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The Great Inundation of 1771 and the Rebuilding of the North-East's Bridges

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In 1771 a major flood on the rivers of north-east England led to the destruction of many bridges. As an entity, the programme of reconstruction has never before been recorded and this paper has been prepared in an effort to rectify this omission. The majority of the bridges were the property of the respective County administrations and, in order to describe the rebuilding, the Quarter Sessions records of the four counties affected have been used extensively.

INTRODUCTION

In the history of river crossings in the north east of England, the major flood of 1771 – the ‘Great Inundation’ – was a landmark, resulting as it did in the destruction of a score of bridges on the rivers Tyne, Wear and Tees. The Tyne was the worst affected and it was reported contemporaneously that there was “not one bridge standing on either North or South Tyne, out of about thirteen or fourteen, except one, called Corbridge”.¹ In spite of the magnitude of the inundation, nevertheless two further very significant floods followed, in 1782 and in 1815; both of them caused substantial damage but did not have such disastrous consequences as had the earlier occurrence.

The three floods resulted in an unprecedented demand for bridge building on all three rivers; in order to give a cohesive account of this work it was decided that this paper should cover only the period 1771 to 1815, dealing with each river in turn and describing events on each of them in sequence from source to sea. The locations of the bridges in question are shown on the accompanying map (fig. 1).

All but one of the bridges were of masonry – arched in form – and the majority of those damaged or destroyed were the responsibility of the Counties’ Justices and administered through Quarter Sessions; some bridges, however, were built under the aegis of private individuals or bodies. Rebuilding work was the responsibility of either the officers of the Counties’ government or consultants. Brief biographical details of some of these are given in the Appendix – their names are followed by an asterisk (*) where they appear in the text. Bridge rebuilding took place at the time of the formation of a civil engineering profession – the Society of Civil Engineers was founded in 1771 – and it brought to the area two of its earliest and most distinguished members, John Smeaton and Robert Mylne, although they were not solely responsible for reconstruction work; much was undertaken by locally-based engineers and architects.

THE FLOOD OF 1771

On Saturday and Sunday, 16/17 November 1771, the north east of England was subjected to a disastrous flood which destroyed or damaged many of the bridges on the rivers Tyne, Wear and Tees, in addition to causing extensive riparian damage as well as several deaths. The result of torrential rainfall in the Pennines, where all three rivers originate in close proximity to each other, the inundation was such that the flows then experienced have not been exceeded since and it is “probable that the flow in this extraordinary flood was at least twice the highest measured in recent decades”.² On

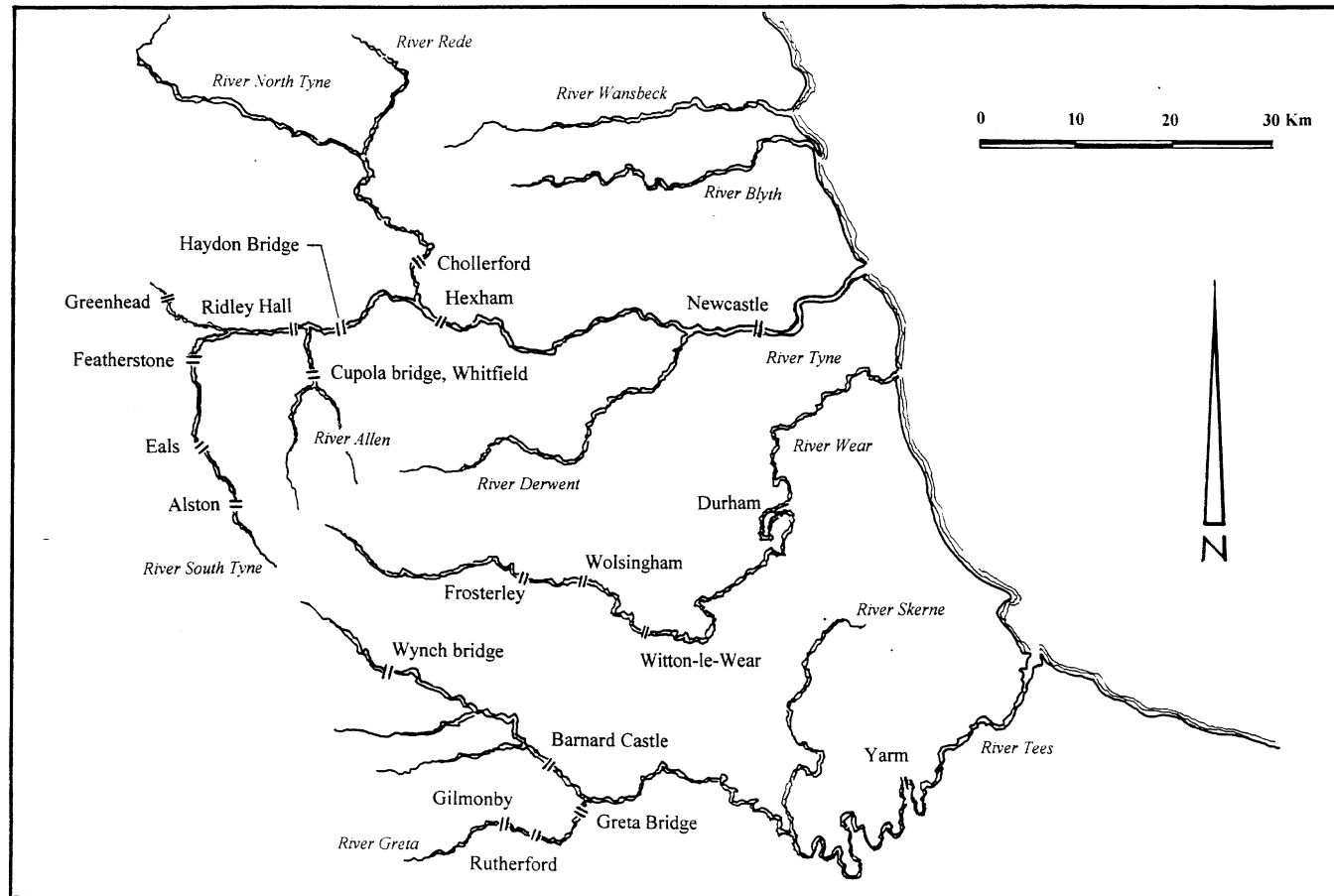


Fig. 1 The bridges damaged or destroyed by the 1771 flood. [R. W. Rennison]

the Tyne, the flood was perhaps not unprecedented as an apparently greater flood had occurred in 1339 when a section of Newcastle's town wall had been destroyed, resulting in more than 100 deaths.³

Damage caused by the rise in the rivers took four forms: shipping; simple flooding by the virtually static rise of water; the carrying away of persons and property; and the destruction of the region's bridges. Bridge damage and rebuilding forms the basis for this paper and is covered in detail – river by river – in the narrative which follows. Although the matter of flood damage generally has been fully described in contemporary accounts, nevertheless some details must be included to show its extent.

The chronology is difficult to establish as much of the damage occurred during the hours of darkness, greatly adding to the terror which was undoubtedly induced by the happening. The inhabitants of the flooded downriver towns were puzzled by the lack of accompanying rainfall as they had experienced only a light fall: the Rev. John Wesley – being appraised of the calamity when in London – noted that there had been but “a little mizzling rain till the very hour when the rivers rose . . . Such an overflowing . . . none ever saw before . . .”⁴ Wesley, however, had been misinformed as to rainfall in the rivers' headwaters and although no figures were available it was recorded that at Kendal, for example, it had rained for three days and nights.⁵

On the Tyne, a house was swept away at Featherstone; near Haltwhistle damage occurred to fields; part of the town of Hexham was flooded; and Bywell was severely affected as a result of a weir in the river causing water to back up, so causing the collapse of ten houses and resulting in extensive damage to other property, including the village's two churches and the churchyard itself where “dead bodies and coffins were torn out of the church-yard, and the living and the dead promiscuously clashed in the torrent”.⁶ The most concentrated loss of life occurred at Ovingham where the boat house was carried away with eight deaths while at Wylam damage was confined to property; 300 acres of coal-workings were flooded

with the damage being estimated at £800.⁷ Flooding also occurred at the Teams, Scotswood and Newburn.

As would be expected, the greatest publicity was given to Newcastle where, in addition to the collapse of the bridge (fig. 2), there was widespread flooding of the lower parts of the town, from the Close to the Ouseburn.⁸ The collapse of the bridge, with its houses and shops, cost the lives of six people but the extensive flooding – the river level was said to be 12ft above normal high water⁹ – led to much distress on the part of the inhabitants; a contemporary account noted that “in every house near the River an immense quantity of mud and ooze”¹⁰ had been left when the flood abated. Shipping was also the subject of damage. All the merchandise lying on the Quay was carried away as were almost all the ships; “three sloops and a brig were driven upon the Quayside, and left there”¹¹ and much shipping was swept downriver where many boats and keels were stranded on the river's banks or were carried out to sea, with some wrecked along the coast. Downstream of Newcastle, however, perhaps because of the widening of the river valley and the beneficial effects of Jarrow Slake, the flood was little higher than a spring tide.¹² The bed of the river was so altered by the flood that Trinity House requested that a survey be made “that ships might be conducted up and down with the usual safety”.¹³

Although not specifically recorded, the flood must have severed the water supply to Newcastle's wealthier inhabitants, then provided by a pipe carrying water from Gateshead Fell over the bridge and so to storage tanks in the town. Fortunately, a proposal had earlier been made for a new system, bringing water from Coxlodge to a reservoir at the south end of the Town Moor. All this planned work was completed by mid-December 1771,¹⁴ implying that the town was without its main source of water only for a month; other public supplies were available during the hiatus.

On the river Wear, too, much damage was occasioned although it was principally to shipping rather than to property or lives. Some 34 ships were wrecked on the bar and almost 200



Fig. 2 The ruins of Newcastle bridge following the flood of 16/17 November 1771. [J. Brand, *The History and Antiquities . . . of Newcastle* (London, 1789)]

keels were carried down the river and so to the sea where many were wrecked.¹⁵ It was recorded that “many men and boys were drowned”;¹⁶ their number has not been accurately ascertained although it was written that eight or nine bodies came ashore in the harbour that morning. The force of the flood damaged the pier at the mouth of the Wear, some of the damage due to the force of water and some to ships driven against it. Ballast had been cast up in the river between Biddick Ford and Sunderland and its removal was put in hand immediately; some 3000 tons of material were subsequently moved.¹⁷ Plans for the pier’s reconstruction were made by the Commissioners’ engineer, Joseph Robson, who was also responsible for the removal of the ballast.

Three collieries on the Wear – North Biddick, Chater’s Haugh and Low Lambton – were flooded and the Newcomen-type steam engines

of two of them were ruined; more than 30 horses were drowned underground. Flooding was also experienced at Chester-le-Street and at Durham where “the inhabitants in the lower parts of the two Elvets sustained great damage”,¹⁸ a result of the water being eight feet higher than ever before.

The towns on the banks of the river Tees did not escape the inundation and both Stockton and Yarm were affected, the latter being almost completely under water, in places to a depth of 12ft. Several houses were destroyed and seven people drowned. The bridge at Yarm had been unable to pass the flow in the river with the result that a “dreadful torrent”¹⁹ ran down the west side of the town. In the vicinity of Darlington, damage was occasioned to roads and fields whilst at Gainford part of the churchyard was swept away, taking with it coffins and corpses. A walk-mill at Piercebridge was

destroyed and at Croft the church was flooded. Additionally, there was much damage of a more minor nature. At Barnard Castle the river's flow was such that the bridge's arches could not cope and the flood washed away the southern approach to the bridge, taking away eight houses. Nearby mills suffered and many cattle were killed but fortunately there was no loss of human life.

Although the major destruction caused by the floods was principally in the North-East, nevertheless the effects of the torrential rain were also felt in Cumberland and Westmorland, a point not always taken as being part of the same phenomenon. At Appleby, part of the town was flooded and much damage of a minor nature ensued, including some disturbance to the foundations of the church; nearby, Bolton mill was destroyed. Carlisle experienced the greatest flood ever known, but without great damage, other than the destruction of a mill at Botcherby; there was no loss of life. At Kendal, however, three lives were lost when Wennington bridge collapsed and at Beetham graves were washed open.²⁰ At Dalston, Hawksdale bridge was "carried away by the great Floods";²¹ its rebuilding was put in hand in 1773.

The other major associated event associated with the flooding was the irruption on 16 November of Solway Moss, an area of some 1300 acres ten miles to the north of Carlisle. An account of the event described the area as a "sort of moss covered at top with a heath, and coarse aquatic grasses; but so soft and watery below, that if a pole is once thrust through the turf, it can easily be pushed through perhaps 15 or 20 feet long, to the bottom".²² The rainfall, "such a deluge . . . as has not been known, for at least 200 years",²³ caused the Moss, at a level above the surrounding firm ground, to erupt on its north-east side, whereupon "it rolled forward like a torrent, and continued its course above a mile, sweeping along with it houses and trees . . .".²⁴ No lives were lost but some 35 families lost their houses and livestock while the dislodged material covered an area of some 400 acres, in places to a depth of approximately eight feet, or even deeper. The flow continued

over several days and was stopped only by the river Esk, which was "rendered as black as ink"²⁵ as a result.

Flood damage resulted in funds being established to assist financially those who had lost their houses and possessions. Newcastle Corporation, in November, arranged a meeting "to take into consideration and set on foot a subscription for the relief of sufferers by the late floods",²⁶ the Council subscribing an immediate £200, later increased to £250; £100 went to Newcastle and £50 each to Northumberland, Durham and Yorkshire. Those affected by the flood in Northumberland were assisted by a fund which classified the degree of damage suffered; some £2200 was distributed. On the Wear a subscription list was opened by the Dean and Chapter of Durham and the amount subscribed soon amounted to £1709. A sum of £41 was paid to five widows "whose husbands were lost at Sunderland in Assisting the Distressed Sufferers there".²⁷ Figures are difficult to reconcile but it is recorded that some £31,000 was subscribed to relieve the suffering in Northumberland and Durham.²⁸

THE FLOODS OF 1782 AND 1815

Although the date of 1815 has been taken as the cutoff point for this paper, another significant inundation took place before that time, on Sunday, 10 March 1782, the result of a fall of snow followed by heavy rain; it was said that the river Tyne had risen to a level higher than ever remembered, other than in 1771.²⁹ The flood brought down three bridges on the Tyne but without loss of life. The principal casualty was the destruction of the bridge at Hexham but, in addition, that at Ridley Hall was carried away and Haydon Bridge was badly damaged.³⁰

Like the 1782 flood that of Saturday, 30 December 1815 was to affect the river Tyne catchment more than those of the Wear and Tees. This rise in river flow was the result of a rapid thaw with heavy rain, the Tyne described as "a resistless torrent",³¹ its level second only to the 1771 flood. Although it did not "rise to

so great a height, yet the injury which has been sustained does not probably fall far short"³² of the 1771 event; it was reported that at Greenhead the flood was actually six inches higher than in 1771.³³ Newcastle quayside was again flooded, timber to an estimated value of £20,000 was washed downriver and shipping was damaged. Agricultural land, especially at Ovingham and Bywell, was flooded and sheep were drowned. Fears were expressed as to the safety of Newcastle bridge where three arches were "almost totally choked with keels and rafts of timber"³⁴ but the widening of the bridge following its rebuilding no doubt accounted for its holding. Whereas damage had been incurred by the underground workings at Wylam colliery in 1771, in 1815 it was the surface workings which were affected, "the cast-iron railway of Wylam colliery [being damaged with] a great part of it entirely destroyed".³⁵

The flood of 1815 caused the failure of bridges at Eals, Haydon Bridge, Glenwhelt and Botcherby, near Carlisle, the last-named having "entirely given way and no person can venture over it".³⁶ Part of the bridge over the river Irthing, on the road between Carlisle and Brampton, was carried away and damage was sustained by the bridge then under construction over the river Eden at Carlisle³⁷ where the piers were said to "stand on nothing but a friable pillar of sand";³⁸ at Gilsland a wooden bridge was swept several miles downstream.³⁹ Unlike the post-flood events of 1771, however, there do not appear to have been the same measures taken for the relief of those who suffered.

REBUILDING THE BRIDGES ON THE RIVER TYNE AND ITS TRIBUTARIES

The 1771 flood did not affect all three rivers equally and it was the Tyne bridges, here described in order from the river's source, which suffered the greatest damage in that the only one which survived was that at Corbridge where, during the flood, "some persons late in the night stood upon the bridge and washed their hands in the rolling river . . .".⁴⁰ Other than that at Newcastle, which fell between 2

and 3 am on 17 November 1771, the times at which the several bridges collapsed is not known.

Alston

The flood of 1771 destroyed the bridge at Alston, under the jurisdiction of the Cumberland County Justices, and it was immediately decided that it should be rebuilt, an advertisement being placed seeking contractors to undertake the work.⁴¹ In the interim period, William Howatson and Jonathan Hilton were paid £39 for the provision of a temporary structure. The advertisement led to John Wilson, John Macvety and Joseph Palmer being appointed for the rebuilding work.⁴² Some uncertainty follows: it is possible that progress was unduly slow; that the new bridge collapsed; or the contractors failed. Whatever the reason, it was not until July 1784 that the arch of the new bridge was "completely closed",⁴³ its builders not those earlier appointed.

Proposals had been received from several contractors. John Parkin offered to build a bridge with two spans of 48 and 32ft for £300 while Lowinger Maddison and Thomas Alan each submitted proposals. Maddison offered to build a bridge with two spans of 39ft for £220 "and Giv sufishont Bond for huplolving it for seven years"⁴⁴ while Alan's price was £380. If built as a single span of 63ft, Maddison's price would be £330 and Alan's £350. John Gaskin and Thomas Gowling – later with John Turner and William Robinson – had estimated the cost at £199 and John Threlkeld at £270. In July 1784 Gaskin and Gowling were paid £70 "due upon completion of the Arch over the river Tyne at Alston"⁴⁵ and were later paid the balance of the cost, possibly for a structure of 63ft span. Alternatively the bridge could have been of 66ft span with a width of 12ft, built in accordance with an extant drawing and specification,⁴⁶ possibly by Francis Murray*, then the County's bridge surveyor.

Repairs to this new bridge, "a high stone bridge with one arch",⁴⁷ although not specified, were required by 1816 and the bridge was replaced by the present structure in 1835.

Eals

Records indicate that a timber bridge had been built at Eals in 1709 but that destroyed by the flood was relatively new. In 1765 the Northumberland Justices had considered that a bridge at Eals was “absolutely necessary [as the ford was] dangerous to Travellers and their Lives frequently in Hazard”.⁴⁸ The bridge then built had two arches and had possibly been constructed by Joseph Railton;⁴⁹ it seems to have become the responsibility of the Northumberland Justices only in 1784 and its destruction in 1771 is not recorded in the Quarter Sessions records although it is noted elsewhere.⁵⁰ Having been rebuilt it was again destroyed in 1815⁵¹ after a period of almost continuous repairs.

Featherstone

The 1771 flood carried away the Northumberland County's bridge at Featherstone but it was not until 1779 that proposals for its rebuilding were sought; responses to the advertisement were slow in forthcoming. In 1780, however, designs for a new bridge were prepared by Jonathan Pickernell*, County Bridge Surveyor from 1776, and work was begun in the same year. The contractors were Isaac Dodds and Thomas Allen who agreed to build the bridge for £548; it was completed by January 1782.⁵² Alone in the local press the *Newcastle Chronicle* reported its destruction as having taken place a second time on 10 March 1782⁵³ but it retracted this statement three weeks later. It is possible, however, that some damage was sustained as on 14 April 1790 the *Quarter Sessions Orders* record that Dodds and Allen were paid “in full for the balance remaining due to them for rebuilding the said Bridge and supporting the same for 7 years”,⁵⁴ so implying that the bridge had actually been completed in 1783. Alternatively, there might simply have been a delay in administrative procedures. The present bridge crosses the river South Tyne by means of a single span of 80ft but details of the earlier structure are not known.

Greenhead (Glenwhelt)

The Tipalt Burn at Greenhead, or Glenwhelt, is crossed by a bridge originally built with the Military Road, completed in 1757; it was destroyed in 1761 and was subsequently rebuilt.⁵⁵ In 1771 the bridge formed a part of the ‘Grand Road’ from Newcastle to Carlisle and was not then the responsibility of the County, as a result of which details of the rebuilding after its destruction have not been located. Proposals for its reconstruction, however, were sought in June 1772, it being then noted that the bridge was “broke down by the great flood”.⁵⁶ The replacement structure comprised two unequal spans, one of which fell in the flood of 1815. Thanks to the assiduity of “T. Forrester, deputy surveyor of the military road”⁵⁷ it was then replaced within a week by a timber structure able to carry all traffic.

Ridley Hall

A bridge at Ridley Hall was completed by the Lowes family, local landowners, in 1764 and it had come under the jurisdiction of the County only shortly before its destruction in 1771. Tenders for its rebuilding were first sought in 1775⁵⁸ but it is not known if a replacement bridge was then built as in August 1779 proposals were again sought. A design was prepared by Pickernell and work was begun in 1780. The contractors were Dodds and Allen and it would seem that Pickernell's design was for a three-span structure.⁵⁹ Like its predecessor, it also was swept away, this time in 1782 after having stood for only ten months. Some five years later, Robert Mylne* was asked to submit a design for the foundations of a new bridge, he and the Newcastle architect, David Stephenson*,⁶⁰ becoming responsible for supervising its construction. In 1786, under the direction of Robert Thompson*, from 1781 surveyor for the County's southern bridges, exploratory borings were undertaken by Thomas and George Rawling, coal borers of Whickham, who had already carried out similar work in relation to bridge reconstruction at Newcastle, Chollerford and Haydon Bridge. Two years

later, “proposals for rebuilding the Superstructure of the . . . Bridge”⁶¹ were sought; drawings could be inspected at Stephenson’s office in Newcastle.

At Easter 1789, William Johnson* – surveyor for the county’s northern bridges – and Thompson were instructed to complete the foundations “to the Plan delivered by Mr. Mylne and to prepare Stones and Materials for the superstructure of the same Bridge according to the Plan now delivered by the said . . . Thompson and . . . Johnson”.⁶² The foundation stone, “at the depth of nine feet below the surface”,⁶³ was laid on 20 August 1789 by John Lowes, upon whom at least some responsibility for the bridge had devolved, as in spite of supervision by the County, some payments for the bridge’s construction were made directly to him, he presumably paying the craftsmen involved. The two-span bridge – both spans were of 67ft – was completed in 1792 having cost the County £1100.⁶⁴

Cupola Bridge, Whitfield

A bridge over the river Allen at Whitfield had been first completed in 1762, following a petition that such a bridge ‘is much wanted and will be of great use . . .’;⁶⁵ the cost to the County had been £300, this sum – approximating to one half of the cost – having been paid to William Ord, a local landowner. In 1765, however, “An Estimate of the Expence of Building a bridge of one arch 68 feet wide [span] over the River Allon near Whitfield”⁶⁶ was presented to Ord by William Newton, architect, quoting a price of £288. Presumably the first bridge was destroyed and the second would seem either to have been demolished or collapsed – probably weakened by the 1771 flood – as by 1779, following several advertisements in the press, it was decided by the Justices (by then the bridge’s owners) to place a contract with William Johnson and Thomas Forster, masons, to rebuild the bridge “near where the Old Bridge lately stood”.⁶⁷ In 1778 an Act of Parliament had been obtained for turnpiking the road running via Whitfield between Alston and Summerrods Bar, Hexham, although the bridge itself did not

form part of the Act. The new bridge was designed by Pickernell and, founded on rock, the three-span structure was completed by the summer of 1782 having cost £733.⁶⁸

Haydon Bridge

Two of the six spans of this bridge, owned by the County, fell in the flood of 1771 and repairs would seem to have been effected with some expedition. Thomas and George Rawling carried out site investigation work and a contract for the rebuilding of the bridge was arranged in July 1772.⁶⁹ At the same time George Brown*, then bridge surveyor, was paid £81 16s 9d for unspecified work on the bridges at Haydon and Chollerford. Presumably under his direction, Lowinger Maddison and his partners, Thomas Layborn and Joseph Nicholson, then undertook to rebuild the bridge by 26 May 1773 for £1350. After this latter date John Fryer*, a Newcastle surveyor, was paid £8 13s 4d “for drawing and copying plans of Haydon, Chollerford and Bolton bridges”.⁷⁰ With work in progress and the Tyne very swollen, “the centre frame of the new bridge, just beginning to be built at Haydon Bridge [was] swept away in the current”⁷¹ on 26 September 1772. The centrings of the two new arches, said to have been of 78 and 69ft span, were struck in August, it then being commented that they were thought to be “the finest and largest arches ever built in any part of the river Tyne”.⁷² At the Michaelmas Sessions of 1773 the contractors were paid £100 for work on the bridge, later said to have been the rebuilding of the south end; the final settlement was made by January 1774.⁷³ By this time, however, further problems were being experienced with the bridge’s structure: during the following summer Maddison received £60 14s 6d for investigating and repairing its north end, the damage later described as a “breach in the Second Old Pier . . . and securing the foundation thereof”.⁷⁴

By the end of 1781 an Indictment had been laid regarding the condition of the bridge but further damage was incurred by the March 1782 flood which destroyed one of the arches,

although within two weeks a temporary crossing was seemingly “finished for horses”;⁷⁵ wheeled traffic had to use a ford. Johnson, Forster and Allan, the undertakers, were instructed to begin repairs within eight days (of the date of the 1782 Midsummer Sessions) although in the following year reference was again made to a temporary bridge and it was then noted that repairs had begun.

Even these repairs appear to have left unresolved the well-being of the bridge and on 21 December 1806, “the middle arch of the bridge . . . gave way and fell in (although already) in so dangerous a state”⁷⁶ that it was intended to have it repaired. In 1807 William Hall was paid £200 for “expenditure towards making the temporary bridge”⁷⁷ and was later paid a further £151. In the summer of 1807, however, John Shaw and James Telford undertook to rebuild the structure for a sum which was not to exceed £1105. By Easter 1808 reference is made to wood from the bridge being recovered from the river Tyne and in the summer of the same year it was noted that Shaw and Telford were “rebuilding three arches”⁷⁸ of the bridge. In 1810 repairs to foundations cost a further £424 and in 1813, because of its condition, William Chapman*, an engineer practising in Newcastle, carried out an inspection.

Two spans were destroyed in 1815 and by Easter 1816 consideration was being given to again rebuilding the bridge; the following year it was agreed that two new arches, costing £536, were required. Within a year a further £136 had been authorised and in 1819 assent was given for up to £50 to be expended on immediate repairs to the bridge; the next year a sum of £200 was spent. By 1824 the bridge had six arches “very recently widened and thoroughly repaired”⁷⁹ and several years later it was stated that the “arches stand on piles in a deep bed of gravel . . . securely defended by strong stone penning, encased in a framework of timber”.⁸⁰

Chollerford

At Chollerford, the Northumberland Justices began reconstruction work on the five-span

structure very soon after the flood. In the summer of 1772, Thomas and George Rawling carried out boring work and Henry Atkinson was paid some £16 for timber; by autumn, the stonemasons William Johnson and Thomas Forster were at work, a contract having been arranged in July.⁸¹ At this time Fryer was paid 25 guineas “for surveying and drawing plans of the environs of Haydon, Hexham and Chollerford bridges and for drawing Constructing Plans of Haydon and Chollerford bridges”;⁸² his drawings showed two designs with maximum spans of 60 and 64ft, both with piled foundations.⁸³ The foundation stone for the bridge was laid on 12 September 1772⁸⁴ but because of slow progress, in January 1774 the contractors were arraigned before the Justices and then promised to complete work by the coming summer. The *Newcastle Courant*, reporting the event, noted that the new bridge was to be “more commodious in many respects, particularly its width”,⁸⁵ increased from 11 to 16ft. In spite of the promise, the last stone of the bridge was not laid until April 1775.⁸⁶ Responsibility for its design is uncertain as the bridge could have been designed by either John Wooler* or Fryer, or perhaps both, as in January 1777 Wooler was paid 40 guineas “for his Trouble and Expences in Drawing Plans for Hexham and Chollerford Bridges . . .”.⁸⁷ With five arches varying from 41 to 56ft the bridge, first estimated at £2500, had actually cost £2707.⁸⁸

Hexham

“All our honours are now in the dust”.⁸⁹ These words of John Smeaton* perhaps epitomise the story of the Hexham bridges, whose history has been very fully covered by E. C. Ruddock,⁹⁰ S. M. Linsley⁹¹ and by Smeaton⁹² himself in his *Reports*. Nevertheless, for completeness, it is necessary to give an outline of the collapse of the bridge extant in 1771 and its subsequent rebuilding.

In 1756 a design for a bridge to cross the river Tyne at Hexham had been prepared by Smeaton but it was not built. Some 20 years later, however, another sponsored by Sir

Walter Blackett and designed by John Gott* was built under the direction of George Brown; it was of seven spans, the largest of 70ft. Opened only in September 1770, it was destroyed by the 1771 flood, Blackett forfeiting to the Northumberland Justices the sum of £3000, rather than undertaking rebuilding.

Subsequently, a proposal was made by the County for a replacement bridge on a site near to that used earlier; a design with piled foundations and spans of up to 70ft⁹³ was then produced by Fryer. Smeaton and Wooler, jointly, had declined to undertake the rebuilding of the bridge but, in 1774, Wooler became involved; at first he seems to have adopted Fryer's design but later amended it. A formal agreement was drawn up with Thomas Laybourn and Lowinger Maddison to build a masonry bridge for £5000 "according to a Plan drawn up by Mr. Fryer and approved by John Wooler Esq"⁹⁴ but it would seem that little progress was made. Recurring notices in the Newcastle press, seeking contractors, would indicate that none was willing to do the work and in April 1775 the Justices ordered that the bridge be built by dayworks "under the direction and inspection of Mr. John Wooler and Mr. Jonathan Pickernell",⁹⁵ the latter brought in "as a proper person to superintend the work";⁹⁶ the materials from the destroyed bridge would be made available.

Work had not proceeded beyond the first pier when ground conditions led Wooler to instigate more extensive site investigations. Undertaken by Pickernell they revealed that the underlying strata were completely unsuitable and he commented that it had been possible to push down an iron bar into the river bed to a depth of 46ft, Wooler commenting that "quicksand . . . cannot be deemed much better than a heap of chaff".⁹⁷ The strata found, comprising a gravel bed underlain by running sand, forced Wooler to write, "very sagaciously and prophetically [that] whoever meddled with a bridge there would burn their fingers".⁹⁸ He added that the site should no longer be considered unless the entire river bed were to be paved with masonry laid over a timber raft which, in

turn, should be piled at its edges.⁹⁹ This expensive proposal was not adopted and it is understandable that Wooler abandoned the work. Pickernell, meanwhile, found an alternative site, approximately a mile downriver, where a new bridge could be built.

Under the aegis of Henry Errington, a prominent local landowner, an Act of Parliament was obtained in May 1778,¹⁰⁰ unusually specifying the dimensions of the structure and stipulating that the engineer should be Smeaton. The bridge was to be 518ft between abutments, 18ft wide between parapets and the carriageway 31ft above the normal level of the river. Smeaton's design showed features very similar to those incorporated in his bridges at Coldstream, Perth and Banff; its nine spans – eight segmental and one elliptical – ranged from 37 to 52ft. His original drawings showed abutments and bankside piers on piles with the bases of the other piers protected by 'beton', masonry placed so as afford protection. The central piers would be founded in caissons, since to employ cofferdams would endanger the integrity of the gravel crust,¹⁰¹ a feature thought by Smeaton to be vital. In Parliament, the Bill's opponents had stated that the location of the proposed structure was dangerous on account of the propensity of floods to move the river bed¹⁰² and, in fact, flash floods during construction had the effect of causing Smeaton to underpin damaged pier foundations with sheet piling, filling with rubble beneath the piers.¹⁰³

The last arch of the bridge was completed on 15 October 1779, construction having "done much honour to Mr. John Smeaton, Engineer, for his good and masterly directions . . . and is also much to the credit of Mr. John Pickernell, the Surveyor, for his steadiness and good conduct"¹⁰⁴ of the work. Completion was achieved in January 1781¹⁰⁵ but the severe flood of 10 March 1782 so damaged the bridge that two arches and a pier collapsed completely and within half an hour only three arches remained, "in a very tottering situation".¹⁰⁶ Collapse was probably due to the restriction in the waterway which had resulted from Smeaton's decision to use sheet piles; it was recorded that during the

flood there had been a 4 or 5ft difference in water level between the upper and lower sides of the bridge and it was also noted that the piers "all fell against the current".¹⁰⁷ Failure of the bridge was commented on by a correspondent writing to the *Newcastle Chronicle*: "To make a bridge withstand the violence of the flood . . . is impossible here, without framing and penning across the river, which might be done for about £600 and might in all probability have been the saving of 3 or 4000L".¹⁰⁸

The destruction of the bridge led to a long involved legal battle and to Errington forfeiting £4000 to the County rather than becoming responsible for rebuilding. Eventually Mylne, retained by the County Justices, advised that it could be rebuilt but he would seem to have played little further part in the work. Reconstruction was undertaken by the County and it was under Johnson and Thompson that work was begun in 1789 and completed in 1795 although the structure had been passable for pedestrian traffic from September 1793.¹⁰⁹ Smeaton's superstructure design was adopted for the rebuilding but with different and more secure foundations. For their "extraordinary trouble, care and attention"¹¹⁰ both Johnson and Thompson received an *ex gratia* payment of £50 together with a significant increase in their salaries, from £25 to £40 p.a. The present structure, which cost c.£7500, occupies the site of Smeaton's bridge but is founded on a piled timber platform extending across the width of the river.¹¹¹ The existing superstructure is identical to Smeaton's design; the roundels are purely a decorative feature.

Smeaton was deeply scarred by the failure of his bridge, which he did not live to see completed, and after its collapse he wrote that he was "unwilling to injure his reputation . . . in attempting another bridge at Hexham upon a limited sum . . . remembering that a burnt child dreads the fire".¹¹²

Newcastle

The major bridge of those destroyed was Newcastle, its six northern arches owned by Newcastle Corporation and the three southern by the

Bishop of Durham. It had earlier been described by Defoe as a "stately Stone Bridge of seven very great arches"¹¹³ and at the time of the flood was, with London Bridge, the only such structure incorporating houses. For the Bishop, Smeaton had inspected the southern section of the bridge in 1769 and, for the Corporation, the northern part in 1771.¹¹⁴ His report to the Bishop led to repairs being put in hand in July 1770,¹¹⁵ mainly involving the replacement by masonry of the timber beams inserted to fill the site of an earlier drawbridge.

On the morning of 17 November 1771 the full effects of the inundation were apparent in Newcastle where it could be seen that the centre span and two others at the Gateshead end of the bridge had fallen. Further falls occurred on 29 and 30 November: "The whole range of shops and houses on both sides . . . was now entirely demolished"¹¹⁶ on the Bishop's section of the structure. The failure was reported upon, jointly, by Smeaton and Wooler in 1772¹¹⁷ and eventually led to Wooler, described as "an engineer under Government",¹¹⁸ being retained by the Corporation and Mylne, having recently completed Blackfriars bridge, by the Bishop. A joint report was submitted by the two men in January 1772 and Mylne wrote a further paper in March; Wooler presented his comments on it the following month. In summary, because of the view taken by the Bishop, the Right Reverend John Egerton, it was agreed that the replacement structure should be on the original site although Wooler had at first proposed a location a little upstream. Mylne subsequently became responsible for the rebuilding of the southern three arches and Wooler for the northern six. The maximum span of the arches was 57½ft.

The destruction of the bridge led to Fryer, until this time a Newcastle schoolmaster, being retained to carry out surveys of the damage to the bridge and of the river bed itself. His investigations revealed that as a result of high water velocities through the arches, scouring had deepened the river downstream of the bridge; at low tide, depths of water upriver were four feet in contrast to a downriver depth 24ft.¹¹⁹ Another schoolmaster with whom Fryer had

been associated was Charles Hutton* and, as a result of the destruction of the bridge, he wrote and published in 1772 *The Principles of Bridges*, a significant book on bridge design; soon afterwards he became Professor of Mathematics at the Royal Military Academy, Woolwich.¹²⁰

Before permanent reinstatement took place, however, an Act of Parliament was obtained for a temporary timber bridge; pile-driving for its foundations began in July 1772¹²¹ and it was completed in October 1772 by John Stephenson, a Newcastle carpenter, to whom the *Newcastle Courant* gave great credit for his work; the temporary bridge was opened with a “procession through the town, preceded by music and colours”.¹²²

Mylne had employed Messrs Rawlings to carry out site investigation work and construction of the northern section of the permanent bridge was at first undertaken by a Newcastle stonemason, Edward Hutchinson, credited with being the first person to suggest that the river should be crossed by a bridge at a high level;¹²³ after his death in 1780, his foreman, John Reed, acted for the Corporation. The Bishop’s southern section was rebuilt by Robert Shout, snr, bridge surveyor for the North Riding of Yorkshire from 1757 until 1765 and a stonemason by trade.¹²⁴ His involvement was not of long duration as his death three months into the contract led to its being continued by his three sons.

Masons and carpenters were sought in April 1773 for the building of the “Stone Bridge”¹²⁵ and the first stone of the southern arches was laid in October 1774 followed by that for the northern section in April 1775. The first of the southern arches was closed in July 1775¹²⁶ but, during 1777, further masons were sought by the Shout brothers, both for the Newcastle bridge and for that over the river Derwent at Swalwell. The final arch of the Newcastle section was closed on 13 September 1779, “on which occasion, the Corporation gave the workmen a plentiful dinner and a hearty regale . . . to which they proceeded with music and colours flying”.¹²⁷ In 1780 Wooler found it necessary to place a weight limit of approximately a ton on the temporary bridge, then “much decayed”¹²⁸

but it was of short duration as the new bridge was opened in April 1781, after which the timber structure was removed, the piles cut off at river-bed level and the materials sold, all under the direction of Wooler.¹²⁹ So impressed with the work was the Mayor of Newcastle, John Erasmus Blackett, that it was ordered that the workmen be given six guineas “to regale themselves on the joyful occasion”.¹³⁰ The new bridge was at first without parapets on the southern section because the Bishop considered that his responsibility lay only with the structure; as houses had existed formerly, without the provision of parapets, he considered himself not now responsible for providing them. The *Newcastle Chronicle* thought otherwise and considered that it would be “a capital ornament to the town, to compleat the superstructure with stone balusters, in the manner of Westminster bridge”;¹³¹ solid parapets were eventually provided.

Almost as soon as it was built the bridge was criticised as being insufficiently wide. In answer to a request made by the Corporation of Newcastle, in December 1800 a drawing was presented to it by Thomas Wilson* (fig. 3), responsible with Rowland Burdon for the building of the Wearmouth bridge at Sunderland.¹³² It showed his proposals for widening the bridge by means of cast-iron arching, spanning from the existing piers and forming new footways; his estimate for the work was £4685. Within three weeks – again at the Corporation’s behest – comments on this design were made by William Chapman and David Stephenson, whose father had built the temporary bridge. Their proposal was that the widening would be in masonry, in form similar to Wilson’s scheme; their estimate was £2661.¹³³ Their views were based on the 1798 widening of the bridge crossing the river Medway at Rochester where masonry had been used rather than cast iron.

In 1801 an Act of Parliament was obtained for the work, to be undertaken “by building on, and projecting from the salient angles of the said bridge, stone arches of such dimensions as to give . . . the additional width of twelve feet at the least”.¹³⁴ In addition to having executed

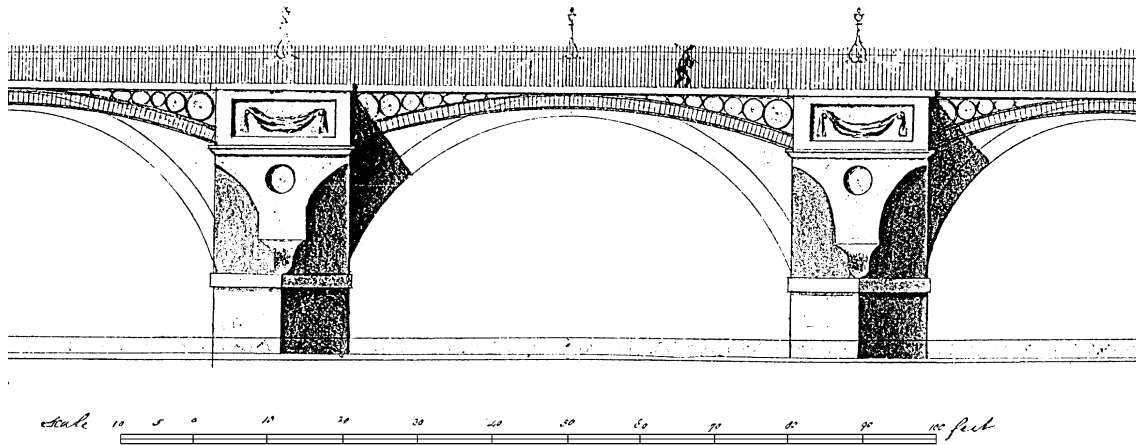


Fig. 3 Thomas Wilson's design for widening Newcastle bridge by means of cast-iron arches, 1800. [By permission of Tyne and Wear Archives Service: TWAS 612/325]

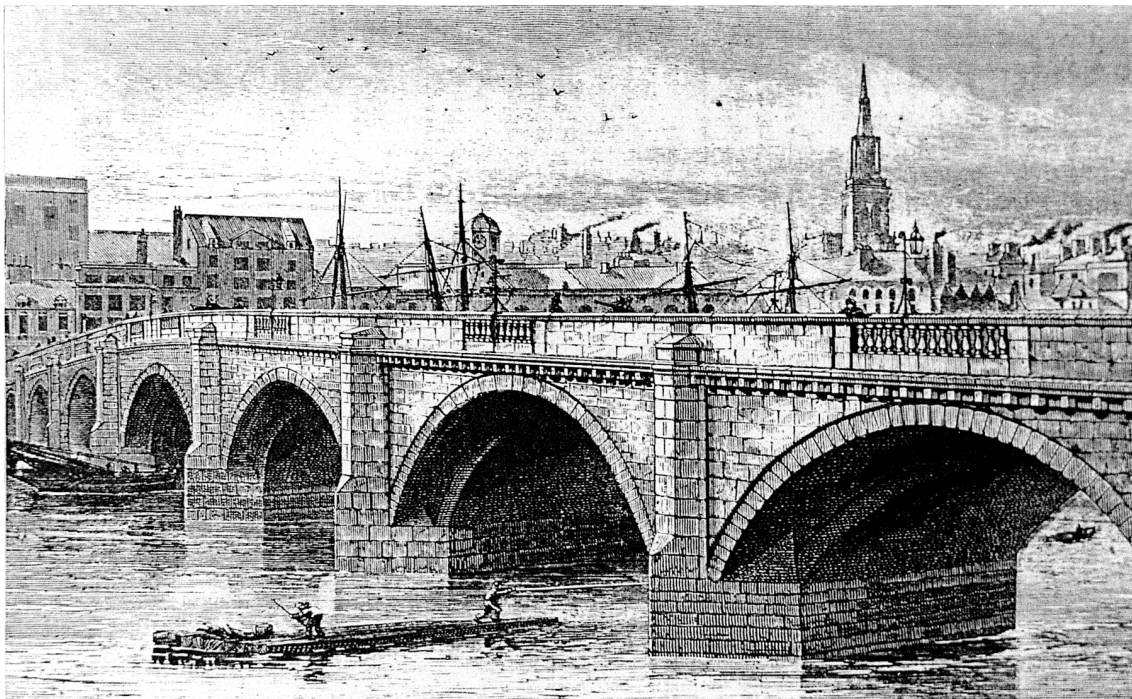


Fig. 4 Newcastle bridge as widened by David Stephenson in 1801. [J. C. Bruce, "The Three Bridges over the Tyne at Newcastle." AA², 10 (1885), 1.]

the design, Stephenson became responsible for the bridge's construction, in 1802 entering into an agreement with the Corporation for building and upholding it for a period of seven years for the sum of £3790.¹³⁵ His work entailed the widening of the bridge from 21½ft to 33½ft by forming additional arches to both faces, attached to the original structure by iron cramps; the use of the existing piers obviated the need for extensive river works and the modifications were described as "an ingenious contrivance".¹³⁶ Widening had the effect of eliminating the former refuges at each pier whilst the parapets, perhaps to lighten the appearance, were partially balustraded (fig. 4). The widened bridge survived until replaced by the Swing Bridge in 1876.

REBUILDING THE BRIDGES ON THE RIVER WEAR

Bridges on the river Wear were not damaged as badly as those on the Tyne and, as on the northern river, it has not been possible to establish a chronology of destruction although at Sunderland the peak of the flood wave occurred on Sunday at 2 am. As before, the river Wear bridges are dealt with from the source of the river.

Frosterley

Contemporary accounts of the 1771 flood note the destruction of the bridge at Frosterley but its loss is not confirmed by the Durham *Quarter Sessions: Orders*, perhaps indicating that it was then privately owned. Although "its place was for some time supplied by a wooden foot-bridge"¹³⁷ it would seem that a permanent bridge was built soon after the flood.¹³⁸ The fate of this structure is unknown but in December 1812 an advertisement was placed for the rebuilding of the bridge, then fallen into disrepair. A contract with Stephen Coulson was drawn up – only for the agreement to be rescinded as a result of his being unable to find sureties. The Durham Justices – by this time responsible for the bridge – thereupon re-let the

contract to John Wooler of Frosterley, mason, and John Nicholson of Wolsingham, joiner. Ralph Day of West Auckland, mason, was employed to supervise the work and construction was completed in July 1815;¹³⁹ the segmental arches have spans of 52, 63 and 52ft.

The bridge was probably designed by Ignatius Bonomi*, a Durham architect appointed as bridge surveyor in 1813,¹⁴⁰ but attribution of the design is a little uncertain as he was appointed only after advertisements for construction had been placed. Bonomi's biographer, however, states that as he was responsible for altering the line of the bridge and its approaches, it is more than likely that he changed the design, too.¹⁴¹ Payments to the builders of £41, £1572 and £2248 are recorded for the years 1812, 1813 and 1814.¹⁴²

Wolsingham

This bridge, with that at Witton-le-Wear, was administered by the Durham Quarter Sessions and in 1772, after the destruction of both of them, the County Justices agreed that they should be rebuilt as they were then "intirely broken down, Ruinous and Prostrated by the late Dreadfull Flood".¹⁴³ The pre-flood bridge at Wolsingham dated from 1723/4 when an earlier structure had been destroyed by floodwaters.¹⁴⁴ It comprised five barrel arches¹⁴⁵ while its replacement – probably designed by Robert Todd* – had two masonry spans.¹⁴⁶ The contractors appointed by the Justices were John Johnson and Philip Todd, both stonemasons from Wolsingham.¹⁴⁷ Their expedition was such that although the foundation stone was laid only on 16 June, the centring for the arches was struck less than a year after the flood, on 10 September 1772.¹⁴⁸ Progress had not, however, been without incident. Work had begun on striking the centring when a "sudden fall of rain caused the river to rise to a great height, and run with such rapidity as was dreadful to behold".¹⁴⁹ Nevertheless, the striking was concluded safely and satisfactorily and was said to reflect very creditably on Joseph Watson and Thomas Rain, carpenters from Wolsingham; the cost of rebuilding was £1100.

Unspecified repairs were undertaken in 1778 and a masonry bridge survived until 1894 when the present steel structure, with a single span of 120ft, was erected.

Witton-le-Wear

During the 1771 flood the river Wear had formed a new channel to the South of the bridge, so causing its collapse. As a County bridge, the design of its replacement was probably undertaken by one of the Bridge Surveyors, Todd or John Bell*, a Durham architect. Contractors for the rebuilding at Witton comprised two joiners, William Ramshaw and Matthew Low, of Ferryhill, and two masons, John and Thomas Todd, of Byers Green.¹⁵⁰ Built at a cost of £1000 the bridge survived only until October 1787 when it was later reported that it was “intirely broken down prostrated and ruinous”.¹⁵¹ George Nicholson* was then instructed to provide designs and estimates and the rebuilding was undertaken by John Nicholson, carpenter, and Stephen Coulson, mason; both men were from Wolsingham and their tender was for £989.¹⁵²

Completed by January 1789, the bridge fell again three years later when the Newcastle Courant – but not the Chronicle – reported in December 1792 that the southern abutment had failed in a flood, causing the adjoining arch to collapse. In view of the fact that no advertisements for its rebuilding were published, coupled with the absence of comment in the Durham Quarter Sessions: Orders, it could well be that repairs were undertaken by the earlier contractors as part of their maintenance responsibilities. The bridge was later described as “a good, substantial structure of two arches”¹⁵³ with spans of 56ft and 68ft.

Durham: Elvet Bridge

This bridge, administered by the Durham Justices, was originally erected by Bishop Pudsey c.1170 with 14 arches but was later rebuilt and in 1771 comprised 10 arches with a maximum span of 32ft. At the time of the flood “the river meeting with obstructions at Elvet Bridge, it

swept away at the south end, a corner house”¹⁵⁴ and other property, as well as causing damage to three (or four) arches of the bridge itself.¹⁵⁵ In early 1772 it was ordered that material blocking the arches be removed and the damage immediately repaired but what was to be of greater benefit to the bridge’s well-being was the decision made in 1800 to widen it. Initially, this work was to be to the designs of George Brown* but in February 1804 Brown was charged with “widening altering and improving”¹⁵⁶ the bridge to the designs of Christopher Ebdon*.

Advertisements for masons were placed in the Newcastle press¹⁵⁷ and widening on the upstream face of the bridge – to 30ft – was completed by the autumn of 1807. The cost entailed had been some £7000.¹⁵⁸ Brown’s work, however, proved unsatisfactory and the Justices instructed that the bridge be repaired at the expense of its builder. Brown was not able to undertake this work – it was noted that he was “late of Durham”¹⁵⁹ – and his sureties were therefore instructed to carry out the work necessary; the outcome has not been ascertained.

Durham: Prebends Bridge

A bridge structure, dating from c.1700 and located some 100 yards upstream of the existing bridge, was destroyed in the 1771 flood and the present Prebends Bridge was built to replace it. As owners of the bridge, the Durham Dean and Chapter agreed in 1772 to realise some £3000 from the sale of standing timber at Muggleswick and Hollingside¹⁶⁰ to finance construction and the bridge was built under the direction of George Nicholson*, architect to the Dean and Chapter. After taking advice from Mylne as to the location and form of the bridge, Nicholson put work in hand and the foundation stone was laid on 17 Aug 1772 with a grand procession and an “excellent sermon”.¹⁶¹

Between 1772 and 1778 payments were made to Nicholson to enable him to carry out the work, presumably using directly employed labour and/or contractors, although no

accounts from the latter are recorded. The payments made were as follows: 1772, £1450; 1775, £790; 1776, £420; 1777, *c.* £450; 1778, £133.¹⁶²

Towards the completion of the bridge, in 1777 or 1778, a sum of five guineas was paid to "Mr. Wooller for his Survey of the Bridge"¹⁶³ and in 1784 the bridge was inspected by another engineer, John Rennie; he was not then impressed by its workmanship although he thought the bridge "a very decent piece of Architecture".¹⁶⁴ The bridge was opened on 11 Apr 1778: "the design and workmanship of it reflect great credit to the builder, Mr. George Nicholson".¹⁶⁵

The bridge comprises three semicircular masonry spans, each of some 67ft with the voussoirs and lower parts of the piers rusticated. The parapets are part balustraded on a corbel course. The height of the deck above the river is 40ft and the width between parapets is 18ft 6ins.

REBUILDING THE BRIDGES ON THE RIVERS TEES AND GRETA

In 1771 the bridges in the river Tees catchment did not suffer to nearly the same extent as those on the river Tyne. At Barnard Castle the peak of the flood was noted as occurring during Saturday evening while at Yarm it was at 8 am on Sunday. Although the bridge at Yarm was itself undamaged, its subsequent history has nevertheless been included here since its modification was a direct result of the flood.

Wynch Bridge

Supposedly the oldest suspension bridge in Europe, this privately-owned structure crossing the river Tees had been built in 1741 and comprised a single span of 60ft with a width of some two feet and the deck laid directly upon the chains; it was restrained by further chains connecting the deck to the rock faces of the 60ft deep chasm below.¹⁶⁶ In the 1771 flood the south end of the bridge was lifted from its moorings¹⁶⁷ but no details of its repair have been located. One of the chains broke in 1802

and, after repair, the bridge continued in use until a replacement was erected in 1830.¹⁶⁸

Barnard Castle

During the flood it had been possible to touch the water of the river Tees from the bridge, the parapets of which were destroyed although the two arches were not affected. The retaining walls, however, were damaged and the south causeway was carried away, ladders being required to get off the bridge as a result of a 12ft level difference.¹⁶⁹ A temporary bridge was quickly erected by John Peacock* and permanent repairs, to the design of John Carr*, were put in hand by John Parkin and George Branson in autumn 1772.¹⁷⁰ The parapets were repaired under Nicholson in 1780, further work was undertaken in 1785 and in *c.* 1798 the bridge was "repaired and widened by successive tiers of closed arches".¹⁷¹ The bridge was the property of the North Riding of Yorkshire.

Gilmonby

The North Riding's bridge at Gilmonby, crossing the river Greta and recorded as having been destroyed by the flood,¹⁷² had been repaired only in 1769. A single span bridge with a two-ring arch of some 30ft span and a width of ten feet, was built as a replacement in 1772¹⁷³ but details have not been located, other than the fact that "Robert Wensley, Gent"¹⁷⁴ was paid £18 7s 6d for repairs in 1772 and John Parkin received £60 for further work in 1782.¹⁷⁵

Rutherford

Following the destruction of the earlier two-span North Riding County bridge, built in *c.* 1750 over the river Greta, John Peacock was instructed by the Justices in February 1772¹⁷⁶ to inspect Rutherford and Barnard Castle bridges and report on their condition. Subsequently Robert Shout, jnr, of Helmsley was successful in obtaining the contract for rebuilding the former structure.¹⁷⁷ Designed by Carr, the replacement bridge was of 78ft span and costs totalled £450.¹⁷⁸

Greta Bridge

Following the destruction of the old bridge over the river Greta, whose rebuilding had been contemplated in both 1766 and 1770, a temporary structure was built by Peacock in February 1772.¹⁷⁹ John Sawrey Morritt, owner from 1770 of the adjoining Rokeby Park, gave up land to enable bridge works to proceed but the rebuilding caused some dispute as to road alignment. The permanent bridge was designed for the North Riding of Yorkshire by Carr – appointed as Bridge Surveyor in 1772 – and comprises a single span of some 74ft with a recessed arch ring, balustrade and a width of 17ft; it was built on oak piles by John and William Peacock and was completed in 1773 at a cost of £850.¹⁸⁰ As a result of its proximity to Rokeby Park the bridge is decorated with niches and roundels, but only on the side facing the house.

Yarm

The inhabitants of Yarm were warned of the impending flood by the Rector of Hurworth, the Rev. George Bramwell, who despatched a messenger by horse to inform the town downstream that the river Tees was rising alarmingly.¹⁸¹ The river rose so as to flood the town to a depth of 15ft but the medieval bridge, built c.1400, survived the onslaught. Such was the damage caused in the town, where every house was under water and the church flooded to a depth of 9ft, that the decision was made to alter the bridge so as to permit it to pass greater volumes of water. John Shout, ordered by the Justices to undertake the minor repairs needed, recommended that the bridge be improved by widening the north arch from 24 to 46ft and building a new north land arch of 20ft;¹⁸² this was not implemented, however, and repairs were undertaken by Shout on a dayworks basis.¹⁸³

In April 1773 the Durham and North Riding bridge authorities – Yarm bridge was jointly owned – ordered their two surveyors, Bell and Carr, to inspect the bridge with a view to providing an additional arch to assist dispersal of

flood water and so reduce the risk of future floods inundating the town. Their report recommended that as the bridge was “not sufficient to admit the water which has been wont and should pass through the same”,¹⁸⁴ a 40ft arch be provided on the north bank. It was not until 1785, however, that a “new arch”¹⁸⁵ of some 60ft was inserted at the north end of the bridge by Appleton Bennison, the span made semicircular for the better passage of floods; the design of the new work was by Carr.

Yarm bridge, as early as 1765, had been considered by the bridge authorities of the two counties as being too narrow.¹⁸⁶ As a replacement, it was decided to adopt an iron bridge with a span of 180ft, to the design of Thomas Wilson (fig. 5) who had been responsible for the erection of the iron bridge at Sunderland in 1796. The new bridge was to be an exact replica of Wilson’s Staines bridge – problems there had not then become apparent – and construction began in September 1803,¹⁸⁷ the site immediately to the west of the original structure.¹⁸⁸ The contractor for the masonry work was Thomas Wheldon, of Nether Siltion, his tender having totalled £2420; Wilson’s price for the ironwork – by Walkers of Rotherham¹⁸⁹ – was £5570.¹⁹⁰ As justification for the use of iron, Peacock, by then deputy surveyor for the North Riding, reported that it would cost £7000 to widen the old bridge or £14000 to build a new stone structure.¹⁹¹

Modifications to the design were made during construction, among them the use of vertical struts in the spandrels in place of circles.¹⁹² As the result of a flood during construction, it was decided to raise the masonry abutments by five feet so as to lift the arches’ springing above flood level¹⁹³ but, nevertheless, completion was effected in September 1805 when success to the bridge’s future was toasted with due ceremony, despite the fact that the southern approach was still unfinished. On 13 January 1806 the ironwork of the bridge collapsed, failure blamed – as at Staines in 1803 – on inadequate abutments.¹⁹⁴

As would be expected, recriminations followed. Reports on the failure were prepared by



Fig. 5 The cast-iron bridge at Yarm, designed by Thomas Wilson; it collapsed in 1806 before being opened to traffic. [J. Graves, *The History and Antiquities of Cleveland* (Carlisle, 1808)]

Wilson, Ebdon, and Peacock. A committee of four – one of whom was David Stephenson – was established to investigate the failure and, after viewing the site and considering the submissions, it made known its findings in May 1806. It concluded that the cause of failure was the insufficiency of the south abutment to “resist the great lateral pressure of the Arch”¹⁹⁵ and although Wilson had inspected the masonry, he had gone ahead with construction. It was considered regrettable that Ebdon, through ill-health, had not given full attention to the work and that Peacock had not stopped construction after he had found the abutments to be insufficient: “In short, the real and proper Survey of this work has been neglected, from the Parties depending too much on each other, and upon the Contractors”.¹⁹⁶ The report concluded that a stone bridge was to be preferred and

the committee expressed the hope that the surveyors would “guard their Professional Reputation . . . with more Caution in future, and not suffer themselves to be trifled with by ignorant Deputies or negligent Contractors”.¹⁹⁷

Wheldon was the only contractor to tender for rebuilding work but his price of £10,000 was not accepted¹⁹⁸ and the ironwork was sold in six-ton lots, realising £1353. Carr had refused to use the abutments for another iron bridge and all remnants of Wilson’s bridge were thereupon removed and the original masonry bridge widened on its downstream side to a total of 35ft in 1807.¹⁹⁹ In view of foundation problems it was decided to build the piers and abutments by dayworks under an inspector resident at Yarm and then complete the arches by contract.²⁰⁰ The iron bridge had cost £8000.²⁰¹

CONCLUSION

During the 45 year period considered, a score of bridges in the North East had been built, rebuilt, substantially repaired or widened. As a result of three floods, greater than anything experienced since, bridges had collapsed or had been swept away by river action. Failure had been caused either by overturning as a result of blockage of the arches or by the undermining of the foundations; collapse could well have been further caused or exacerbated by poor maintenance. All three causes of failure were to be ameliorated in the rebuilding which followed.

The floods led to all the relevant authorities instituting a more methodical programme of inspection and maintenance of their bridges and the appointment of more highly-qualified engineers or architects as bridge surveyors, in turn leading to well-built structures able to withstand floods. From the time of the ending of this survey, the study and knowledge of soil mechanics began to improve although there were to be future failures of the same type. What was, perhaps, of the greatest significance was the fact that many bridges, built originally only for the passage of horses, were substantially widened, so rendering the structures much more stable and less likely to be destroyed.

Other than the Wynch bridge, all those destroyed or damaged in 1771 were of masonry, the maximum span involved being some 80ft. Looking to the future, however, the cast-iron Wearmouth bridge of 1796, only the second such structure to be built in England, boasted a span of 236ft and it is interesting to note that iron, still a relatively new material in this application, was so early considered for use at Newcastle, if only for widening purposes. The collapse of the iron bridge at Yarm in 1806 perhaps led to a lack of confidence in that material; in 1808 it was recorded that the failure, "from whatever cause it might proceed, is a proof that something is yet wanting in the construction of *iron-arches* to ensure that permanence and durability, which the experience of ages affords in favour of *stone-bridges*".²⁰² This comment, however, was perhaps

unjustified as the collapse had been the result of abutment failure rather than shortcomings in the ironwork. Apart from a small estate bridge at Alnwick, designed by David Stephenson, no other iron bridge was built in the North East until the Stockton and Darlington Railway erected its crossing of the river Gaunless in 1825. From that time masonry would no longer be the only material to be considered for future bridge structures; iron would become a common material for both suspension and arch bridges.

ACKNOWLEDGEMENTS

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APPENDIX

Note: Brief biographical details are given below of some of the consultants and surveyors, etc., mentioned in the article. Where their names appear in the text of the article they are followed by an asterisk ().*

Consultants

Chapman, William, MIRA (1749–1832), resident in Newcastle, civil engineer.
 Fryer, John (1745/6–1825) of Newcastle, schoolmaster and land surveyor.
 Gott, John (1720–1789) of Woodhall, Yorkshire, bridge surveyor and stonemason.
 Hutton, Charles, FRS (1737–1823) of Newcastle, schoolmaster and mathematician.

Mylne, Robert, FRS (1733–1811) of Edinburgh, civil engineer and architect.

Smeaton, John, FRS (1724–1792) of Austhorpe, near Leeds, civil engineer.

Stephenson, David (1757–1819) of Newcastle, architect.

Wilson, Thomas (1751–1820) of Sunderland, schoolmaster and engineer.

Wooler, John (d.1783), civil and military engineer.

Cumberland County Bridge Surveyors

[Until 1775 the High Constables of the five County Wards, all described as ‘Gent’, acted as Bridge Surveyors for their own areas.]

Murray, Francis, stonemason: Surveyor 1775–1787.

Stephenson, Thomas: Surveyor 1787–1797.

Jackson, Richard: Surveyor 1797–1804.

Borrowscale, Joseph, stonemason: Surveyor Western Area, 1804–1817.

Stubbs, Joseph: Surveyor Eastern Area, 1804–1809.

Sanderson, William: Surveyor Eastern Area, 1809–1829.

Northumberland County Bridge Surveyors

Brown, George: Surveyor, 1765–1776.

Pickernell, Jonathan (1738–1812) of Hampshire: Surveyor, 1776–1781.

Thompson, Robert (1742–1806), innkeeper and stonemason of Hexham: Surveyor of South District, 1781–1803.

Harle, John (d.1788?) of Bavington: Surveyor of North District, 1781–1788.

Johnson, William (1730–1807), innkeeper and stonemason of Stamfordham: Surveyor of North District, 1788–1802.

Dodds, Isaac: Surveyor of North District, 1802–1803.

Hall, William, stonemason of Stamfordham: Surveyor of South District, 1803–1809.

Hall, John: Surveyor of North District, 1804–1817.

Robson, George, of Cartington: Surveyor of South District, 1809–1818.

Durham County Bridge Surveyors

Bell, John (d.1784), architect of Durham: Surveyor for north of County, 1765–1784.

Todd, Robert (d.1776), stonemason of Byers Green: Surveyor for south part of County, 1770–1776.

Nicholson, George (1736–1793), stonemason and architect of Durham: appointed Surveyor for south of County in 1776 but took over whole area in 1784.

Ebdon, Christopher (d.1813?): Surveyor 1793–1813; appointed to whole County with two assistants; held post solely from c.1805.

Richardby, Thomas, joiner and cabinetmaker: assistant to Ebdon, 1793–1794.

Brown, George, 1793–c.1805, stonemason of Durham: assistant to Ebdon, 1805–1813?

Bonomi, Ignatius (1787–1870), architect of Durham: Surveyor for whole County, 1813–1850.

North Riding of Yorkshire Bridge Surveyors

[Appointment of Bridge Surveyor appears to have lapsed before 1771]

Carr, John (1723–1807), architect of York: County Bridge Surveyor, 1772–1803.

King, Henry (d.1789), stonemason of Ripon: Deputy Surveyor, 1773–1789.

Peacock, John (d.1807?), stonemason of Dishforth: Deputy Surveyor, 1789–1803 and Surveyor from 1803.

Peacock, Matthew: appointed Deputy Surveyor, 1803.

Foss, John: appointed Surveyor, 1807.

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Abbreviations

CRO:	Cumbria Record Office, Carlisle
DRO:	Durham County Record Office
NRO:	Northumberland County Record Office
NYRO:	North Yorkshire County Record Office
TWAS:	Tyne and Wear Archive Service
NCL:	Newcastle City Library
NQSO:	(Northumberland) Quarter Sessions: Orders
DQSO:	(Durham) Quarter Sessions: Orders
NYQS:	(North Yorkshire) Quarter Sessions: Minute and Order Book

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