches are hollow. By this mode of construction, a very considerable proportion of the masonry is saved in the breadth of the Aqueduct; the risk of expansion or contraction from puddling is avoided. In case of any leakage, the water may find its way through the spandrels, without injuring the work; and every part of the masonry, and the bottom of the waterway, may be readily examined at all times.

At the north end of the aqueduct, there is a Tunnel four hundred and fifty yards in length, which (Excepting a small portion of the towing-path) is also compleated.- To form ths tunnel, the ground, though deep, was cut open in different lengths, which afforded an opportunity of making the brick work very perfect, and securing the top of the arch with clay and loose stones, to prevent the waters of the upper strata from injuring the work; by this means, if any water flows from the hill, it will fall into the Canal, and a very considerable quantity now falls in from the strata cut through by the Tunnel.

To the north of the tunnel, the deep cutting, which continued for about three quarters of a mile, and was a tedious operation, is now finished and will be ready for the navigation by Christmas.

Along the south bank of the Chirk valley, the canal is formed, lined and filled with water. We have great pleasure in reporting this as completely successful; particular pains having been taken with this work in consequence of many persons, whose judgment we value, having entertained some doubts of its practicability. The Irish Road at the Union Bridge is much improved, when compared with its former state.

By Christmas the navigation will be perfected, and opened from Chirk bank to the south end of the embankment adjoining Pontcysylte. The process of this great work is now carried on with as much dispatch, as the nature of the business will admit of- During the

last year and a half, five piers have been built from the foundations up to the level of one hundred and ten feet above the common surface of the river Dee. Nine other piers have been raised twenty three feet in height,which has brought them up to the same level; there are five other piers which require twenty three feet each to raise them to the before-mentioned level. Many persons of judgment who have visited the works of Pontcysylte and Chirk have expressed themselves satisfied with the manner in which they are executed, as well as with the time which they have been in hand, which they consider as essential to the consolidating of works of so great a mass and extent, as well as to the making every enquiry and experiment which may tend to the perfection of undertakings of so great magnitude and expence.

1802 (8 March) *Letter of William Jessop to John Rennie concerning the measurements of the piers at Pontcysyllte Aqueduct (National Library of Scotland MSS 19771 no.113)*

Mr Telford's account of the pillars at Pontcysyllte is as follows

Height from the low water's surface of River Dee to the surface of water in the Canal - 125 ft.
Distance of piers at top - 45 feet
Dimensions at the top- 12 feet long 7 ft
Ditto at the foot of the shaft 20 feet long 7 ft
Pedestral larger of course

As the bridge is now intended for a railway descending toward the Canal, the Pillars will now be something higher.

Yours etc W. Jessop

1802 (12 March) *Inspection report of John Rennie on the Pontcysyllte Aqueduct with diagram of a pier (National Library of Scotland MSS 19875 f.18)*

The Piers of this Bridge are 20 feet wide up and downstream at the top of the saliants angles 10 feet thick, from the salient angles downwards the pier is both thicker and wider this I cannot say how much that it must be pretty considerable. They taper much towards the top and may be after thought of. The piers at the top of the said angles are 40 feet asunder.

1802 (March 17) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/2)*

Mr William Hazeldine of Shrewsbury having proposed to execute the cast iron work at Pontcysyltee Aqueduct upon the following terms (viz).

The castings at eleven pounds per ton. The wrought iron at eight pence per pound. And being allowed thirty pounds for Cast Iron Keys to connect the plates of the Aqueduct over and above the price of eleven pounds per ton upon the whole weight and to perform the work in every respect according to the conditions and specification now produced and signed by the said William Hazeldine and the said William Hazeldine's proposal being the most for the advantage of the Company this Committee accepts of the proposal of the said William Hazeldine and order that the general agent of the Company do contract with the said William Hazeldine for the performance of the said Contract and

the said William Hazeldine is to propose two sufficient sureties who are to be bound with him in the sum of two thousand five hundred pounds each for his duly performing his contract the names of such sureties to be given to Mr Hunt the Chairman of this Committee or sent to Messrs Potts and Leeke in Chester within fourteen days from this time.

1802 (30 June) *Report by Thomas Telford to the General Assembly of Ellesmere Canal Proprietors (Shropshire Record Centre No. 15039)*

The navigation of the Chirk Line of Canal is now carried over the Aqueduct, and through the tunnels and deep cuttings in that neighbourhood, up to theBason at the South end of the Embankment at Pontcysylte. This has cut off a great portion of the land carriage of the coal from Ruabon, and has added four miles of tonnage to the Canal: by this means, the supply of both fire and lime coals will, in future, be more regular and abundant and the lime kiln at Hampton-bank being now in work, the demand for coal will also be much encreased. On account of the encreasing demand for coals, several companies have lately been formed and have opened new coal works in the neighbourhood of Plas Kynaston and Ruabon; some of these works are perfected, and others are in great forwardness, so that by the time the embankment and aqueduct of Pontcysylte are completed, the Coalworks will be sufficiently numerous, and in a state to supply the demands of the country.

By the original act of Parliament, about seven miles in this quarter were exempted from paying tonnage, but by an act obtained last Sessions of Parliament, this distance is subjected to the same rates of Tonnage as the other parts of the Canal; and Railways will be adopted in place of a canal, from near the north end of Pontcysylte, through the canal works to Ruabon: measures are now taking to put these railways in hand, so that they may be completed about the same time that the Aqueduct and Embankment are finished.

It must be evident that the supply of the Canal will never be compleat until the Connections with the coal works are perfected; the land carriage over from the pits across the river Dee is a considerable expence; carriage cannot be procured to the extent wanted; and as the canal will soon be finished; it is not an object to any person to form any new plans for land carriage.

The canal is now in hand from Hampton Bank towards Whitchurch and Wem, in consequence of that part of the country opening a great consumption for Coal and Lime, as well as being a part of the line, which, when joined to the Chester Canal near Nantwich, will open the Communication through which commercial goods will pass from Liverpool and Manchester into Shropshire and Montgomeryshire; it is a desirable object, next to the works at Pontcysyllte, to employ the chief exertions of the Company in that quarter.

1804 (28 November) *A report of the General Assembly of Ellesmere Canal Proprietors (Shropshire Record Centre 212/Box 366 Bridgewater Papers: Bundle of correspondence and papers re. holdings on the Ellesmere Canal)*

Since the General Assembly which was held in June last, the Attention of the Committee has been directed chiefly to the following portions of the Canal.

1st The making the water line from the summit level at Pontcysylte up the north side of the Vale of Llangollen.

2d Proceeding with the Aqueduct and Embankment at Pontcysylte.

3d Proceeding with the Line of Canal from Tilstock Park to the Chester Canal near Nantwich.

These several extensive works have all been carried on with great vigour, upwards of five hundred men, on average, having been constantly employed upon them.

As soon as the Act of Parliament for the water line had received the Royal Assent, measures were immediately taken to carry the same into execution, with all possible dispatch; about two hundred and fifty men are now employed upon it: There is a prospect of getting most of the earth cutting completed in the course of the ensuing winter; a considerable portion of the rocky part of the line, opposite to Llangollen, is already cut, and the masonry of several of the culverts is executed.

The Ironwork of the Trough-Part of the Aqueduct of Pontcysylte over nine arches, is now put up, being nearly one half of the whole length, many plates now being cast and brought to the bank at the North end of the Aqueduct- the Workmen being familiar with the operations of putting the Plates together- and the operations of the foundry being in a very regular train and well supplied with metal, there is a reason to expect that the whole of the Trough part will be completed about midsummer next. Timber has been provided for a part of the towing path, which will be put up early in the Spring, as well as the iron railing to protect it.

The earthen embankment and lining for the canal, is carrying on by means of three iron railways; and it is proposed to have this part finished at the same time with the aqueduct.

With respect to the canal from Tilstock Park to Whitchurch and Nantwich, being a distance of a about sixteen miles, a premium has been offered to the contractors, Messrs Fletcher and Simpson, to induce them to make this part navigable at Midsummer, instead of Christmas 1805. Great exertions have been made by them for this purpose; most of the groundwork is already completed- the bridges are nearly all built- seven of the Locks have either been built or are now in hand- and as most of the stone and timber, and a great proportion of the bricks are already provided, there is a reasonable prospect (unless the ensuing winter is uncommonly unfavourable) that they will be able to render this part navigable by Midsummer next.

It being reasonable to expect, that as soon as the Aqueduct and Embankment at Pontcysylte are completed- Water procured upon the Summit level- and the Navigation opened beyond Whitchurch- the demand for coals will be very much increased. In order to ensure a plentiful supply, the Committee have taken measures to make a cast iron double railway from the Bason near the north end of Pontcysylte, through the Acre-fair, Plas Maddoc and Plas Benyon collieries; and Mr Hazeldine has undertaken to deliver the iron rails upon the spot, of the best quality, at eleven pounds per ton, and to maintain the same for twelve months after they are laid.

During the dry weather in autumn, the canal through the deep cutting at Chirk was

cleaned out, and will now admit boats with full loading to pass.

The other parts of the Canal which are navigable, are all in good condition. Ten new boats have been built, and two more are now in hand; they are at present rented by Mr Fletcher, and will be ready to work upon the Canal when the Navigation is extended.

Sundry meetings have been held, and communications taken place, between deputations from the Ellesmere and Chester Canal Committees, but they have not as yet been able to agree upon a plan for uniting the two interests, and the Chester Canal Company are taking measures to render that Canal effective.

The revenue of the Canal, for the last twelve months, notwithstanding the insufficiency of the supply of water during the dry weather, exceeds that of the preceeding twelve months about six hundred pounds.

A considerable portion of the arrears due upon the Canal Stock, has been paid into the hands of the Treasurers, and the Law agents of the Company are taking vigorous measures to enforce the payment of what yet remain due.

Thomas Telford

1805 (January) *Universal Magazine Vol 3 p.88*

'The Pontcysylte Aqueduct consisting of nineteen pairs of conical pillars placed at the distance of 52 feet asunder, each pair supporting a kind of elliptical bridge of cast iron, should be completed about midsummer next... The engineer proposes to erect an iron platform and railing on the south side for the towing path for horses, but as this will be attended with an immense additional expense and would in some measure weaken the present work, there is some reason to hope and expect that some plan may be devised for rendering such towing path unnecessary.'

1805 (27 November) *Report of Thomas Telford to the General Assembly of the Ellesmere Canal Proprietors on the opening of the Pontcysyllte Aqueduct (Institute of Civil Engineers Gibb Collection Box 73)*

Chirk Bank, to Pontcysylte, &c. &e.

This division of the canal is composed of works more difficult of execution, than can perhaps any where be found within an equal distance upon canal Navigation.

From Chirk Bank on the south side of the River Ceriog to the north bank of the River Dee, is only four miles, but in this distance there are two very large Aqueducts, two Tunnels, nearly a mile of very deep cutting, and the remainder consists of benchings along very high and steep banks.

Chirk Aqueduct is six hundred feet in length and seventy feet in height; it consists of ten arches, forty feet span each, and is constructed chiefly of rubble stone, excepting the bottom of the canal, which is formed with plates of cast iron.

The Aqueduct of Pontcysylte is one thousand and seven feet in length, and one hundred and twenty six feet eight inches in height, from the surface of the rock on the south side

of the river Dee, to the top of the iron side plates of the water-way; and there are nineteen Arches of forty five feet span each. The piers (eighteen in number) are constructed of square masonry, and the arches and water-way are composed or cast iron. At the fourth end of the Aqueduct, there is an earthen embankment fifteen hundred feet in length, and seventy five feet in height at the north end. Between these Aqueducts there is one tunnel about five hundred, and another about two hundred yards in length; the deepest of the open cutting is about forty five feet.

The Chirk Aqueduct tunnels, and deep cuttings have been completed; the canal has been navigated through them for some years; and they have been found to answer their several purposes.

Pontcysylte Aqueduct is now also completed, and the navigation is thus carried across the valley of the Dee, to the Ruabon Collieries and Trevor Lime Rocks, and connected with the water line from the Dee above Llangollen.

From the north end of the Aqueduct, the Canal is continued for a distance of about three hundred yards, and there terminates in an extensive Bason, which is completed and formed so as to afford a double wharfage with iron railways.

From this bason an iron railway has been laid and carried near Plas Kynafton stone Quarries, through the Acrefoir Collieries and is to be continued to the Ruabon Brook. The length of this railway will be about three miles.

Pontcysylte Embankment

William Hazledine, iron work rails and waggons

		£	s.	d.
Wheels		219	19.	0.
Davies and Co. by contract	5827	7.	7.	
Raising the towing path and opposite bank, By measurement and lining the canal part, by the day		2523	9.	1.

Pontcysylte Aqueduct

	£	s.	d.
Trials for stone, &c paid by Thomas Telford	16	12	1
James Varley, for masonry	2001	19	10½
Simpson and Varley, ditto	10,445	14	7
John Simpson, ditto	8520	1	1
William Hazledine, for iron work	17,284	17	5½

Carried forward	38,369	5	1
	360,547	0	6½
Bought forward	38,369	5	1
William Smith, for a model of one arch, &c	46	15	10
John Fletcher, for deals	82	10	0

1807 (Nov 25) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/3)*

The difficult works upon the Water Line from Pontcysylte to Llantisilio being now nearly completed and it being thought unnecessary that there should be a separate Inspector of the said line. It is ordered that a proper bank tenter (?) shall be immediately appointed, whose sole occupation shall be the attending to that line, the Acqueduct at Pontcysylte and the Canal Banks as far as the Irish Bridge near thereto. And that he report any defects or appearance of defects in the Acqueduct at Pontcysylte to Mr William Stutter and any other defects in the line to Mr Denson.

Ordered that the Acqueduct at Pontcysylte be painted at a proper season in the manner pointed out by Mr Telford's report of this day.

1813 (July 19) *Minutes of the Committee of the Ellesmere Canal Company (PRO RAIL 827/3)*

It appearing by Mr Telford's report of the 5th of January "that the Iron work at Pontcysylte Aqueduct should receive a proper coating to preserve it from the actions of the Atmosphere", it is ordered that such part of it, as now wants such coating, be immediately done, either with coal tar, or such other coating as may be thought proper and effectual and attended with the least expense, and if the whole of the Aqueduct cannot be coated in the present year, then, that such part only as most requires it be done the present year, and the remainder as early as possible in the ensuing year.

1818 (1 May) *Instructions from Telford to James Thomson re. his inspection of Pontcysyllte Aqueduct. (Institute of Civil Engineers: Edinburgh and Glasgow Union Canal Papers no.308)*

Pontcysylte

Mr Thomson to examine the whole of the iron work carefully and compare each part of it with the similar parts of the drawings made in London, and note any difference.

To enquire of Mr Stuttle

1 What was the thickness of the plates when cast, and whether in his opinion they might be with safety made any thinner.

2 The size of the screw bolts and nuts, at what distance they were put, and whither fewer might do.

3 The size of the flanges, that is, depth and thickness.

4 The quality, and thickness of the jointing stuff, how prepared and uses, with his opinion whither anything better could be substituted.

5 The best mode of setting a complete arch.

6 Observations respecting boxes, moulding and casting the different parts.

7 The best sort of scaffolding on centres.

8 Nature of framing, and distance of supports under the towing path.

9 Whither any end flanges to bottom plates, and how caulked.

10 Whither Mr Stuttle has observed any particular effects upon contraction and expansion in the iron ever.

11 Whither the embankments at the ends are quite consolidated, or if they continue to sit, or when they became consolidated.

12 Explain to Mr Stuttle the manner of finishing the iron work at each end, and saving the bearing walls.

1818 (8 May) *Report of James Thomson to Thomas Telford re. his inspection of Pontcysyllte Aqueduct (Institute of Civil Engineers: Edinburgh and Glasgow Union Canal Papers no.306)*

Since leaving London, I have in conformity with letter of 1st last been at the iron works at Calcutt etc, where I examined the whole but owing to my taking the coaches and came up to them after leaving Wrexham, I have not had a spare hour to write until now.

At Calcutt, the material from which the iron is made, are those called the best all over that quarter. And from all the trials and examinations I made, the iron certainly is the strongest I have met with. Here the accommodations for doing such castings as your state, are simple, with abundance of material and very convenient for shipping on the Severn. I also attended particularly to the wrought iron works at Upton, where, from the tryals I made on several bars of different sizes, I have no hesitation in saying, I would prefer this iron for the fitting up of such work to swedish iron.

The foundry at Shrewsbury is extensive and the castings are principally made from Calcut iron, using the weakest for small and general castings.

In going over every part possible of the Pontcysylte Aqueduct, the whole of the iron work is in as good condition as when completed, and without the least appearance of a drop of water having passed at any part.

The bottom and side plates are 1 inch thick and Mr Stuttle would not recommend them any thinner. He agrees that the sides might be as well or better 7/8 of an inch at top and 1 1/8 inch thick at bottom.

Distance of bolts from centre to centre is 9 inches. Those for fastening the ribs are 1½ ×1½ inches, and those for the bottom and the side plates 1¼ × 1¼ inches. He also agrees that the bolts for the plates might be as well a little smaller than 1¼ and rather closer together than 9 inches.

The flanges on bottom plates are 6 inches broad, very little stouter than body of metal, and would not do well, he says, any narrower.

The jointing is done with very coarse flannel in the state it comes from the loom, cut into pieces to suit the flanges and well covered with white lead of the usual consistency for jointing, and more or less of these pieces are put in according to the inequality of the joints which come together. They are also cut a little narrower than the flange so as to leave a space on both sides to be caulked firmly up with good hemp rolled in tar, and being well caulked and pitched over. I know of no simpler or cheaper method of jointing for cold water, and the only difference I have seen when such was used, was to roll the flannel on a thin piece of lead, but this, though firmer and easier fitted, would add to the expense- and I have never seen a piece of cast iron work more water tight than this aqueduct.

Notes 5th and 6th I consulted with Mr Stuttle on also. The scaffolding and centering was done by leaving square holes in the piers two courses from the top, and running beams along from pier to pier in these holes, supporting each beam by diagonal braces under, and raising tressels over the beams. These answered completely.

The supports under tracking path are of fir- an upright in front, and diagonals crossed under path. They are 5 feet apart and are very much decayed. And likewise the planking under gravel (3 inch oak plank) is now considerably failed.

There are end flanges to the bottom plates, same depth as those stated (6 inches) caulked downwards from within and horizontally from without. I think the flanges next the side plates should be 6 inches and the other (on bottom plates) 4 inches.

Mr Stuttle has never observed the least difference of any kind from expansion or contraction, although he has seen the ice on the aqueduct from 6 to 8 inches thick.

The embankments at the ends from being so often repaired, he cannot say whither they have sunk very little, and were very troublesome for several years at first, particularly the N E end of Pontcysylte where the stuff was not quite so good. And even the large embankment where the best of material was used has sunk 4 inches besides the breaking out close to the building.

1821 (27 August) *Report of the Committee appointed at the General assembly of the Proprietors to inspect the whole line of the Ellesmere and Chester Canal for the purpose of ascertaining whether any saving of expense can be effected in the supporting and maintaining of the same. (Shropshire Record Centre 212/Box 366 Bridgewater Papers:*

painting of the aqueduct at Pontcysyllte (Institute of Civil Engineers)

To the best of my recollection in the joints of the cast iron plates for the waterway of Pontcysyllte Aqueduct were introduced 2 or 3 thicknesses of flannel and white lead, and when screwed up all the vacuities were filled with iron borings etc. this mode of jointing proved by experience to be effectual.

If such a thing were now to do, I should prefer patent felt, saturated with tar, not as a preferable substance to the other, but entirely on the score of economy.

1832 (25 July) *Report of Thomas Telford in the Ellesmere and Chester Canal (PRO Ref. RAIL 826/3 pp.143-44)*

The great aqueducts and feeder are in a perfect state by the latter a plentiful supply is passed along the summit and from thence is directed to the Severn, Dee and Mersey.

1838 *Extracts from the Life of Thomas Telford (ed. Rickman) concerning the construction of the Pontcysyllte Aqueduct (pp.41-46)*

'On account of gravelly earth being readily procured from the adjacent bank, it was found most economical to push forward an earthen embankment 1500 ft in length from the level of the water way of the canal, until its perpendicular height became 75 feet, still a distance of 1007 feet intervened before arriving at the north bank, and in the middle of this space the River Dee was 127 feet below the water level of the canal which was to be carried over it; therefore serious consideration was requisite...To lock down on each side 50 or 60 feet, by 7 or 8 inches, as originally intended, I perceived was indeed impracticable, as involving serious loss of water on both sides of the valley.

To construct an aqueduct upon the usual principles, would have been hazardous and enormously expensive. I had about that time carried the Shrewsbury canal by a cast iron trough at about 16 feet above the level of the ground and finding this practicable, it occurred to me, as there was hard sandstone adjacent to Pont y Cysylte, that no very serious difficulty could occur in building a number of square pillars, of sufficient dimensions to support a cast iron trough, with ribs under it for the canal. After due consultation I caused a model to be made of two piers, a set or compartment of ribs, the canal trough, the towing path and side railing, with all the flinches, their nuts and screws and jointing complete (Note: this model, by William Smith, is preserved in the Stoke Bruerne Museum). The height of the piers above the low water in the river is 121 feet, their section at the level of high water in the river is 20 feet by 12 feet, at the top 13 feet by 7 feet 6 inches. To 70 ft elevation from the base they are solid, but the upper 50 feet is built hollow, the outer walls being only 2 feet in thickness, with one cross inner wall. The width of the waterway is 11 feet 10 inches, of which the towing path covers 4 feet 8 inches , leaving 7 feet 2 inches for the boat, but as the towing path stands upon iron pillars, under which the water fluctuates and recedes freely, the boat passes with ease. The stone piers are 18 in number, besides the abutment piers...one man fell during the whole of the operation in building the piers, and affixing the ironwork on the summit, and this took place from carelessness on his part.

Opened in 1805

Cost Embankment - £8570 15s 8d
Masonry - £21 162 13s 5½d
Iron Works- £17, 284 17s 5½d
Total - £47,018 6s 7d

1846-49 *Index to the Minutes of the Committees of the Shropshire Union Railway and Canal*
Company (PRO RAIL 623/29 E 90)

Executive Committee no.90 Pontcysyllte Aqueduct to be repaired.

1866 (27 June) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.5661)*

Pontcysyllte Aqueduct- The attention of the Committee was called to this and the London and North Western members of the Committee undertake to request that Mr Baker should be
instructed to inspect the Aqueduct with Mr Beech and to report as to its present condition.

1866 (August 9) *Report of William Baker on the state of the Pontcysyllte Aqueduct (British Waterways Archives Ref. WM 75/90)*

My dear Sir,

In accordance with minute of the special Committee dated 5th ult', I inspected the Pontcysylte Aqueduct with Mr Beech on Tuesday last, and have to report that after carefully examining the whole of this magnificent structure, I found every part of it in a thorough state of repair, with the exception of the South Abutment, and Southerly Pier, and the arch between these. The abutments and piers of this aqueduct are of stone, carrying 19 Cast Iron Arches (each 45 feet span), upon which is the trough or waterway for the passage of the boats. The face stones of the south abutment from the springing of the arch to the underside of the trough (a height of about 9 feet) have in some places slightly moved forward, and in others have pressed against the iron ribs, causing the stone to chip away; the iron ribs are in several places broken, shewing that an undue pressure is acting upon them; there is also a considerable quantity of water finding its way through the masonry. Upon examining the work and hearing the evidence of the foremen and workmen on the spot, with a view of ascertaining the cause of the failure, I am of opinion that the movement in the stone work, and the fractures in the iron, proceed from the swelling of the material at the back of the abutment, and wing walls, caused I have no doubt, by a leakage between the end of the trough and the embankment. To remedy this I recommend that the material at the back of the abutment be removed, the abutment strengthened, and a water tight joint made by puddle or otherwise, at the end of the trough, in doing which, it may be found advantageous to slightly lengthen the trough itself.

The broken joints of the iron ribs should be fished or repaired by some simple method.

The cost of these repairs will not exceed £300 or £400 and it would be adviseable to take an early opportunity of carrying this out. The settlement in the southern pier at first sight appears rather serious from the large openings in the joints of the stone work, but I do not apprehend any danger arising from this, as I am informed by the foreman on the spot that no change has taken place in this pier for several year. I should however recommend that these joints be pointed and the work carefully watched.

Before concluding this report I may add that the iron work of the aqueduct does not appear to have been painted since its erection 70 years ago, some oxidation has taken place but not to the extent that I could recommend your incurring the cost of repairing at present.

1866 (29 August) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.5695*)

Mr Baker's report dated 9th August as to the Pontcysyllte Aqueduct (for particulars see Appendix) was read and after discussion Mr Beech was instructed to submit to the Manager
without delay plan and estimate for the works required to the Aqueduct in order that the same may be put in hand forthwith. The Manager to communicate when ready with the Special Sub Committee.

1866 (26 September) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.5741)*

The engineer reported that the necessary materials materials had been ordered for the repair of the Pontcysyllte Aqueduct and he was instructed to get everything ready with as little delay as possible and to report to the Manager in due time, when he should be ready for a stoppage.

1866 (24 October) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.5762)*

It was reported that a stoppage for a week had been arranged Llantisilio and Hurleston (53 miles) from the 22nd to the 29th instant for the lengthening of the trough of the Pontcysyllte Aqueduct.

1868 (29 January) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.6197)*

Read Mr Beech's letter (no.31) to Mr Bragge stating that the works carried out at the north pier of the Pontcysyllte Aqueduct had completely met the requirement of the case as reported to Mr Baker, but that there was a leak at the north abutment. Mr Beech to carefully examine this abutment and report to the next meeting of the Committee what steps should be taken.

1868 (26 February 1868) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.6244)*

Read Mr Beech's report dated 22nd instant as to the state of the works with reference to Larch plants reporting that the arches of the bridges referred to in Mr Wilbraham

Tollemache's letter were now being restored and stating with reference to Pontcysyllte Aqueduct that the extension of the trough at the north embankment had been quite effectual but that the north abutment as well as the Chirk Aqueduct would require some attention early in April which could be arranged.

1873 (29 January) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/14 no.932)*

The Monthly report of the Engineer (Mr Jebb) dated the 27th was read.. reporting that a slip had occurred at Pontcysyllte threatening to draw down the Canal, and the measures taken to secure the safety of the canal, also stating the progress of the Glyn Valley Railway.

1879 (30 April) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/19 no.12844)*

Mr Jebb reported that the Towing path over the Pontcysyllte Aqueduct made of timber planking had become unsafe and that he was arranging to remove the same and substitute wrought iron buckle plates of about £250 approved.

1886 (24 March) *Minutes of the Executive Committee of the Shropshire Union Railway and*
Canal Company (PRO RAIL 623/22 no.16585)

Painting of Pontcysyllte Aqueduct ordered- Mr Jebb pointed out the necessity of the Pontcysyllte Aqueduct being scraped and painted, and estimated the cost at £500. It was ordered that the work be put in hand. Mr Jebb to arrange with Mr Smith, Bangor for a staff of painters from the Britannia Tubes to be employed and to use the least expensive materials.

1915 (24 February) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/27)*

Leakage at Pontcysyllte- A slight slip in the Embankment at the north end of the aqueduct took place on the 28th of December which caused an old leakage to break out. Canal was emptied on the 18th January, the walls rebuilt and repaired, and some stone drains put in the embankment where the slip occurred, the canal being refilled on the 30th January.

1915 (14 April) *Minutes of the Executive Committee of the Shropshire Union Railway and Canal Company (PRO RAIL 623/29)*

Engineers Report

Slip at Pontcysyllte - The embankment at the north east end of the Aqueduct where the slip
occurred has been restored.

1936 (28th October) *London Midland and Scottish Railway- Works Committee Minutes (RAIL 418/97)*

no. 4188 The Chief Civil Engineer reported that the following tenders had been accepted since the last meeting of the Committee

Nature of Work- Shropshire Union Canal- Tarring of Pontcysyllte aqueduct.

1950-65 Extensive remedial works carried out to the towpath.

1965 Outside elevation of the trough wall plates and outer arched girders repainted with 'Wailes Dove Super Service Black Solution' (C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989) Part 1 Introduction)

1975 (17 June) Report of Damage to Pontcysyllte Aqueduct by B.P. Haskins (Area Engineer)
(Printed in full in C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989

'In addition to some extra spawling, the two central of the four cast iron arches supporting the upstream south end tank had sheared right across in three or four places. The outside two arches had buckled badly.... Having examined the structure it was decided that none of the four cast iron arches was carrying any substantial load and that the rough itself was spanning from pillar to abutment'.

1989 Detailed engineering assessment of Pontcysyllte Aqueduct by Arup associates (C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989) Part 9.1

'It is noticeable that the bitumastic compound used in 1965 for the exterior elevations is still performing well.'

2001 Report on the trial refurbishment of Pontcysyllte Aqueduct concluded that the life span of the existing paintwork had expired and that the structure required repainting. It was recommended that 'a modern, long life paint protection system is applied, with the maximum life to first maintenance of approximately 30 years'.

(S.B. Dennis, *Report on the Trial Refurbishment of Pontcysyllte Aqueduct* (British Waterways 2001)

Appendix: Draft estimates for the masonry and ironwork at Pontcysyllte Aqueduct (undated c.1800) Institute of Civil Engineers Gibb Collection Box 73

Particulars respecting the masonry at Pontcysylte

The remaining part of the piers which have already been carried up to the height of 87 feet above the level of low water in the river Dee, - to be built of squared masonry,

worked so as to correspond on the external surfaces with that which has already been executed in the lower parts – the other piers which are yet to be built are to be executed in the same manner. The piers are to be carried up hollow, the masonry of the upper parts to be 2 feet in thickness – the beds and Joints are to be worked square quite thro of the whole width of each stone, chissel Drafts to be run true around the whole of each beds and Joints to (be) neatly scabbled (?) or pointed of between those Drafts, and also chissed (chiselled ?) roughly with a broad chissel. – The back parts of the stones which form the inside cavity of the pier – the masonry (?) is either to consist of one stone in thickness, being 2 feet in the Bed, or if two stones of each one foot on the Bed, and neatly jointed in the middle – with binders of the width of two feet, placed (?) immediately over them the thickness of the masonry in the pier yet to be built to be determined by the company's engineers.

The whole of the masonry to be laid in a workmanlike manner in proper Lime Mortar and each course of stone to be well grouted. –

The abutments to be built of the form expressed by the amended(?) Drawing, to consist of rubble work to be rough axe dressed with a square form for the outside work, and the Beds scabbled (?) flat for the inside work to be laid in courses in good Lime Mortar, flushed .....(?) as they are laid, and grouted every 18 Inches in height if so directed by the company's surveyor.

(Note: This document was sent to us by Mr. Eustace W. Porter, who assigns it to Simpson. The writing is, however, very much like the writing of Telford about this time, as is the composition. The document is, I think, undoubtedly by Telford himself. Simpson's writing, of which we have specimens following this sheet, is of quite a different character there.)

(c.1800) *Draft Estimate for completing the masonry and ironwork of one opening and a pier at Pontcysyllte Aqueduct (Institute of Civil Engineers: Gibb Collection Box 73)*

(Note: This undated draft estimate only survives in a typescript copy in the Gibb Collection at the Institute of Civil Engineers. It is attached to John Simpson's estimate for the completion of the masonry work of Pontcysyllte, dated 5 Feb 1800, so it was presumably compiled about the same time. However, the parts of the estimate relating to the ironwork of the aqueduct may well have been produced by William Hazeldine, who was associated with the work at Pontcysyllte as early as 1800, although his formal estimate for the completion of the ironwork at Pontcysyllte was not accepted until March 1802.)

Estimate of one opening & pier of Pontcysylte

	£	s	d
171 cwt of Cast Iron.....15sh/ - p cwts.....	128.	5.	0.
Wrot. Iron Screws &c.....	5	0.	0.

3 Inch Plank 52ft x 4.....208 feet...1sh/-	10.	0.	0.
52 feet of Baulk.....3/	7	16.	–
Railing on ditto. .....39 feet ... 5sh/..	9.	15	–
D0 --------do ..... do.....	9.	15.	–
Top Rail.....100 feet.....	2.	10.	–
Iron Staples..... 704....	17.	12.	–
(?) Deal Skirting.....9 x 2....100.. .at 9d....	3.	15.	–
Tar and Paint.....	5.	0.	–
Gravel.....	-	10.	–
Masonry to raise the pier.....672 at 12d/ - .		33. 2.	–
		233.18.	–

16
1398
233
3728
16
3744

Canal – one opening & one pier

	£
46 Tons of cast Iron ...at 15. .	690
Wrot Iron.....	40
Value	£730
	16
	4380
	730
	11680
	3744
	7936

100 Yards long
11 D0 wide
1100
23 N° deep
3300
2200
25300 yards ---at 9d----------948. 15----
12650
6325
/1897/5

Total saving £8884. 15. 0.

948.15 Deduct Pipes to
Carry water 500
8384. 15 0.

Elevation of the aqueduct memorandum for D°.

		Ft	In
Foundations under the river water ---	11	- 9	
Height of the old shaft pedestal	---	26	- 0
Height of the old shaft up to the Ironwork	94	- 2	
Horizontal Rib 6 In Bottom plates 1 In water (4/6)		5	- 1
Add to the North pier in the River for Inclination for the Railroad at 1/10th in. In a yard or 2 1/8 In an arch - - - -		8 - 0	
		145 - 0	
Pier carried up to top of the Railing -		5 - 0	
Total height of the River piers - - -	feet	150 - 0	

I think, the waters in this scheme ought to come no farther than the Bason. – or to make a right Railroad it should come to the end if the bridge, then if the slope was increased to ¼ In. to a yard the North pier abut instead of 8 Ft 10½ In added to the height above top water for 1/10th slope need only be 6 feet for ¼ slope to 18 arches or 5 feet to 15 arches.

- at 1/10th slope suppose a horse draw 3 Tons along the Bridge to the Basin he must go 3 journeys to carry of what he bought to the end of the bridge and all that follow him must wait till this is done so that the cart may be obliged to wait till next day, and if two be going contrariwise the trouble will be insupportable but if the Railroad be made double it will remedy this, and a small more expense will do it, as there will be no need for side braces which would come to the expense of another rib nearly, only the planking would be double in this case, but this is trifling.

- a wharf in the embankment is an immense expense of money and time.
- at the Bason more time will be Lost then would have been in the old scheme of Locking down and up again – we may please ourselves with the Railroad, but when it is finished our troubles are only beginning and the thing is incurable for ever – If the aqueduct were finished in the old way and a Basin and a wharf on the north bank it would avoid much trouble and leave the business in a condition to be carried on at any future period as the company might see convenient.

Draft Estimate for Bridging and Embamking at Pontcysyllte Aqueduct (Institute of Civil Engineers Gibb Collection Box 73

Cyssylltu : Bridging and Embanking compared south side of the river

Comparative estimate between stone piers with Iron Through at top, and embanking with earth.

Beginning at 78ft – 4in on the section, or at the 6th pier on the Land, and ending at 72ft deep on the section or at the situation of the 10th pier on the south side of the river.

Each distance estimating 52 feet in length.

	£	sh	d.
1st Distance contains – 25395 cube yds of earth at 1sh	1269	-15	- 0
By Iron arches &c – 10960 feet cube of stone to 1 pier at 1sh - - -	546	-0	- 0
To 52 feet running of Ironwork to Trough &c at 10£ Pr Ft.	520	- 0	- 0
	1068	- 0	- 0
Ballance in favour of arch &c - - - - - - - - - - - - - - - - - -	201	- 15	- 0
2d Distance 25395 yds of earth at 11d pr yd - - -	1163	-18	- 9
To pier and Ironwork the same as the last above - -	1068	-0	- 0
Ballance in favour in arch &c - - - - - - - - - - - - - - - - - -	95	- 18	- 9
3d Distance contains 25120 cube yards at 10d pr yd - - -	1046	-13	- 4
Stone to D° 10900 feet cube at 1sh - - £545 – 0 – 0)) To 52 feet run of Ironwork at 10£ pr foot 520 – 0 – 0)	1065	-0	- 0
Ballance in favour of embankment - - - - - - - - - - - - - - - -	156	- 17	- 9

If the Iron work can be finished at 10£ pr foot running,and the stone work at 1sh pr foot cube) The Ballance in favour of piers and Ironwork for the above 4 spaces, instead of embanking would be - - -)

£	sh.	d.
122	- 9	- 4

Ft -In

From 72 feet deep on the section to 43 –10 at the back of the Bason containing 312 feet or 6 arches and piers, requires 125370 cube yards of earth to embank it.

A Comparative Estimate betwixt stone piers and Iron Railway and Embanking with common Railway begining at 78 feet W. on the section or at the piers on the land - -

	£	- s	- d
First opening - -			
is 20316 yards cube at 9d	761	- 17	- 0
10960 feet cube of stone at 12d -	548.	0.	0.
52 feet Running of Iron Railway	234.	0.	0.
	762.	0.	0.

By a rough estimate of terminating the aqueduct with or without wings to the south abutment

To Wings with ashlar fronts - - -	£5000.	0.	0.
To Earth slopes without wings - -	£2500.	0.	0.
In favour of Earth slopes - -	£2500.	0.	0.

NB The ground where the abutment is marked on the south side of the river is 20 feet 6 in above the level of the bottom of the shafts of the river piers or 79ft 4 in below the top bank level.

The foundation of the north abutment or cut out is 54 feet below top bank level.

WRITTEN SOURCES

List of primary and secondary written sources relating to Pontcysyllte Aqueduct

1/Primary Sources

Public Records Office

RAIL 418 Minutes of the Committees of the London, Midland and Scottish Railway Company (1923-48)

RAIL 623 Records of the Shropshire Union Canal Company (1846-1923)

RAIL 826 Records of the Ellesmere and Chester Canal Company (1813-46)

RAIL 827 Records of the Ellesmere Canal Company (microfilm copies of originals in the Shropshire Records Centre (1791-1813)

Shropshire Records Centre

Original Minute Books of the Ellesmere Canal Company (1791-1813)

Deed No.15025 William Jessop's Report on the Ellesmere Canal (14 July 1795)

Deed No. 15030 Notebook of John Knight (Nov 1795)

Deed No. 15033 Ellesmere Canal Company Summary statement of accounts (28 Oct 1795)

Deed No. 15035 Report on the Ellesmere Canal Navigation by Thomas Telford (21 October 1795)

Deed No. 15036 Report of Thomas Telford to the General Assembly of Ellesmere Canal Proprietors (27 Nov 1799)

Deed No. 15037 Report of William Jessop to the General Assembly of Ellesmere Canal Proprietors (24 Jan 1800)

Deed No. 15038 Report to the General Assembly of Ellesmere Canal Proprietors (25 Nov 1801)

Deed No. 15039 Report by Thomas Telford to the General Assembly of Ellesmere Canal Proprietors (30 June 1802)

Box 212/Bridgewater Papers Box 366 A report of the General Assembly of Ellesmere Canal Proprietors (Shropshire Record Centre (28 Nov 1804)

Institute of Civil Engineers Library

Edinburgh and Glasgow Union Canal Papers no 306 Instructions from Telford to James Thomson re. his inspection of Pontcysyllte Aqueduct (1 May 1818)

Edinburgh and Glasgow Union Canal Papers no 308 Report of James Thomson to Thomas Telford re. his inspection of Pontcysyllte Aqueduct (8 May 1818)

Gibb Collection Box 73 (Collection of documents re. Ellesmere Canal Company & Chirk and Pontcysyllte Aqueducts)

Gibb Collection Box 80

Hadfield Papers

Letter from John Wilson to Thomas Telford concerning the painting of the aqueduct at Pontcysyllte (July 1829)

British Waterways Archive

WM 69.76 - Typewritten copy of "oration delivered at Pontcysyllte Aqueduct on its first opening 1805", including copies of some minutes, report. (1805)

WM 90.75 - Inspection report & repair estimates, Pontcysyllte Aqueduct, dated 1865 &1866.

363.95-File - Llangollen Canal - General Correspondences - Slip in valley to River Dee at Pontcysyllte, project No. 63631 - Shropshire Union Canal (1966)

Ironbridge Gorge Museum Trust Library

MS of the Autobiography of Thomas Telford.

Letter from Thomas Telford to Matthew Davidson concerning drawings for Pontcysyllte Aqueduct (October 10 1796)

Letter from Telford to Matthew Davidson concerning Pontcysyllte Aqueduct (1796)

National Library of Scotland

National Library of Scotland MSS 19771 no.113 - Letter of William Jessop to John Rennie concerning the measurements of the piers at Pontcysyllte Aqueduct - 8 March 1802

National Library of Scotland MSS. 19972 f.83 - Letter of Thomas Telford to Rowland Hunt - 17 July 1795

National Library of Scotland MSS 19875 f.18 - Inspection report of John Rennie on the Pontcysyllte Aqueduct with diagram of a pier - 12 March 1802

2/ Secondary Sources

'Diary of Josiah Field's Tour of England in 1821', *Newcomen Society Transactions,* Vol. 13 (1932-33).

A. Burton, *Thomas Telford* (London 1999)

P. Cohen, 'The Origins of the Pontcysyllte Aqueduct', *Transactions of the Newcomen Society*, Vol 51 (1979-80).

S.R. Dennis, Report on the Trial Refurbishment of Pontcysyllte Aqueduct (British Waterways 2001)

D. Fowler, 'Pontcysyllte Probed', *New Civil Engineer*, August 1989

Sir Alexander Gibb, *The Story of Telford* (London 1936)

C. Hadfield and A.W. Skempton, *William Jessop Engineer* (Newton Abbot 1979)

C. Hadfield, *Thomas Telford's temptation* (Cleobury Mortimer1993).

G. Haider, 'Reconstruction of the Llangollen Canal', Proceedings of the Institute of Civil Engineers Vol 86 (December 1989)

C. Harris, S. Chewins & I. Statham, *Pontcysyllte Aqueduct Engineering Assessment* (Ove Arup & Partners, Wrexham 1989)

C.D.R. Jones & D. Parry, Telford in the Dee Valley (Clwyd 1991)

R. Quenby, *Thomas Telford's Aqueducts on the Shropshire Union Canal* (Shrewsbury 1992).

J. Rickman (ed.), Autobiography of Thomas Telford (London 1838)

L.T.C. Rolt, *Thomas Telford* (Harmondsworth 1958, rev ed. 1985).

E.A. Wilson, *The Ellesmere and Llangollen Canals* (Chichester 1975)

BW PLANS

List of plans, elevations and other pictorial material relating to Pontcysyllte Aqueduct in the British Waterways Archive and other libraries

British Waterways Archive: Gloucester

WM 310.71 - Drawing (incomplete) elevation of an aqueduct for carrying the Ellesmere Canal over the river Dee at Pontcysyllte, undated. (1800: Location- R-Plan Box)

W 17.69 - A plan of a railroad through the several collieries to the Ellesmere Canal at the north end of Pontcysyllte Aqueduct (1803: Location- Plan Box)

WM 534.72 - An Act for Ellesmere Canal to make a railway from Ruabon Brook to the Ellesmere Canal near the Aqueduct at Pontcysyllte Llang. (1804: Location- Act)

WD 19.66 - Engraving, framed, of Pontcysyllte Aqueduct 1805. (1805 Location- P.Q. Display)

(negative no.5780) Elevation of an aqueduct at Pontcysyllte, plan drawing (1805)

WM 33.75 - Colour litho, Pontcysyllte Aqueduct. (1810)

WM 116.72 - Ordnance Survey Map of Llangollen Pontcysyllte & Wrexham, Shropshire Union Canal. Date 1830 (1830: Location- Box)

Telford Atlas- Plan of Pontcysyllte Aqueduct Plate 14 (1838)

WM 105.74 - Plan & distance tables, SUC Autherley J/Ellesmere port, Newport, Ellesmere Lines, Pontcysyllte, Middlewich Donnington Wood (1850)

WM 103.72- Ordnance survey Map of Llangollen showing Pontcysyllte Railway, Printed 1873. (1873: Location- Box)

WM 81.77 - Shropshire Union Canal Distance Table, Hurleston Junction to Newtown, & Whitchurch, Prees, Ellesmere, Pontcysyllte, Weston etc (1880)

WM 198.72 - Map - Shropshire Union Canal - Pontcysyllte Railway, Scale 25"/mile. Date 1895. (1895)

W 31.64 - Shropshire Union Railway & Canal Co. Dimensions of the Pontcysyllte Aqueduct & the Chirk Aqueduct on Ellesmere Canal. (1935: Location- Filing Cabinet)

212.81 - Plan - LMS railway (S.U. Section) Pontcysyllte Aqueduct - supporting cast-iron standards, 1940. (1940: Locastion- R-Plan Box)

WM 77.75 - Drawing No 780s, dated 8th April 1965, Pontcysyllte Aqueduct, Llangollen Canal, showing (1) west elevation of the Aqueduct (2). (1965)

WM 470.72 - Photograph-Negatives of Pontcysyllte & Chirk Aqueduct, Llangollen Canal

& Dundas Aqueduct, Kennet & Avon Canal (Photo).

550.98 - Photo's (contact prints) & negatives of Heritage stamp Issue at Pontcysyllte Aqueduct, 1989 Jul. (1989)

100.90 - Article with illustrations of inspection of Pontcysyllte Aqueduct in "New Civil Engineer" magazine, August 1989. (1989: Location -Filing Cabinet)

Photographs of Pontcysyllte at the BW Archives Gloucester

Arthur Watts Collection

605.4 - Pontcysyllte Aqueduct & road bridge, from river. (Easter 1958)

605.5 - Pontcysyllte Aqueduct & road bridge, from river. (Easter 1958)

605.6 - Pontcysyllte Aqueduc from the river. (Easter 1958)

1176.5 - Inland Hire Cruisers Ltd, Christleton, boat on Pontcysyllte Aq. (July 1969?)

1175.1 - Inland Hire Cruisers Ltd, Christleton, boat on Pontcysyllte Aq. (July 1969?)

1176.6 - Inland Hire Cruisers Ltd, Christleton, boat on Pontcysyllte Aq. (July 1969?)

1592.1 - Pontcysyllte Aqueduct. (Sept 1971)

1592.1 - Pontcysyllte Aqueduct. (Sept 1971)

35.6 - Pontcysyllte Aqueduct from north end. (Whitsun 1954)

36.5 - From towpath on Pontcysyllte Aqueduct. (Witsun1954)

36.6 - From towpath on Pontcysyllte Aqueduct. (Whitsun 1954)

44.1 - Pontcysyllte Aqueduct from north. (Whitsun 1954)

34.1 - Pontcysyllte Aqueduct. (Whitsun 1954)

736.5 - River Dee bridge from Pontcysyllte Aqueduct. (Whitsun 1959)

736.4 - Pontcysyllte Aqueduct. (Whitsun 1959)

736.3 - Pontcysyllte Aqueduct. (Whitsun 1959)

736.2 - Pontcysyllte Aqueduct. (Whitsun 1959)

739.5 - Pontcysyllte Aqueduct. (Whitsun 1959)

736.1 - Pontcysyllte Aqueduct. (Whitsun 1959)

739.1 - Pontcysyllte Aqueduct & Pleasure craft. (Whitsun 1959)

739.2 - Junction at north end of Pontcysyllte Aqueduct. (Whitsun 1959)

739.4 - Pontcysyllte Aqueduct from north. (whitsun1959)

739.6 - Pontcysyllte Aqueduct (Whitsun 1959)

766.2 - Lift bridge at Pontcysyllte. (Whitsun 1959)

766.3 - Lift bridge at Pontcysyllte. (Whitsun 1959)

766.4 - Boat on Pontcysyllte Aqueduct. (Whitsun 1959)

766.5 - Boat on Pontcysyllte Aqueduct. (Whitsun 1959)

766.6 - Boat on Pontcysyllte Aqueduct. (Whitsun 1959)

739.3 - Pontcysyllte Aqueduct from north. (Whitsun 1959)

851.1 - Pontcysyllte Aqueduct. (Whitsun 1959)

851.2 - Pontcysyllte Aqueduct with boat. (Whitsun 1962)

851.3 - Pontcysyllte Aqueduct with boat. (Whitsun 1962)

851.4 - Pontcysyllte Aqueduct with boat. (Whitsun 1962)

852.6 - Pontcysyllte Aqueduct. (Whitsun 1962)

British Waterways Museum Ellesmere Port

D690 Detailed plan and elevation of Pontcysyllte Aqueduct (1939)

British Waterways Museum Stoke Bruerne (Northants)

W 112.63 - Model of one Arch of the Pontcysyllte Aqueduct (c.1795).

WM 6.78 - Iron span of Pontcysyllte Aqueduct. First arch Froncyclite side, removed during maintenance(1976)

Institute of Civil Engineers Library

Gibb Collection Box 73 Plan of the top and base of the abutment for Pontcysyllte c.1800

(19th c. copy of plan taken from MS papers signed John Simpson)

Watercolour Painting of Pontcysyllte Aqueduct by G Arnold – 1826 (Telford Bequest)

National Library of Scotland

MSS 19875 f.18 - Diagram of a pier at Pontcysyllte Aqueduct by John Rennie (12 March 1802)

Science Museum Library, Kensington

Sketchbook of William Reynolds (1793-96) includes drawings of a proposed stone aqueduct at Pontcysyllte by John Duncombe dated April 1794 (no.1) and a drawing by Thomas Telford of an idea for an iron aqueduct dated March 1794 (no.110)

Note: A large number of recent (post 1950) plans and elevations for Pontcysyllte Aqueduct are reproduced in C. Harris, S. Chewins & I. Statham *Pontcysyllte Aqueduct: Engineering Assessment* (Arup Associates- Wrexham 1989