

BRIDGES: PAST AND FUTURE

The current state of knowledge and proposals for future research

By DAVID HARRISON

When I began my research into medieval bridges in the 1970s, there was little interest in the subject. My fellow post graduates viewed it with mild amusement. No major studies had been undertaken since before the Second World War. Flower had published a collection of court cases relating to bridges and other public works in two volumes (1915; 1923). In 1926 Jervoise was commissioned to undertake his survey of English bridges river by river, which he published in four volumes (1930; 1931; 1932; 1936) together with brief histories of extant ancient bridges and of those which had disappeared. Similar volumes were also produced on Cornwall (Henderson and Coates 1928) and Devon (Henderson and Jervoise 1938). Both Flower and Jervoise have been plundered freely by historians and others ever since.

Despite these impressive efforts, even in the 1970s there were no secure generalisations about bridges. Some scholars still believed that medieval communications were poor. Professor Darby (1973, 74–5) took for granted that ‘before 1750, large rivers were usually crossed by fords and ferries’. Subsequently the importance of road transport from the sixteenth to the nineteenth century was re-assessed (Albert 1972; Chartres 1977; Pawson 1977), but often the revisionists continued to consider the medieval road system primitive. One of the few scholarly articles had concluded that major bridges were of timber (Rigold 1975); unfortunately this generalisation was based on study of the lower Thames, which was exceptional. A small, elderly display about bridges at the Science Museum, South Kensington, reflected this view.

Since the 1970s the situation has been transformed. There have been a series of important studies of individual bridges, including a collection of essays on Rochester Bridge to commemorate the 600th anniversary of its construction, which contained an appendix on the long series of bridge wardens’ accounts (Yates and Gibson 1994). The publication of the London and York bridge accounts followed (Harding and Wright 1995; Stell 2003). Several books have been based on important excavations, including Watson’s on London (2001), Rowland’s on Monmouth (1994), and Ripper and Cooper’s on Hemington (2009). The Victoria County History (VCH) volumes published from the 1970s have tended to provide more detailed information about specific bridges of all sizes than earlier ones. There have also been excellent studies of rivers and counties, for example of bridges over the River Wey (Renn 1974) and the bridges of Northamptonshire (Goodfellow 1985–6) and Bedfordshire (Simco and McKeague 1997), the latter an impressive collaborative work undertaken by engineers, planners, archaeologists and historians; in addition retired county bridge surveyors have published accounts of their experiences (Wallis 1974). There have even been two books. *The Bridges of Medieval*

England sought to outline a general history of bridges in England from the post-Roman period to the 18th century (Harrison 2004). Two years later Cooper (2006) published *Bridges, Law and Power in Medieval England*, which concentrated on the financing of bridges, particularly the rise and fall of the obligation to build and repair bridges. The Cambridge Group for the History of Population and Social Structure (2010) has begun a project to create a GIS of the Transport Infrastructure of England and Wales 1379–1729, including an examination of the crossing points of major rivers at four points in time. During the past 40 years similar work had been undertaken in other European countries, and having examined them all, Nicholas Brooks published a survey of European medieval bridges (1995). Post-medieval bridges have also received attention, notably in Chalkin’s *English Counties and Public Building, 1650–1830* (1998), and Ruddock’s *Arch Bridges and their Builders, 1735–1835* (1979).

Since the 1970s there has also been a growing body of research on other aspects of medieval road transport, for example Langdon’s studies of road haulage (1984, 1986) and Professor Dyer’s work on trading networks (1994). Our knowledge of waterways has also grown with a colloquium which led to a collection of essays edited by Blair (2007). These demonstrated the improvements to waterways, including the digging of canals. As the MSRG’s 2009 Winter Seminar in Leicester demonstrated, the study of bridges and waterways is flourishing.

What then is the current state of knowledge following the last four decades of activity? The main message must be the remarkable achievement in constructing an extensive network of bridges which supported English road transport up to the eve of the Industrial Revolution (where no reference is given below, the source is Harrison 2004). In tracing this important development, it is convenient to divide the study into two distinct periods. From the 12th century there is an increasing amount of documentary evidence (by the late Middle Ages, a huge amount) and a large number of bridges survive. In contrast, before the 12th century, we are confronted by the paradox of so many references to bridge work and so few to specific bridges. As a result, there remains a good deal of uncertainty even about basic questions such as how many bridges were built.

Pre-12th century

The first question to be addressed is that of continuity from Roman Britain. It is unclear how many bridges the Romans built (Dymond 1963), but it seems likely to have been considerably fewer than the number in the Middle Ages. Some Roman bridges disappeared: the Ermine Street crossing of the Nene moved from the Roman

bridge at Water Newton to the ford at Wansford, where a bridge was subsequently built. Early Anglo-Saxon England was a land of fords. It is striking that there are many place-names with a *-ford* element where there was a bridge in the later Middle Ages. For instance, there were bridges in the fifteenth century across the Thames at Lechlade (from the Old English *gelad*, meaning 'passage'), Oxford and Wallingford, across the Severn at Montford and across the Great Ouse at Water Stratford, Stony Stratford, Stafford, Great Barford and Bedford. Bede (Colgrave and Mynors 1969, 258–9) tells a story about St Aidan, which shows that in the first half of the 7th century it was a good idea in the north of England to have a horse to ford rivers: the saint 'had been given an excellent horse, and although he usually walked, he would ride it when he had to cross a river'. Some Roman bridges, however, probably survived, as Brooks' (1994) essay on Rochester bridge suggests; the Roman stone piers survived even if the timber roadway was out of use and it is even possible that ancient territorial obligations continued. The situation may have been the same at Newcastle and some form of continuity is implied by the place names Piercebridge and Corbridge, both the site of Roman bridges.

By the beginning of the 8th century major new structures were being constructed. A large piled causeway linking Mersea Island to the Essex mainland, which was found when a water main was laid, has been dated to c. 700 (Crummy *et al.* 1982). In the middle of the century we begin to find references to building bridges associated with work on fortifications (Brooks 1971). The evidence for any bridges associated with these references to bridge work is, however, rather slim and Cooper has argued that no bridges were built in a chapter entitled 'Bridge work, but no bridges' (2006). Yet there is some evidence of a mid-8th century Mercian building campaign. A bridge was built at Cambridge between 730 and 875 and a mid-Saxon bridge was excavated at Oxford (Dodd *et al.* 2003). There are also the remains of the bridge at Cromwell, once thought to be Roman but now dated to the 8th century (Salisbury 1995). The bridge was found a little way downstream of Newark and may have been a major crossing of an important road heading to Doncaster and the north (I am grateful to John Blair for pointing this out); the main medieval route is close. Given the ability to mobilise men to construct Offa's Dyke the construction of a number of bridges would certainly have been within the means of the Mercian state.

The construction of fortified settlements of a variety of sizes, described as burhs, was a key policy in the 9th and 10th century wars with the Danes and has been much studied. Some of these settlements, as is well known, were associated with bridges. The *Anglo-Saxon Chronicle* records as one of the key events of the year, that before midsummer in 920 Edward 'went to Nottingham with an army, and ordered a stronghold to be made opposite the other on the south side of the river, and the bridge over the Trent between the two strongholds' (Swanton 2000, 104). The bridge was a formidable undertaking of great strategic importance. Projects of this type were undertaken throughout the midlands and south, but it is uncertain how many bridges were constructed. A maximalist position is

taken by Haslam, namely that bridges were erected at all burhs built by rivers. This may have been the situation but we do not have documentary proof in most cases.

By the 11th century we know a little more. The unique 'Rochester bridge document' provides a detailed description of the bridge work obligation, indicating how the liabilities were allocated (Brooks 1994). Excavations at Hemington have revealed two types of timber bridge from the late 11th and 12th centuries: the first consisting of lozenge-shaped piers in the form of wooden boxes filled with rubble, the second a trestle structure (Ripper and Cooper 2009). However, key questions remain to be answered, most importantly how many bridges there were. Domesday Book reveals so much about so many subjects, for example recording as many as 6,000 mills (Holt 1988, 107), but is largely silent about bridges, presumably because they were not a source of income. We do know that many of the most important bridges in the country existed by 1100, including those at London, Rochester, Chester, Nottingham, Stamford and Bristol. While the number of specific bridges is small by later standards, it is likely that there were many more than are known. Blair (1994, 130–2) has mapped the landscape revealed in a number of contiguous charter bounds in the lower Windrush valley, dating from the second half of the 10th century and the early 11th century. It contained several bridges within a relatively small area. Finally, court cases from the 13th century record many types of obligations which may be of Anglo-Saxon origin like those of Rochester Bridge.

Post-1100

In contrast to the uncertainties of the 11th century in later centuries we can come to clear conclusions. Notably, the scale of the network is well-established. By the 15th century there were so many bridges that on many rivers they were less than 5 miles apart. Where a major road met a river there was a bridge. At all but a few sites where there was a bridge in 1750 there had been a bridge in 1500 and where the evidence survives, as it does for the Great Ouse, it is apparent there had been a bridge by the 12th century.

We also have a considerable body of evidence about the design and construction of these bridges. From the late 11th century in England as in other parts of Europe stone arched bridges became more common. Their construction was a remarkable feat of engineering and was probably connected with the contemporary vaulting of great churches. As Ranulf Flambard, bishop of Durham, completed the revolutionary vaults of the cathedral nave he also constructed one of the earliest arched bridges. Symeon of Durham thought that Flambard had built something very special, observing that he 'joined the two banks of the River Wear with a stone bridge, a major construction supported on arches' (Rollason 2000, 276–7).

Laying foundations where river flows are substantial all the year round was not easy, but the next few centuries saw a transformation of the network. Vaulted bridges were built in every situation. By the sixteenth century a few timber bridges survived, for example on the lower Swale and lower Wye, but they were uncommon except

around the middle Thames (from Reading to Kingston all the bridges were timber until the late 18th century) and possibly in East Anglia. The majority of major bridges were stone and were multi-arched, and a surprising number remain. Among many fine survivals are those at Huntingdon which carried the old North Road across the Great Ouse, Newbridge on the Upper Thames and Bideford across the Torridge estuary.

Arched bridges began to be constructed across wide, deep, tidal rivers by the 12th century. Old London Bridge was begun in 1176 and took 33 years to build (Watson *et al.* 2001). As foundations could not be firmly laid on the river bed, a technique involving the use of ‘starlings’ was employed. Other bridges followed, for example in Rochester where the ancient timber-decked bridge was eventually replaced in the 1390s (Britnell 1994).

In the north of England, masons confronted a different challenge. The 5-metre arch spans of most southern bridges would have been inadequate to cope with the floods experienced in the north. Much larger arches were required as Defoe noted:

‘The River Wharfe seemed very small, and the water low, at Harwood Bridge, so that I was surprised to see so fine a bridge over it ... [however], coming another time this way after a heavy rain, I was convinced the bridge was not at all too big, or too long, the water filling up to the very crown of the arches...’. (1974, 211)

Elvet Bridge in Durham is typical of the structures built to provide a bigger opening. It has tall arches with

individual spans of almost 10 metres; it probably dates from a reconstruction of the 1230s. Similar bridges were built throughout the north and as far south as Cromford and Matlock in Derbyshire (fig. 3).

Soon even larger and flatter arches were being built. Flat arches were employed in the Pontevecchio in Florence in 1345 and were being constructed by the second half of the century in England, notably at Dee Bridge, Chester. Thereafter bridges with giant arches replaced bridges of the Elvet type. Masons seem to have competed with one another in constructing huge spans of up to 100 ft. The climax of late medieval design can be seen in two bridges built around 1500. One is Piercebridge over the Tees with its three sublime segmental arches constructed of precisely-cut ashlar voussoirs and its huge abutments to resist the powerful lateral thrusts. The other is Twizel Bridge in Northumberland. Leland described it as ‘of stone one bow but greate and stronge’ (Toulmin Smith 1964, v, 66). With its single span of 90 ft, it far exceeded the spans of the largest churches.

Low-lying land created yet another challenge (fig. 1). On his way to Nottingham Defoe noted

‘...for the Trent being, at the last time I was there, ...swelled over its ordinary bound, the river reached quite up to the town; yet a high causeway, with arches at proper distances, carried us dry over the whole breadth over the meadows, which, I think, is at least a mile.’ (1974, ii, 145)

One great causeway survives, also in the Trent valley, at Swarkeston; the arches over the main channel of the

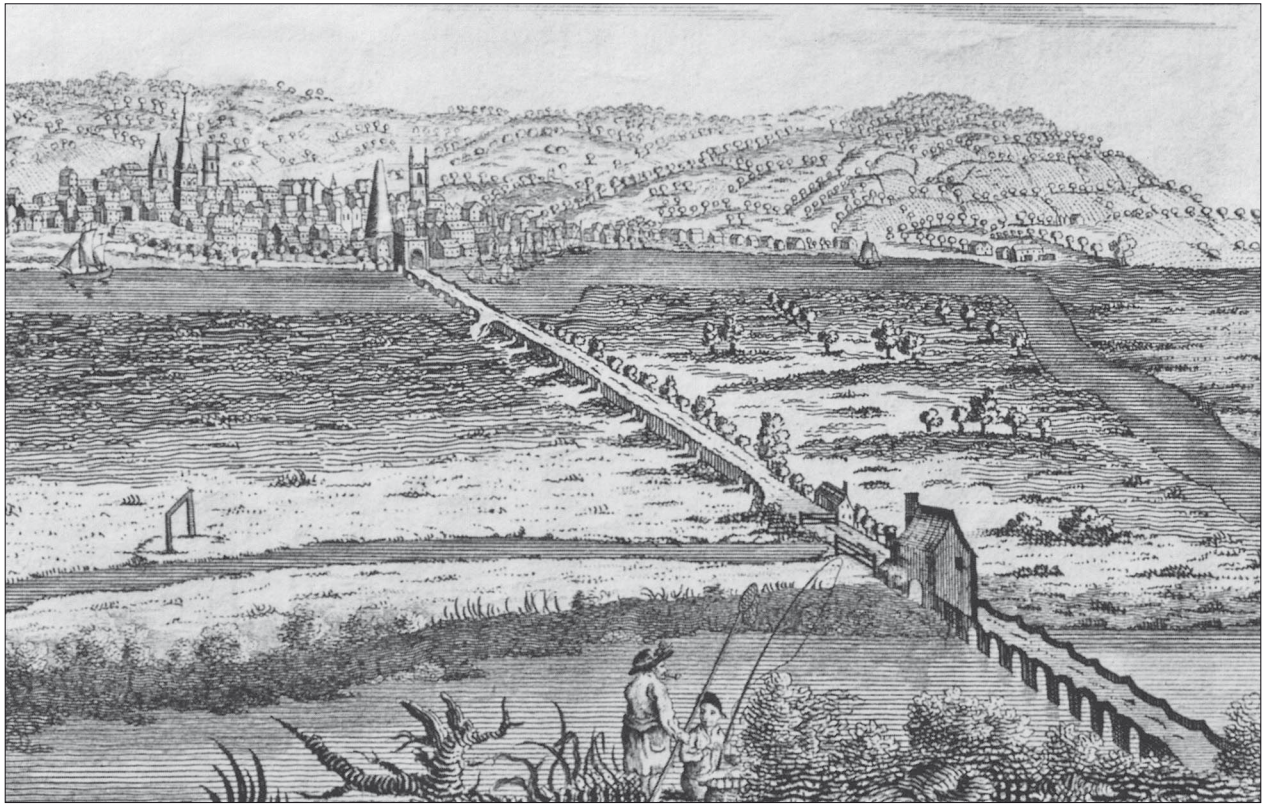


Figure 1 Perspective view of the city of Gloucester engraved for the Complete English Traveller. Roads across broad river valleys, like the Severn at Gloucester, were carried by causeways sometimes a mile or more long. The causeways were commonly made of earth retained by a stone wall. There were bridges over the many river channels.

river were replaced in 1795–7, but much of the rest of the almost mile-long structure is medieval. Although the arches across the main channel have been replaced, the earth causeway still rises above the Trent flood plain, with its retaining walls and medieval arches above the many water channels. Even longer was a causeway known as Holland Bridge on the route from Nottingham and Grantham to Boston which contained in one of its two sections 30 bridges.

The building and upkeep of the network of bridges was a huge task, involving large sums of money. We do not have figures for the full cost of a major medieval bridge, but many insights into the large sums involved. Repairs to old Tyne Bridge in 1369 were estimated to be in excess of £1500. Just one of the donors to the bridges and causeways at Abingdon and Culham, Geoffrey Barbour spent 1000 marks (£666) (Fig. 2). 300 men were at work in the summer of 1416 building the road across Andersey Island, digging ditches in hard ground and building up earth to carry the roadway (Toulmin-Smith 1964, v, 77–8). Under a contract of 1421 masons agreed to erect the stonework of a bridge at Catterick in Yorkshire of three very large arches for 260 marks. This sum excluded other considerable costs, including the materials (mainly stone and timber), haulage to the site, the coffer dam and the work of carpenters on making the centring and scaffolding (Salzman 1967, 497–9).

From about 1100 there is an increasing amount of evidence that bridges were being financed in other ways from the bridge work liabilities employed by the Anglo-Saxon state. These seem to reflect changes in the nature

of the state with increasing reliance on private initiative. New bridges were funded by private, charitable bequests, like hospitals, schools, and almshouses. Most of the money was provided by wealthy people with strong local connections, like Hugh Clopton, a lord mayor of London, who built the existing stone bridge in his home town of Stratford-on-Avon. Their motives were a mixture of charity, civic pride and self-interest mixed in many different proportions. Some bridges built up very large endowments for their repair and maintenance. London Bridge had annual income of over £500 (Harding and Wright 1995). Richard II granted to the city of York the right to acquire land, tenements and rents to the value of £100 to pay for the upkeep of the two bridges and the chapel on Ouse Bridge (Stell 2003).

Bridges were a great source of civic pride and interest for townsmen and women, as a unique 15th poem, which celebrates the construction of the bridges at Abingdon, indicates (Toulmin Smith, 1964, v, 117):

Wyves went oute to wite how they wrought:
 V. score in a flok it was a fayre syght.
 In bord clothes bright white brede they brought,
 Chees and chekens clerelych A dyght.

Future research

The general outline of the history of medieval bridges from the 12th century is established, but there is a plethora of material yet to be examined which will doubtless lead us to take a different view of many of the



Figure 2 Culham Bridge, early 15th century. Bridges were expensive and their construction a great source of civic pride, as a unique poem about the building of a series of bridges and causeways between Abingdon and Culham indicates (photograph by the author).

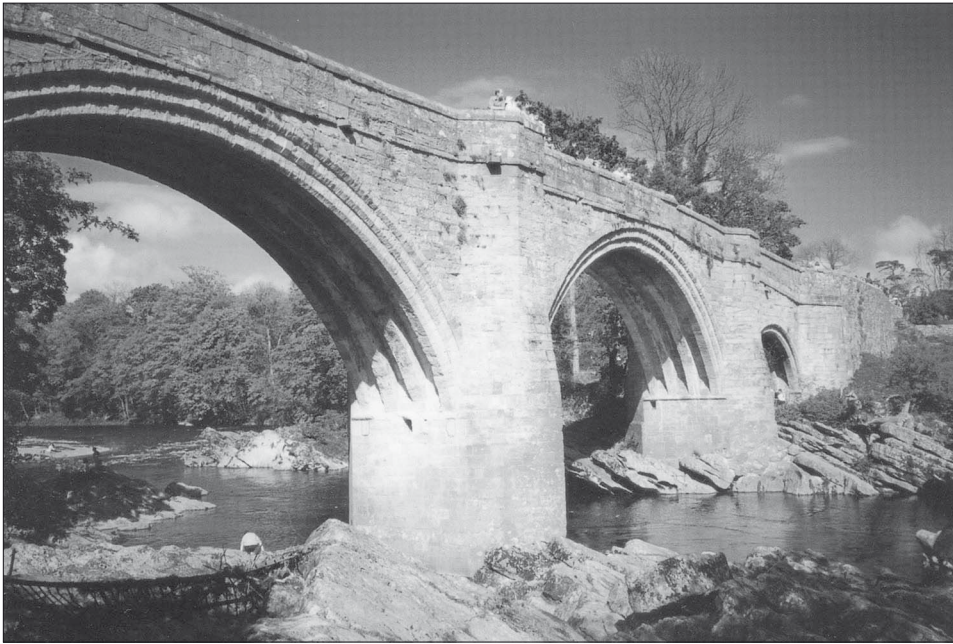


Figure 3 Devil's bridge, Kirby Lonsdale. In the north bridges were constructed of huge arches with spans of 20-30 metres, far exceeding those of any great churches.

details. In contrast, even the outlines of the history of Anglo-Saxon bridges remain sketchy, but many of the key sources have been thoroughly examined.

Documentary

Pre-12th century

The main documentary sources which would repay further study for the history of pre-12th century bridges are the descriptions of the boundaries attached to many Anglo-Saxon charters, which refer *inter alia* to roads, fords and bridges. An analysis of these charter bounds would have three main purposes. First, it could consider whether the density of bridges revealed by Blair (1994) in the Windrush valley was repeated elsewhere. Secondly, the study of charter bounds could be part of a project to consider the continuity of bridge sites. It is striking that the sites of bridges in the 12th and 13th centuries, even of comparatively unimportant 12th century bridges such as those over the middle Ouse at Harrold and Turvey, remain the sites of bridges today. The loss of the bridge at Pounteys over the Tees, with its presumed replacement by Croft Bridge, is the rare exception which proves the rule. Was the situation the same in earlier centuries? There was continuity from the 8th century, for example at Oxford and Cambridge, but not at Cromwell (near the major crossing at Newark), or later at Quatbridge which was replaced by Bridgnorth. Thirdly, thorough analysis of the bounds would enable us to plot the roads referred to in a number of contiguous bounds as well as the bridges on them and to consider their relation to Roman roads. Langlands has begun research along these lines in Wiltshire as part of his and Reynold's *Mapping Anglo-Saxon Charters Project* (Langlands and Reynolds, *MASC*). Another area which should be a priority for study is Kent where roads and river crossings indicated in the charter bounds could be compared with those shown on Symonson's early 1596 road map of the county. Such work would be particularly timely as it could take advantage of the *LangScape* on-line searchable database of Anglo-Saxon estate

boundaries developed at King's College, London (Senior Researcher, Joy Jenkyns; *LangScape* 2008).

The other documentary sources which might shed light on the early history of bridges are the many post-Conquest court cases which refer to liabilities to repair bridges. These arose in a variety of ways, but some have an old English origin; possibly a more detailed examination might reveal more about the origins of the liabilities and make a better assessment of the proportion which have an Old English origin. Finally, the most important discoveries to shed new light on pre-12th century bridges have been revealed through excavations. This is considered below.

Post-1100

While I believe that the basic picture I have outlined for the post-1100 period is right, the increasing mass of sources mean that just about every aspect of bridges can be examined in far more detail. There are a number of aspects of the subject which have scarcely been considered and hypotheses which require further examination; some are disputed.

- The location of bridges

An important subject which has been little studied is the location of bridges. Bridges over sizeable rivers were built on main roads; these were the roads between important centres so in practical terms, major bridges were either in towns or between two towns. However, the precise location of some bridges is likely to have depended on river and other environmental conditions. The discovery of a series of collapsed medieval bridges at Hemington on the road between Leicester and Derby suggests that at this site it proved impossible to permanently establish a bridge and that it was a mistake to construct bridges there (Ripper and Cooper 2009). However, it seems that this was not a common problem since, as we have seen, the great majority of medieval bridge sites have been in continuous use to the present day; the Hemington bridges were exceptional. Nevertheless, we need to find out more about the sites of medieval bridges to find out

what made them the right location; for example, was a ford a good site for a bridge?

- Small bridges on main roads

One of the main claims of *The Bridges of Medieval England* was that an impressive network of river crossings had been constructed which in many respects survived into the 20th century. We know that on major roads, the bridges over rivers were cart bridges and access to them over flood plains was by means of the massive causeways described above, but it is unclear how travellers on main roads crossed streams and smaller water channels. Sometimes this was by means of a cart bridge. Barras Bridge carried the Great North Road across the Pandon Burn just north of Newcastle. Remains of the bridge arch, including at least two of the medieval ribs survive and an 18th century illustration shows a stone structure with a pointed medieval arch (Tyne and Wear Historic Environment Record). A 16th-century German traveller, Von Wedel, observed that 'in England there are fine stone bridges everywhere even over small streams (cited in Palliser 1983, 272). In the late 17th century Ogilby's 'maps' reveal many bridges over brooks, becks and streams. For instance, the road from Newcastle to Hexham indicates at Newburn a 'wood bridge over a brook', and also near Heddon-on-the-Wall. Between Wylam and Ovingham there was a 'stone bridge over a brook' as there was at Ovingham (Ogilby 1971, plate 86). However, whether bridges, and specifically cart bridges, were the norm over streams on main roads in the Middle Ages is yet to be established.

- The continuity of the bridge network

It seems likely that in most parts of the country the medieval bridge sites formed the main crossings of the road network not only into the 18th century but even in the 20th. For example, over the Swale, there were medieval bridges at Catterick, Morton-on-Swale, Skipton-on-Swale and Topcliffe. These sites, or the nearby successor bridges, remain the crossings of 'A' roads today. Was the situation similar in other parts of the country?

In the early 19th century, Telford constructed a new road to Holyhead, now the A5, which ignored the medieval route and in several places adopted the route of the Roman road. However, it seems to have been exceptional; soon after its completion the railways arrived and new roads were unnecessary for almost a century as long distance traffic switched from road to rail. It seems that most turnpike roads continued to pass through ancient bridge sites and towns although the routes between these nodes were altered. This needs to be checked.

- Keeping the bridge network in use

Historians have traditionally argued that medieval bridges were poorly maintained. Recently this was forcefully expressed by Crook who claimed that they were 'so often unsafe and so commonly left in disrepair that a ferry may have been regarded as safer and more reliable' (Crook 1998, 9). I argued on the contrary that great efforts were put into repair and maintenance, that when even out of repair they could often be used, that if an arch collapsed it could swiftly be patched up and that

travellers such as John Leland commented on the large numbers of fine bridges, with only the rare reference to collapse; on the other hand, Cooper is more sceptical, stressing the perennial shortage of funds (2006, 7). This is an important area for further research.

- The need for a database

In pursuing the questions raised above, historians of bridges have to examine in a painstaking way a wide range of disparate sources. It would be a great advantage if the work already done and the references collected could be made accessible to new researchers. There is a pressing need for a research project to establish a bridge database, which would provide ready access to the references to a bridge. It could probably build on the existing, but very patchy, Historic Environment Records scheme.

- The design and structure of bridges

More also remains to be discovered about the design and structure of bridges. Unlike modern bridges, many major medieval bridges supported a range of other structures, in particular chapels and towers. A project to examine this subject in more detail has thrown up a great deal of interesting information, notably on just how many structures there were (Harrison, McKeague and Watson, this volume). In particular, the fortification of bridges is more common than we had expected.

The chronology of the reconstruction of the network of bridges in stone is another area awaiting investigation. The construction of arched stone bridges was in full sway by the 12th century and was in most parts of the country largely complete by the 16th. However, we do not know when most major bridges were stone. Was it 1300 or 1500? The one area where bridges remained timber was the lower Thames where new timber bridges continued to be built in the 18th century and where older timber bridges were not replaced until the late 18th century. In some parts of the country the situation remains unclear, notably East Anglia.

Physical remains

One of the most important sources for an examination of their design and construction are the surviving bridges themselves. Over 100 medieval bridges survive substantially intact; many are major monuments. In addition, many others survive in part. Surprisingly, very little is known about them:

- There is no comprehensive gazetteer of the surviving bridges
- Many of the bridges cannot be dated with any precision – even to within the nearest century; with a few exceptions, most bridges lack distinct architectural features and different authorities often suggest a wide range of dates for the same bridge
- There have been few examinations about the less visible aspects of construction, including foundations, infill and arch construction (an exception is Heyman *et al.* 1980); for example, double arch rings are visible in the elevation of most medieval arches; were the arches really constructed of two arch rings or was the second arch ring decorative?

A priority for research is a thorough stone by stone examination of surviving bridges. This should include a consideration of the bridge's location and the river environment. Many bridges have distinct forms of arch construction (Harrison 1990) and this would pay further investigation. Comparison might also be made with arches in local churches.

Some of the most significant findings in recent years have come through chance discoveries made during engineering or quarrying works, such as the causeway to Mersea Island and the Hemington bridges. These findings were unexpected but an 8th century bridge over the Thames at Oxford was found where we might have expected it on the approach to Folly Bridge. Excavations in similar locations, in particular at causeways to historic bridges could produce some very interesting results. Unfortunately, a programme of excavations of this type would be expensive. Bridges are, however, subject to frequent works by highway departments. Their records might be usefully examined. In addition, as we have seen, in Bedfordshire collaboration between engineers, planners, archaeologists and historians was extremely productive. This approach should be applied more widely, even nationally: archaeologists and historians should take the initiative in interesting engineers in the history of bridges and causeways and be involved in work carried out on them.

Conclusion

To conclude, much has been learnt about bridges since the 1970s, but there is more to be done. As well as collaborating with highway engineers, there are two other priorities for research which involve a more comprehensive approach to the study of bridges. The first is the establishment of a database of references, building on the local authority Historic Environment Records database as part of the process of addressing the gaps in our knowledge described above. This approach is essential because information about bridges comes from so many disparate sources. The second is a detailed survey of the extant bridges, including an examination of their relation to the river and to fords. For all the progress made, bridges have been remarkably little studied compared with most other building types. These research projects should go a long way to address this failing.

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