River Witham

The source of the 8th longest river wholly in England is just outside the county, Lincolnshire, through which it follows almost all of a 132km course to the sea, which is shown on the map which accompanies Table Wi1 at the end of the document. Three kilometres west of the village of South Witham, on a minor road called Fosse Lane, a sign points west over a stile to a nature reserve. There, the borders of 3 counties, Lincolnshire, Rutland and Leicestershire meet. The reserve is called Cribb's Meadow, named for a famous prize fighter of the early 19th century; at first sight a bizarre choice at such a location, though there is a rational explanation. It was known as Thistleton Gap when Tom Cribb had a victory here in a world championship boxing match against an American, Tom Molineaux, on 28th September 1811; presumably it was the only time he was near the place, as he was a Bristolian who lived much of his life in London. The organisers of bare-knuckle fights favoured venues at such meeting points of counties, which were distant from centres of population; they aimed to confuse Justices of the Peace who had a duty to interrupt the illegal contests. Even if the responsible Justices managed to attend and intervene, a contest might be restarted nearby, by slipping over the border into a different jurisdiction. In this fight, which bore little resemblance to the largely sanitised boxing matches of today, it is certain that heavy blows were landed, blood was drawn, and money changed hands, before Cribb won in 11 rounds; a relatively short fight, as it had taken him over 30 rounds to beat the same opponent at the end of the previous year to win his title.

When I visited on an autumn day of heavy rain, the reserve, which comprises 5 hectares of low-lying grassy terrain spattered with patches of rushes, was an uninviting bog, but the river, which I thought to follow upstream, seemed little more than a near-stagnant ditch, even in these wet conditions. As suggested by the photograph, it is hardly visible beneath dense undergrowth at this point. According to the description given in Phil Clayton's book 'Headwaters' the river forms from a number of trickling branches in the meadow, which he followed to springs a little further west; I stopped short. His evidence and OS maps indicate that the River Witham has more than one possible 'true source', but as they are separated by only a few hundreds of metres, and none of them feeds much more water than another, any choice between them would be arbitrary. There is another problem with defining such sources, namely that their effusions can depend on recent rainfall, so there is a possibility that an 'upstream' spring might appear in wet conditions, or that a spell of dry weather might effectively move the source 'downstream'. This probably reads like what it is, an elaborate justification for not risking wet feet, but there is uncertainty associated with where many rivers start their journeys. In this case, all the possible sources are in Leicestershire, in spite of the proximity of Rutland, and

since the 130m contour is only just breached, the River Witham is in the ranks of the English lowland rivers with a mean rate of fall below 1m/km (placing it in the company of the Rivers Thames, Great Ouse and Nene).

Having decided that ploughing into the boggy meadow would represent many steps too far, I began my historical journey down the River Witham as it emerged from the dense foliage in Cribb's Meadow, flowing hardly perceptibly eastwards, under the aforementioned Fosse Lane, to enter Lincolnshire. Over millennia it has carved a shallow valley, in which a ribbon of shrubs, stunted trees, and other vegetation form a clear boundary between cultivated fields on each gentle slope. This pattern persists as its contents flow east to South Witham, named for it, like the partner village of North Witham, c2km to the north. The former expanded greatly in the 1960s when a housing estate was built to its north-west for personnel working at two airbases nearby, and there is now a population of about 1500; its character must have been changed quite dramatically then. The village has a pleasant, if outwardly-plain church, part medieval but part 20th century, and some nice old houses, mainly of the 19th century. I was unable to enter this Church of St. John the Baptist, so did not see arcades of the 12th and 13th century to which references are made by Pevsner; perhaps the interior is more impressive than the exterior.

Historically, the village is notable because of the one-time presence of a Preceptory of the Knights Templar. The river performs an abrupt left turn, immediately east of the village and begins to flow northwards, at which point Temple Hill is on the left bank. There are no remains above ground, but excavations during the 1960s uncovered foundations of a rectangular chapel, living accommodation including a hall, and farm buildings, all dating from the 12th century, and quite typical of Templar properties. The establishment would have been in the charge of a Preceptor, while one or two knight-chaplains together with servants and serfs would also have lived there. The Templars were suppressed in the years after 1308, a rather euphemistic description if applied to the Knights who lost everything including their liberty and sometimes their lives, and this property passed to the Knights Hospittaler, who absorbed it into a larger and wealthier Preceptory at Temple Bruer, 36km to the north, also acquired from the Knights Templar. As with most monastic establishments, the Reformation resulted in the sale of Temple Bruer, with its lands and possessions to the profit of the crown. Some of the buildings on its site survive, but whatever was left at South Witham did not, and its buildings were probably quarried fairly soon thereafter, and the remnants were re-buried after the aforementioned excavations.

The river continues north, skirting North Witham to the east, and can be viewed easily at a ford on the minor road to Colsterworth, shown alongside. In travelling 6km from the location of my previous photograph it had grown, but not a lot. Here, the river is keeping company with the A1 trunk road which is also aligned north/south, slightly less than 1km from the right bank of the river. The route is ancient as it was once followed by the Roman road, Ermine Street which linked London and Lincoln. Colsterworth is a rural village of similar

population to South Witham; there is an interesting church with signs of possible Saxon origins about which more will be said, but I will look first at the building in which the great man associated with the village grew up.

The River Witham skirts the village on its west side, and separates the main part from the hamlet of Woolsthorpe, where stands the small manor house, shown alongside, which was the childhood home of Isaac Newton. Born in 1642, after his father's death, his childhood in that house was mainly in the care of his maternal grandmother after his mother remarried and produced a second family, which she brought up elsewhere; there are plenty clues that mother and son had a fraught relationship. Probably well-enough schooled at the King's School in nearby Grantham, Newton showed sufficient promise to gain admission to Cambridge University, but only as a 'subsizar' who had to pay for his upkeep by performing menial tasks, though he was soon awarded a scholarship and graduated in the summer of 1665. There he might have remained, but an outbreak of the plague caused the closure of the university, and he returned to Woolsthorpe, for 2 years. The results of his studies there, when fully developed, and eventually released over the next few decades, were to transform understanding of gravitation, mechanics, and optics, and in parallel do much for mathematics. While acknowledging the contributions of the likes of Galileo, Descartes, and Hooke, it is not too much to say that what we now understand as science was invented by Newton, especially in his formulation of the Laws of Gravitation in the 'Principia', 1st published in 1687. However he was a most reluctant publisher; his revolutionary insights and theories were dragged out of him, in answer to Edmund Halley's pleas, but also because he feared that his rival, Robert Hooke, might be given priority for them. Newton was secretive and sensitive to criticism to such a degree that without such prompting and motivation, much of his work might not have seen the light of day, in his lifetime, or ever.

Woolsthorpe Manor House is now owned by the National Trust, and is furnished as the yeoman farmer's dwelling that it was in the 17th century, albeit with a different lay-out now, and without many artefacts linked even tenuously to Newton. Outside, to the front of the house, is an orchard where reputedly an apple dropped onto Newton's head while he was thinking about gravitation. The story that this was key to the ordering of his thoughts is probably apocryphal but not impossible. The apple tree in question is confidently identified, which is surprising as apple trees do not normally live for three and a half centuries. The National Trust's explanation is that the original tree was struck by lightning but that the root survived, and regrew into the tree to be seen now, so effectively doubling the natural lifespan. My interest in the house should have been considerable as a physicist by training and career, but I am afraid it disappointed in its treatment of the Newton connection. As noted earlier, Isaac Newton was undoubtedly one of the greatest scientists of all time, but he had a weird personality, and incredibly might have achieved even more had he been willing to engage in debate with other very able thinkers around in Britain at the time, including Robert Hooke (another prickly character), and Robert

Boyle. To us it also seems strange that he gave so much of his time to astrology and alchemy, with unsurprisingly, no end-product. The National Trust presentation is bland and glosses over issues of this type.

As a boy, Newton attended Colsterworth parish church, dedicated to St. John the Baptist; its claim to Anglo-Saxon, or at least 11th century, origins is supported by herringbone masonry visible in the nave, and shown in the photograph of part of the arcade, alongside. Otherwise, there is evidence that the church gradually expanded through the medieval period, with the addition of Norman, Decorated and Perpendicular features; the pinnacled tower carries a date of 1305. The chancel was rebuilt in 1876, and the church was generally refurbished in sympathetic fashion then. On the north wall a marble plaque carries a sundial with grooves cut in limestone, said to have been made by a young church attendee, Isaac Newton, at the age of 9.

At the north end of Colsterworth, the A1 crosses over to the left bank (west) of the River Witham while also diverging from Roman Ermine Street, which is thereafter followed north towards Lincoln by the B6403. A little further north, and just west of the A1, is Stoke Rochford Hall, now a hotel, which is shown alongside. Pevsner suggests that there was a Roman Villa on the site, and refers to mansions built in succession in the 14th,15th,16th,17th and 18th centuries, each a fresh start from what had gone before. Finally in 1843, the present extravaganza was designed by the distinguished Scottish architect, William Burn for the Turnor family who had owned the estate since the late 17th century. They continued in ownership until the 2nd World War when the house was requisitioned. Since then it has been used as a training college and conference venue by various organisations. In 2005, it was seriously damaged by fire, but it has been restored, and very recently became a hotel.

Continuing northwards on the left bank of the river, the small village of Great Ponton is unfortunately carved in two by the A1, but it is distinguished by a fine-looking church with its origins in the 13th century, but even more by the small manor house built by Anthony Ellis around the turn of the 15th century. The photograph shows the house and the church tower; both signal the wool merchant's

prosperity. The house is open to the public under the aegis of the Historic Houses Association, and is of Flemish appearance with its distinctive crow-stepped gable end. Though Pevsner thought the interior much modified, mutilated was his pejorative term, there apparently remain large period fireplaces, and a room-full of 16th century wall paintings.

The photograph alongside was taken east of Great Ponton; the stream is 14km from the source, a little more than 10% of the way to the sea, yet it has cut the 70m contour, so is at half its starting height. The mean flow rate a little downstream is 0.81 m^3/s (10700 gallons/minute), that of a small river. Further north, along the left bank, is the twin village of Little Ponton, which is the smaller of the two Pontons, but is served by St. Guthlac's Church, listed Grade 1, mainly I guess for its 11th century chancel arch, which causes experts to debate whether it was crafted before or after the great divide of 1066. Though some of the church dates from not long after that, judging by the Early English style, questions about the appearance of the original church built around the chancel arch come quickly to mind, but of course they cannot really be answered.

Approaching the southern outskirts of Grantham, a few kilometres from the left bank of the river, there is what must be near the last word in grandiose Victorian mansions, Harlaxton Manor; it is visible from one of the main roads into Grantham, the A607, though not as clearly as in the photograph below. The first manor house here was built in the 14th century, for John of Gaunt, Duke of Lancaster, but was demolished by a later owner; the present house was completed in 1845 with architect William Burn largely responsible. Pevsner clearly regarded it as a masterpiece of its type, even if he found some aspects to criticise. It had great days in the 19th century, with the future King Edward VII a visitor, but declined before the 2nd World War. Requisition followed; thereafter it became a training establishment for various bodies, and is now used by American universities as a study centre; it is occasionally opened to the public.

Grantham is a market town of population around 45000, but it seems to me a place of lost opportunities, which is perhaps reflected in the fact that it is not larger. It is old, probably with Anglo-Saxon origins, hence a mention in the Domesday Book, has a fine broad main street cum market, and a number of interesting buildings dating from the 18th century, and earlier. The Church of St. Wulfram, hard to photograph because of the height of the spire, and masking by surrounding buildings, is shown alongside as depicted in a painting in Grantham Museum. It has been praised by Pevsner, and given 5-stars by Jenkins, in his '1000 Best Churches' volume. The core of the church dates from the late-12th century, and the spacious interior, 'sympathetically' restored in the 19th century attracts favourable comment from those who know about such things. The 14th century tower and spire are 84m high, and said by some connoisseurs to be the most striking in England, but it suffers a bit from being hemmed in on a rather cramped site, so it is hard to view without getting a crick in the neck. Surprisingly perhaps, this grandiose church has always been parochial; it never became collegiate nor it would seem, entered the frame to be upgraded to a cathedral. I suppose the town's proximity to Lincoln might have told against the latter possibility. Nonetheless, the scale of the church, and the existence nearby of fine buildings like the Old School and Grantham House indicate the prosperity of Grantham in the later medieval period, a prosperity built as for many English towns, on the wool trade.

Grantham has had other things going for it through history, especially its transport links, which have brought business into the town, and allowed goods of all types to be sent to other destinations. The town now sits, bypassed, beside the A1, but for centuries the Great North Road passed along the aforementioned main street. Turnpike roads from West Bridgford (Nottingham) to Grantham, which were extended to Lincoln and Boston, may have preceded turnpiking of the northern end of the Fosse Way, from near Nottingham via Newark to Lincoln, so enabling Grantham to steal a march on the seemingly more vibrant town of Newark, at least for a while. It is on the main east-coast railway line from London to the North and Scotland, and was a junction giving access to Nottingham and Lincoln, amongst other Midland cities. Its excellent east-west links included the Grantham Canal, opened in 1797, to allow barges to reach the town from the River Trent near Nottingham, along a route 52km long with 18 locks. The canal's main function was to carry coal, and it struggled when rail links grew, but only closed in 1936. It was never filled in, and a restoration society has every intention of re-opening the full length for leisure rather than commercial purposes. The River Witham passes south to north through the town, to the east of the main street, but is not a very visible presence, and is too small to have made any contribution to the town's transport links. Although several roads cross the river, none of the bridges are particularly distinguished or old.

There are many English towns like Grantham which have grown steadily over a long history but have never 'taken off', mainly because the Industrial Revolution largely passed them by. Grantham was never an important manufacturing town although a local foundry named for Richard Hornby built and patented very

early versions of both diesel engines and caterpillar tracks, but sadly profited little. It seems to this outsider that the town is in real danger of allowing a current 'revolution' to pass by as well, namely the great expansion in tourism. The town has a famous son and a famous daughter, namely Isaac Newton, and Margaret Thatcher, yet the casual visitor is hardly overwhelmed by reminders. As already discussed, Newton has a stellar name in science, whatever his peculiarities, and although born in nearby Woolsthorpe, he was schooled in Grantham. There is a statue, and slightly oddly, a shopping centre named for Newton, but I am not aware of much else.

With Margaret Thatcher, who was born Margaret Roberts in 1925 and brought up in Grantham, the overwhelming impression given is that the town would like to forget the association altogether. Her risible memorial in the town, shown in the photograph, is the minute grey plaque beside the 1st floor window, of the flat, then above a grocer's shop, in which she lived her early years. There is no statue though one has recently been offered to the town, and certainly no museum. It was still unusual for a woman to achieve Cabinet office when she did so as Minister of Education in 1970, but she entered totally new territory by becoming leader of the Conservative Party in 1975, and then Prime Minister in 1979. She won 3 elections and held office until 1990, but it is her use of power that will be most remembered, in that she raised the status of her country abroad, and galvanised a moribund economy with reforms which have endured. Of course, she had her failures, like the poll tax, and probably did too little to mitigate the social costs associated with the changes she made. It cannot be denied that she remains a controversial figure, only a few years after her death in 2013, since balanced 'historical' views have not yet crystallised. Nonetheless, many qualified to judge, not all supportive of her politics, would accord her a very high place amongst British premiers of the 20th century, and it is surely true that she achieved things in her time thought impossible for a woman. I suspect that the authorities in the town will claim that they do not want to exacerbate division or incite vandalism by erecting prominent memorials. Unfortunately, their attitude means that a great opportunity to bring business into the town is being lost. Margaret Thatcher has a higher reputation abroad, especially in the USA, than in her own country, and Grantham could put itself on the tourist map for Americans in a big way. The Isaac Newton connection has never been exploited properly, and at the moment it looks as though the Margaret Thatcher connection is going to fare similarly, but perhaps there is still an opportunity. The creation of way-marked heritage trails for Newton and Thatcher, and a museum, ought to be priorities; they need not be seen as promoting either the alchemy practiced by Newton or the politics of Thatcher, any more than a recently-opened museum in Liverpool supports the idea of slavery, but such initiatives could be transformative for rather a dull place. Anyway, this document is not intended as a polemic, so it is past time to move on.

Leaving Grantham, still flowing north the river enters golfing country, though it keeps a sufficient distance to avoid collecting errant shots; beside the right bank, are the 27 holes of Belton Park Golf Club founded in 1890, earlier than most inland courses, and on the left bank, the more recently opened (1991) 45 holes (2½ courses) of Belton Woods, owned by a nearby hotel and golf resort. They look pleasant in a parkland setting, but the days are gone when I could have investigated and pronounced on their qualities. In previous centuries, the land occupied by the former was in the deer-park of Belton House which stands a little further north, near the planned 19th century village of Belton. The H-shaped mansion, (a 2-storey central block with attic dormers, and wings projecting to the front and back) has been little-altered since it was built in the late 17th century for a family by the name of Cust. Success in law and politics propelled their rise to the Earldom of Brownlow in Victorian times, before failure of the direct line 'reduced' them to a barony, and death duties compelled them to donate their house to the National Trust. I visited a few years ago and would describe it as pleasing, outside and inside, though quite modest as such places go, though Pevsner viewed it very favourably, while correcting its erroneous attribution to Sir Christopher Wren. The Belton village parish church of St. Peter and St. Paul is adjacent to the house, and long predates it, being mainly a 12th and 14th century structure, albeit heavily restored in the late 19th century. As might be expected, the association with the Cust and Brownlow families since 1638 is reflected in many memorials in the church. The tower which was refurbished in the 17th century is interesting because its fabric contains reddish-brown ironstone as well as the creamy oolitic limestone which has predominated in the stone buildings encountered upriver. This is not a one-off, because the 12th century churches of St. Mary in Syston, and St. Nicholas in Barkston, the next two villages by the river, also mix ironstone and limestone; both have interesting features, but I refer those who want more detail to the obvious publications, as I do not want this part of the journey to become only a succession of church descriptions.

There is also a manor house in Barkston which incorporates 14th century elements though it was remodelled in the 19th century; unfortunately it is hardly visible from public roads, so I cannot add to information in its Listing. The village does mark a change in the direction of flow of the river, but not the change that might have been expected. My journey along the River Witham did not start in ignorance of the eventual destination, namely a meeting with the North Sea near Boston, slightly north, and a long way east of the source. With this in mind, it was reasonable to anticipate, while following the river northwards, that it would sooner or later veer eastwards, but here it does the opposite turning north-west, then west, and even for a short stretch, south-west, before resuming a northward course, having moved some 10km further west. Of course, there is a logical explanation to do with higher ground on the east closing in to the north, and the resistance of the underlying rocks to erosion being sufficient to force a change in course on a slow moving water-flow; it was not as though the water 'knew' where it should be heading.

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Before setting off on the new phase of the journey, I wish to pick up on an aspect of the river not yet considered. Through history, rivers have been used in different ways by those living nearby, for transport, defence, as providers of food either through fishing, or irrigation of crops, and as a source of power. For the latter, the technology was for centuries the water mill, and they are often as much a feature of the villages and towns on the river banks as the manor houses and churches to which attention has been drawn already. An

indispensable tool for locating artefacts which have mostly either disappeared, or been altered to create desirable river-side homes, is the portfolio of digitised maps made freely available by the National Library of Scotland on their maps.nls.uk website. They describe the landscape of c150 years ago when many water mills were still in use, or at least had not yet been demolished or converted. My perusal of these maps brought to light another means of utilising the water carried by the River Witham, namely hydraulic rams, and on the assumption that many are not familiar with those devices, I give a brief account in Appendix 1. Here it is enough to say that they are devices which make use of energy in a stream diverted from the river to pump a proportion of the water in that stream to locations on the banks, above and at some distance from the river. There are 6 hydraulic rams marked on the OS 6'' map series, 1888-1913, between North Witham and Little Ponton, though I found no surviving structures on the ground at the one location I have visited, to-date. It seems most likely that these hydraulic rams supplied water in the 19th century and maybe for some time after, to manor houses, farm houses and estates in relatively close proximity to the river, presumably not for human consumption, but for other domestic, horticultural and agricultural purposes. As to why they seem to have been confined to a relatively short stretch of the river, it may be that upstream the river is simply too small to allow abstraction at useful rates, while for a large part of its downstream course, in fenland, the issue is removal rather than supply of water.

Turning now to water mills, I will make a few general points before dealing briefly with those to be found on the upper reaches of the River Witham. Water mills extract energy from flowing water by directing it at a wheel in such a fashion as to make it rotate; the wheel is coupled by way of gears or sometimes crankshafts to tools which might grind, pound, or cut. The power made available is normally in the range 5 to 10kW, which might seem surprisingly low given the size of the buildings and complexity of the power train associated with typical water mills, but the important comparisons through most of history have been with a horse (0.5kW) and a man (0.1kW), (the figures applying to sustained effort), rather than with say a modern car engine (c100kW). In rural areas, the majority of mills grind corn to produce flour, and that is the case for the upper River Witham; the mill furthest upstream at Colsterworth was a corn mill, as were those at Great Ponton, and at Spittlegate on the southern outskirts of Grantham. North of the town, the sequence is continued by Harrowby Mill, Manthorpe Mill, Londonthorpe Mill, and Barkston Mill, making a total of 7 mills along a 20km stretch of the river. Houses associated with 3 of them, Spittlegate, Harrowby, and Londonthorpe date to the 18th century, so it can be taken that the mills operated then, but it is certain that some of the 7 will have had medieval predecessors. There was a paper mill at Houghton, just south of Grantham, which operated from before 1731, when it is first documented, until 1888, and to the north of the town the rather mysterious Grantham Slate Mill once stood. No trace of the latter remains, and even a road-name referring to it has been changed; normally such mills were built close to a mine to cut and shape the material, before it was brought to building sites, but I am unaware of any such mine in the neighbourhood, hence the mystery. The mills mentioned here, and those yet to be encountered, are located on the map at the end of the document, associated with Table Wi1. More information on water mills is available, in the Appendix of another document on the website, 'A Historical Journey along the Lothian Rivers', and in a referenced 'Shire' book.

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Just north-west of Barkston the River Witham is joined by a small right bank tributary, Honington Beck, c4km long, which rises in ponds just south of Caythorpe, and flows first south, then west, by way of Normanton-on-Cliffe, Carlton Scroop and Honington. Each of these villages has a fine church, respectively of St. Vincent, St. Nicholas, St. Nicholas, again, and St. Wilfrid, with different shades of reddish-brown ironstone prominent; all but the first have Norman features, so date in part from the 12th century; Caythorpe church was built a century later so its oldest parts are Early English in style. To the south-west of Honington, on Willoughby Heath at a height of c100m is what is thought to be one of only 4 hillforts in Lincolnshire, surprisingly few given that the Wolds and hillier areas were probably more habitable in the relevant period than the largely undrained fens. As for their function, this is much disputed, though most experts are willing to concede that defence was at least part of the motivation for building them. The hillfort is viewed from the south in the aerial photograph, above. The area, enclosed by 2 banks, with traces of a 3rd, together with ditches, is just less than ½ha and the entrance can be seen to the south-east (right). Roman coins have been unearthed there, indicating that the site was still occupied in the first few centuries AD, though built several centuries before then.

If one looks north from the site of the hillfort, there is a distinct, if shallow, valley below the 50m contour which extends east to Ancaster and beyond, containing a stream which becomes the River Slea, flowing east to join the River Witham far downstream along its course. The tributary and the points of interest near its banks will be considered in due time, but for the moment it is worth noting that far larger streams may once have occupied the valley. It is thought that the River Witham once turned east near Barkston, short-circuiting a large part of its present course, and progressed through the Ancaster Gap towards its mouth near Boston. Earlier than that, the River Trent which currently flows north at some distance to the west, by way of Newark to the River Humber, instead also turned east, collecting the nascent River Witham, and followed the same short-circuited route to Boston, from where it continued east across a land-mass, since submerged by the North Sea, to join the River Rhine. The present river courses date to when these predecessors were blocked off by debris piled up behind retreating icecaps at the end of intermittent glacial periods, the most recent of which ended c10000 years ago.

Resuming the journey along the River Witham, Marston is a cluster of buildings on its left bank, 4½km north-west of Barkston with some similar features to other villages encountered so far. The river has continued to grow, and is c7m wide in the photograph alongside taken from Bridge Street. There is a hall here, largely hidden by trees, dating to the 16th century, but much altered and truncated, in the 18th century. Nearby is the parish church, 4 centuries older with its fabric a mix of ironstone and limestone, and a tower crowned with a

broached spire. The brick-built corn mill to the south-east dates only to the mid-19th century, but apparently has a working wheel and drive train, though I don't think it can be viewed by the general public. South-west of the village, near where a small left bank tributary, Foston Beck, is crossed by the A1, is Gonerby Moor where, in May 1643, Oliver Cromwell had his first military success of the Civil War and indeed of his life at the age of 44. His cavalry regiment was part of a force which had tried to threaten the Royalist stronghold of Newark, but had been chased away south. The engagement, often called the battle of Grantham, was brought about when Cromwell halted the flight, turned and charged the pursuing force, routing them and harrying the survivors as they sought to escape, before he resumed a retreat to Lincoln. It was only a skirmish, though there may have been a hundred Royalist casualties, and it hardly influenced the ongoing campaign in Lincolnshire, but it has gained significance in retrospect as a harbinger of the future successes of the victorious commander.

The River Witham swings successively north, west then south-west through rather featureless country to arrive at Westborough, a small settlement round a church with nave arcades dating back to the 12th century, but otherwise with additions in most of the succeeding centuries, until the tower was rebuilt in the 1800s. The river's westward move has almost brought it back to the A1 and to within 3½km of the River Devon, a tributary of the River Trent, at the Nottinghamshire village of Staunton-in-the-Vale, but it turns north again here, passing east of the straggly village of Long Bennington. So, the catchments of the Rivers Trent and Witham remain just separated, but streams and drains belonging to each seem to mingle in the intervening flat landscape, as the rivers drift gently northwards. Here is to be found Shire Dyke, now a steep sided field ditch, connecting to the River Witham, but an ancient boundary marker between divisions of Lincolnshire and Nottinghamshire. Long Bennington church, specifically its tower, dates back to the 12th century, and around the end of that century it became a dependency of the Cistercian Abbey of Savigny in Normandy. Some authorities suggest that an alien (Norman French-owned) priory existed in Long Bennington until 1403, but there is no evidence in and around the church, and other sources suggest that only a single monk lived there. Near the village-centre, a building called The Priory contains 13th century stonework; perhaps it was a grange housing the monk, who would have been charged with managing the properties of Savigny Abbey for profit, and taking services in the village church. Otherwise, the A1 or Great North Road was the main street of the village, until a bypass was built to the west in 1968, and since then much of the gap between the village and the new road has been filled with housing, raising the population to c2000. There was a watermill beside the river, and a windmill west of the main road, but neither survives.

Tracking the river downstream on minor roads, the next settlement is Claypole, c4½km to the north-east. On the way, Claypole Watermill, once a flax mill, but latterly a cornmill, with its high river weir is passed, before the road crosses the stream to enter the village. Here was a scene both gloomy and iconic in the Victorian era, as preserved in the old photograph, alongside, taken from the website indicated. In the background is Newark's workhouse for able-bodied paupers, (this is of itself

curious as Claypole is firmly in Lincolnshire, while Newark is and was in Nottinghamshire, and such distinctions mattered then), in which as many as 250 inmates were housed, fed, and put to work on what we would now call community projects. It would be wrong to downplay the casual cruelty of a system which split up families, and destroyed human dignity, but the cruelty was heartless rather than intentional; there was no easy answer to the problem of looking after the many displaced from the countryside, and unable to find work in the towns. The bridge takes the eye in the photograph, as a near-perfect artefact of its time. It was built in the mid-14th century, with twin-Gothic arches carried on 4 chamfered ribs, and with prominent chamfered arch rings. Few will have been sorry to see the closure and demolition of the workhouse in the early 20th century, but the destruction of the medieval bridge in 1906 was an act of unthinking vandalism, as within the confines of the large county, only in Lincoln itself, is there a finer medieval bridge.

A short distance downstream from Claypole, the river becomes the county boundary between Lincolnshire and Nottinghamshire, though old maps show that changes in its course left a number of pockets of land on the 'wrong side' of the river, until rationalisation took place in recent years. The situation does not last for long, because river and boundary diverge a few kilometres downstream at Beckingham where the A17 crosses the river; for the remainder of its course it flows in Lincolnshire. The next 4km is within an area set aside for military use, terminated by the curiously named Scotwater Bridge, carrying a minor road between the villages of Norton Disney and Carlton-le-Moorland. The photograph looks downstream from there and shows how the river proceeds on the rest of its journey to the sea, at least where it has not been fully canalised. The water appears to be hardly moving; beyond its banks are ditches, and outside them, flood banks, protecting water meadows. The landscape is artificial as this is drained fenland.

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The river continues north then east, past the villages of Bassingham, Witham St. Hughs, and Aubourn, where there was a corn mill, to the point where it is joined on the right bank by its first sizeable tributary, the River Brant. This stream rises on Somersfield's Hill, 2km north-east of Marston, and thus is as close as that to the River Witham itself, but because of the lie of the land, water flows 22km northwards before merging with the parent river. Near to its source, is Hough-on-the Hill, where the photograph alongside shows

tangible evidence of a very long history, stretching back to the Anglo-Saxon period. The lowest two stages of the tower, along with the rounded stair turret are normally dated to the first years of the 11th century, and there was also a high nave typical of Anglo-Saxon churches then. Much of the body of All Saints Church was built in the 13th century, when it was at the centre of a small alien Augustinian Priory Cell founded in 1164. Along with many such establishments, it was suppressed in the early 15th century to prevent any of its income passing to a mother house in France. There was only a prior and a canon-chaplain, so it may be that there were never substantial domestic buildings; at any rate none survive above-ground. It is possible that King John, campaigning against rebel barons and French and Scottish invasions, while slowly succumbing to dysentery, rested in the monastery before entering Newark where he died in October 1216. To the east of the church are remnants of a motte, probably part of a timber and earthworks castle of the 12th century.

From here the River Brant heads north through cultivated fields, passing by villages named Stragglethorpe and Brant Broughton, the former also with Anglo-Saxon content in its church of St. Michael. Some 5km downstream from the latter village, a kilometre from the right bank, is Somerton Castle, viewed from the south in the photograph alongside. Antony Bek, long-time Bishop of Durham, and scourge of Scotland as a formidable commander of English invading forces during the 1st Scottish Wars of Independence, received Somerton Manor on the death of his mother, Eva de Grey, in the late 1270s, and probably built the castle in the 1280s. In 1309, he gifted the property to King Edward II, perhaps in return for royal support in disputes with the Pope which punctuated his career; thereafter it remained in the hands of Kings or their high connections and was attached to the Duchy of Lancaster in 1478. King John I of France was confined here after being taken prisoner at the Battle of Poitiers in 1356. Its 13th century origins were as a large quadrangular castle, with circular towers at the angles, curtain walls between them, and surrounded by a moat. Of that building, only the south-east tower with three storeys and a conical roof, and the ground floors of the north-east and north-west towers survive, together with the moat. The castle is not open to the public, nor easily seen amongst trees, from the nearest roads, though more visible from a minor road at a rather greater distance and height, which runs east to the village of Navenby.

By this point the River Brant is clearly a fenland stream, with drains feeding it by way of sluices. The photograph taken on a very wet day from Blackmoor Bridge shows one such, close to its junction with the River Witham. Large parts of West Lincolnshire and its borderlands with Nottinghamshire are fenlands, but the landscape changes dramatically a few kilometres to the east of the River Brant. Mention has already been made

of the high ground which directs the River Witham westwards, a few kilometres north of Grantham, and the low hill there is an outlier of the Lincolnshire Scarp or Lincoln Cliff, a Jurassic Limestone ridge, which is the eastern boundary to the low-lying river valleys. Two ancient roads ran to Lincoln along the top of the ridge, that to the west was the Jurassic Way on the line now followed by the A607, whereas a short distance to its east was Roman Ermine Street, last encountered diverging from the A1 south of Grantham, but reduced here to tracks and minor roads. Travelling north-west from Kings Lynn and Sleaford along the A17 towards Newark, the dramatic nature of the Scarp is well seen at the village of Leadenham, where the road drops abruptly by c80m, yielding a striking view over the flatlands towards the River Trent, especially on sunlit evenings, but the photograph below, taken near the village of Coleby looks in the opposite direction (east) from the flatlands up to the Scarp.

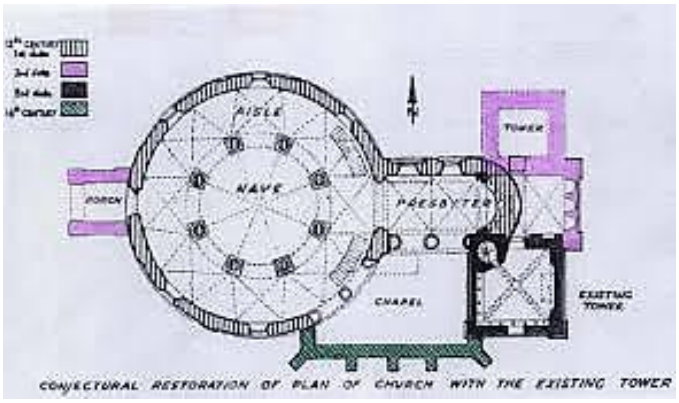
There is a series of villages along this stretch of the ridge; in order from the south, Caythorpe (already briefly mentioned), Fulbeck, Leadenham, Welbourn, Wellingore, Navenby, Boothby Graffoe, Coleby, Harmston, and Waddington. The feature falls away just south of the city of Lincoln, creating a gap which allows the eastward passage of the River Witham, but reappears as the hill on which stand the castle and cathedral, and continues northwards to the shores of the River Humber. The villages are too close to the right banks of the River Brant, and then the River Witham itself, to be passed by without comment, though I shall be fairly brief. Fulbeck has a fine 13th century church (of St. Nicholas) with a few elements surviving from the 11th century; there are 3 substantial houses including Fulbeck Hall, the seat of the Fane family, and a manor house dating from the 17th century, albeit altered and restored. Leadenham has St. Swithin's Church of the 12th and 13th centuries and a 17th century hall praised by Pevsner.

Welbourn repeats the pattern with a 13th century church and a 17th century manor house, though it adds the earthwork remains of a 12th century castle. However, I shall pause there longer to consider a remarkable military career commemorated now by the naming of the local school for Sir William Robertson, who was born in the village in 1860. Son of a tailor of Scottish descent, his first employment in 1875 was as a footman at Deene Park, the Northamptonshire Seat of the Earls of Cardigan, though he arrived there a few years after the death of the 7th Earl, who had led the Charge of the Light Brigade at the Battle of Balaclava. In 1877, lying about his age and to his mother's chagrin, he enlisted as a trooper in a cavalry regiment. He advanced quickly through the non-commissioned ranks but it was only in 1888 that he was commissioned, and his career path

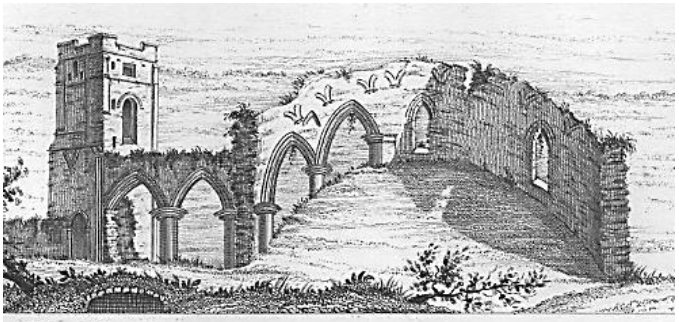
thereafter was dictated in part by his capabilities and diligence, part by a helping hand from superiors who recognised his promise, but also by his lack of money which ruled out appointments for which a private income was essential. Nonetheless, promotion was fast, and one of the oldest lieutenants in the army became one of the youngest colonels in 1903. Thereafter he rose inexorably through the senior ranks, until at the outbreak of the 1st World War in August 1914 he became Quartermaster General, responsible for supply and logistics, of the British Expeditionary Force. Having distinguished himself in that role, during the Retreat from Mons, he became Chief of Staff to the Commander in Chief, Sir John French, and in 1915 he was appointed Chief of the Imperial General Staff, (CIGS), the professional head of the army, and chief military advisor to the government. Perceptions of military failure had persuaded the government that changes in the command were necessary, and that Sir Douglas Haig and Robertson should be promoted to the key positions of CIGS, and Commander in Chief of the army in France. Robertson may well have been preferred for the field command, in spite of the fact that he had never commanded even a platoon in action, but no-one thought that Haig would cope with the political and strategic aspects of the CIGS role, so he remained in France. Robertson's firm belief in the need to win the war on the Western Front, and consequent backing for Haig, led to escalating disputes with David Lloyd George, Prime Minister after 1916, and eventually to Robertson's dismissal in early 1918. The rest of his military career was anti-climax, and he was surely slighted by the award of a baronetcy rather than a peerage in 1919, but was promoted to Field Marshal in 1920, the only trooper (private) to rise to that rank. After making a small fortune as a businessman, a contrast with his always-straightened circumstances as a serving officer, he died in 1933, and was interred in London. He was the most intelligent and capable British general of his day, but in a class-ridden organisation, never disguised his origins, and indeed exaggerated them in his habits and speech, (invariably dropping his 'h's), yet he formed a good and lasting accord with another taciturn individual, King George V.

On Welbourn Heath, c3km east of the village, the remains of Temple Bruer Preceptory are beside a minor road. When I visited the site on an autumn Sunday evening, it was in the midst of fields of high ripening corn, and seemed completely deserted, though it is in an inhabited steading. The preceptory was built by the Knights Templar, and at the time of the order's suppression in the first decade of the 14th century was their second richest property in the country, with an income of £185. The Knights Hospittaler acquired the preceptory in c1330, and later combined it with South Witham and Heather Preceptories in a Commandery run from Temple Bruer. It was held by them until the Dissolution in 1540, though its condition seems to have deteriorated before then. The photograph alongside is a view from the south-west of the only structure visible now, namely the much-patched southern tower, (there were once two of them).

The schematic indicates that the towers, a 13th century addition, were at the west end of the original 12th century church, separated from a characteristic round, aisled nave of diameter, 15m, by the presbytery (choir), of dimensions 8 X 4m. There was a crypt beneath the church, of similar overall dimensions, and excavations in the 19th century suggested that compartments included dungeons. The preceptory had additional buildings within a gated enclosure, including the knight's hall, and other domestic buildings for them and the servants who farmed the land round about and performed other tasks; traces including much of the knight's hall, survive in the present farm buildings. By the time of Buck's engraving of 1736, all except the tower which still survives was ruinous, though fortunately enough remained of the church at that time to confirm its unique shape.



CONJECTURAL RESTORATION OF PLAN OF CHURCH WITH THE EXISTING TOWER


Temple Bruer, as standing in 1736 from Buck's Print.

A few kilometres south of Temple Bruer is RAF Cranwell where since 1918, generations of officers have trained before entering the flying arm of the services.

Continuing northwards, Wellingore and Navenby have old churches of some distinction, but they and Boothby Graffoe will not detain me. Coleby, seen in the distance in the photograph of the Lincolnshire Scarp, and alongside, has a church (of All Saints) which has an Anglo-Saxon tower, topped with a Norman stage later in the 11th century. The remainder of the church is mainly early 13th century, though the spire was added much later. The village also houses a 17th century hall, and in 1939, Coleby Grange Airfield opened to the east, though it was never more than a relief landing ground, until in 1959 it became the launching site for Thor Intermediate Range Ballistic Missiles, albeit only for a few years. A far greater RAF presence is a few kilometres further north, at the commuter village (into Lincoln) of Waddington, where an airfield opened in 1916, and was used to train squadrons before they went to France. It re-opened as a bomber station in 1937, housing squadrons of Hampdens, Manchesters and Lancasters (after 1943) during the 2nd World War. In 1957 the first Vulcan Squadron was formed there, and Waddington was a base for that iconic aircraft until 1984. The airfield is now home to units which operate remotely controlled drones as far afield as Afghanistan. North from here is Bracebridge Heath, really a suburb of Lincoln, where the Lincolnshire Scarp begins to descend towards the city, and the River Witham valley, and from here I return to the River Witham, where it receives the waters of the River Brant.

The river flows north between meadows within North Hykeham, once a separate village but now another suburb of Lincoln. There are few traces of the past here, save for the fact that the village is aligned with Fosse Way, nearing the end of its 370km journey from Exeter. Its southern end may have begun in the mid-1st century as a ditch marking the western boundary of Roman Britain, but it was converted to a roadway, and extended north-west a few decades later, when the conquest of England and Wales had moved on. No-one would build a motorway along its route now in London-centric England, so while some sections are parts of important trunk roads and bypasses, others are no more than farm tracks; probably the full length can only be travelled on a bicycle. A section of the original surface is preserved under the Mansion House in Lincoln. I first wandered round the city in the mid-1970s, when over weekends I was keeping a watching brief over trials on the steelworks at Scunthorpe, some way to the north. When the plant 'went down' there was nothing for me to do, but I had to stay within reach in case there was a quick restart, hence my trips to Lincoln. I will not attempt any full description of a fascinating place; of the Roman City with its gates and walls, of the religious precinct with the stunning dominant cathedral, and bishop's palace, of the castle with its early medieval walls and turrets, and the bustling township around Brayford Pool at the foot of Steep Hill. Such information is best sought in guidebooks, local histories, and the relevant Pevsner volume; I shall limit myself to tracking the River Witham and its feeders.

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Downstream from North Hykeham, the River Witham receives Pike Drain on the left bank. This large ditch now carries water from a system of interconnected ponds called Richmond Lakes and Whisby Nature Park, which it long predates. There was extensive gravel quarrying here in the years following the 2nd World War, and the resulting pits have filled with water, forming part of a terrain which now supports wildlife and leisure pursuits. A short distance further north, the river arrives at the watery 'crossroads', shown in the photograph taken by a Mr. Heaton. The view is from the left bank of the River Witham from where Lincoln Catchwater Drain feeds water (and swans) into the river, while on the right bank, Bargate Sluice controls the passage of water into Sincil Dyke; the river is flowing turgidly from right to left across the photograph. Considering first the former, it was originally cut as part of a drainage scheme conceived after severe floods in 1795 to protect farmland and houses around a village called Skellingthorpe, to the west of the city. Then in 1848, a small stream, Prial Brook, was dammed to form a reservoir, now Hartsholme Lake. Water from there fed into the Catchwater Drain which carried it to the filter beds of a water treatment plant beside the River Witham, from which unfortunately water was also drawn. From there, the supposedly purified water was pumped to a reservoir near the centre of the city. Fears about the use of river water for human consumption were expressed a number of times in the late 19th century, not least because it was known to receive sewage, but nothing was done, and a serious typhoid epidemic which eventually killed 113 people, broke out in 1905. Belatedly action was triggered. Artesian sources in Nottinghamshire were

located, and water was taken from there to a tower built near Lincoln Castle, which stored and distributed it around the city; still in use, it is a city landmark, 36m high, housing a tank holding 300000 gallons of water. Extraction of water from the river ceased, and the treatment plant closed. Of course, this meant that the water from Hartsholme Lake, probably blameless for the epidemic, was no longer used, but the lake is now a pleasant feature in Hartsholme Country Park, while Catchwater Drain feeds directly into the river, as shown in the photograph.

The same photograph shows that the flow into Sincil Dyke is controlled by a relatively modern sluice gate, but the dyke itself is very old. Some have suggested that like other artificial channels in the area, it might date back to the Roman occupation, but when its function is considered, it seems more likely that it was cut in the 13th century. Though it runs through the city now, then, its course was to the south of a smaller township, flowing for 2½km, to rejoin the River Witham; in the 19th century its outflow was diverted into South Delph Ditch, a new drainage channel, so its water only returned to the river much further downstream. I think it likely that its construction was linked to a problem caused by the iconic Lincoln High Bridge which had been built in the 12th century to carry the main road into the city from the south, over the River Witham. I shall have plenty to say about that bridge in due time, but for the moment I simply note that it restricted the river flow; any increase resulted in water backing up, causing flooding, and making the water channel beneath the bridge impassable. Some have wondered if the Sincil Dyke was designed to allow passage of boats, but this seems unlikely as river traffic would have been able to avoid the city where tolls were demanded, and there would have been the danger, from the viewpoint of the city's guilds of the emergence of some kind of unofficial entrepôt beyond their control. Certainly, plans to open such a route were given short shrift as late as the 19th century. Sincil Dyke is mostly visible still, running east from the River Witham beside Altham Terrace, and then north beside Sincil Bank, where it passes Lincoln City Football Ground; it is culverted below Lincoln Railway Station and emerges flowing eastwards, a short distance south of the River Witham, a pattern which is maintained until the city is left behind.

The river continues northwards, reaching another 'watery crossroads' where on the left bank it is joined by Main Drain bringing water from a flood relief system to the west, while on the right bank there is a small sluice-controlled channel which connects to the Sincil Dyke. A century ago there was a flour mill on the left bank here, and a little further downstream, a saw mill, while other workshops which used water, if not power supplied by the river, were clustered around. A few hundred metres further and the river enters Brayford Pool, for many centuries the port of Lincoln. The painting crafted by John Carmichael gives an impression of what the Pool might have looked like in c1850. It is the meeting point between the river, and the oldest surviving canal in England, credibly attributed to the Romans in 120 AD, Fossdyke. Later, I shall track back 18.5km to its other terminus at Torksey on the River Trent, but for now it is sufficient to highlight its role in making Lincoln a viable inland port from medieval times until the 20th

century. As recently as 1920, in spite of competition from railway companies, the canal carried 70000 tonnes/year of agricultural produce and industrial goods. The decline, which set in thereafter, left its wharves, warehouses and not a few half-sunken boats to decay during the next 50 years, until the Pool and its surrounds had become an eyesore, in a city dependent on tourism. Fortunately, those responsible took action, and now Brayford Pool houses a marina, and facilities for leisure craft, while on its banks there are new houses and a university campus. Albeit in a much-changed way, as shown in the photograph, the Pool is once again a real asset to the city of Lincoln.

The River Witham exits from the north-east corner of Brayford Pool, and almost immediately arrives at Lincoln High Bridge. The river was crossed at this point near the centre of the city during the Roman occupation in the 1st century AD. Then, Ermine Street was probably supported on a timber bridge, or negotiated the river by a ford, and for the next 10 centuries one or other of those means of crossing will usually have been in place. The bridge built in c1160, was probably the first of stone and may have had five arches over a then shallower, wider river. On its east side, the street sloped down into a ford, but the bridge was extended there in c1235 to carry a chapel dedicated to St Thomas Becket, which is represented in the drawing which shows the east aspect in c1400. The photograph is a view from downstream. The bridge carries a row of timber-framed shops which were built in c1550 on a western extension, making it unique in England as the only medieval bridge carrying domestic and commercial buildings. The west side was further extended in c1800 to create annexes for the shops, but this small projection was removed during a major restoration in 1902. The chapel had been removed in 1762 and replaced by a stone obelisk containing a public water conduit, which survived until 1939. The remarkable 12th and 13th

century rib pattern beneath the arch, with remains of a most unusual vault (for a bridge) supported by central diagonal ribs, as well as chamfered transverse ribs is shown alongside, also viewed from downstream. This oldest section of High Bridge is 9.9m wide. The 13th century extension at the east face, to accommodate the chapel, added 8.7m to the width, and had quadripartite groined stone vaulting with diagonal ribs. Later in the 13th century, the ribs and vaulting here were removed, replaced by the brickwork visible behind the chamfered arch ring at the east face. In c1550, the western extension carrying the timber-framed shops added 6m to the width with a flattish pointed arch without vaulting. Finally, when the medieval chapel was demolished in 1762, a small downstream (east) extension with the anachronistic chamfered arch ring below a hood mould was added, increasing the bridge's overall width, and the length of the channel beneath to 26.5m. There is probably no more complex bridge in England, and inevitably its description reflects that, but hopefully the words and pictures convey its main features.

Misalignment of the various extensions is largely responsible for the way the bridge axis, and thus the water channel twists through the vault. However, it is obvious even to the casual bystander, that lack of headroom in that channel, sometimes known as ‘the glory hole’, is likely to be more of a problem for anyone seeking to navigate a boat under the bridge. It is my belief that at the time the bridge was built, and for a long time afterwards, this was not seen as a matter of much concern by those who ran the city. It is recorded that Fossdyke was dug out at the instance of King Henry I in 1121 (whether this means clearing an existing canal, or excavating a new one, is a matter of contention amongst historians). Thereafter, it can be assumed that the preferred shipping route to Lincoln was from the River Trent, by way of Fossdyke, that cargos were unloaded on the wharves at Brayford Pool, and that there was very little call for boats to be able to proceed further along the River Witham. The High Bridge was built in the years immediately following, and while it was not made impossible to pass under the bridge, it certainly was not made as easy as it would have been if the central arch had been higher from the start. Perceptions did not alter over the next few hundreds of years, and the extensions which increased the difficulty associated with passage under the bridge reflect that complacency. Efforts were made to reduce the water level by dredging, but this may have been more to do with flood prevention than making things easier for shipping. In the mid-17th century, Lincoln obtained an Act of Parliament which allowed improvement of the waterway along Fossdyke, and then down to the mouth of the River Witham, but nothing was done at High Bridge or downstream.

Things changed in the 18th century, with the creation of the River Witham Navigation, which potentially offered a greatly improved route into Lincoln from the south-east by water. The scheme will be discussed later, but any value to the city was reduced by the severe restriction of access from that direction to the dock at Brayford Pool, by High Bridge. Distinguished engineers, including William Jessup, and John Rennie, were asked to advise on how the problem might be overcome. There was no easy answer. In 1791, Jessop suggested a bypass canal to the south, but that was rejected on the grounds that it would take business away

from the centre of the city; in 1803, Rennie suggested demolishing and replacing the High Bridge, but this was regarded as a step too far, even at that time. So the High Bridge has survived for 850+ years now; probably it is as old as any bridge in the country and with unique features. Lincoln is a city of iconic buildings, and High Bridge is very much in that category. Once clear of the bridge, the river flows east in a narrow channel between retail and light industrial premises, soon as noted earlier in company with Sincil Dyke just to its south, until it reaches the edge of the city. Before continuing down-river, I will say more about the Fossdyke.

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England's oldest canal is dated by some experts to the year 120 AD largely on the basis of a few archaeological finds. The history cannot really be picked up again for a millennium, but a document refers to a canal being cut from Torksey to Lincoln in 1121 on the authority of King Henry I. Those who would discount the Roman origins gain support from this, but those in the other camp suggest that the reference is to a reworking of an existing channel. Thereafter, evidence appears often enough to trace the canal through to modern times, albeit that it experienced periods of disuse which left it needing restoration, as in the 17th century. Torksey is 35km downstream from Newark along the River Trent, which becomes tidal about half-way along that stretch, so there are large variations in river level, hour by hour, in addition to those due to rainfall in the large Trent catchment. In consequence, it is likely that there always had to be some means of control of the channel into Fossdyke; the present lock, shown in the photograph above, dates to c1800, though it has been refurbished in recent years.

The take-off for the canal is a few hundred metres south of the village of Torksey, a rather bleak place in a flat landscape, but with a long history stretching back to the Roman occupation, and the Danish invasions in the 9th century; at the time of the latter, it is reputed to have been the 3rd largest settlement in Lincolnshire, smaller only than Lincoln and Stamford. It was mentioned in the Domesday Book, and the Augustinian Priory of St. Leonard was founded there in the 12th century, housing a prior and 6 canons, though it would seem to have been too poor to afford all of the standard claustral buildings such as cloisters and a dormitory. At any rate nothing of them survives above ground, and archaeological investigations have been inconclusive. The parish church of St. Peter dates to the 13th century and was appropriated by the priory in the early 14th century, so probably served as the priory church, though authorities seem curiously reluctant to say so. At any rate, it will have reverted to serving the parish after the priory was suppressed in 1536; its tower dates to later that century, and the church was refurbished in the 19th century. Unfortunately, even less is known of a medieval Cistercian nunnery which was also located in Torksey.

Between the village and the right bank of the River Trent, but best viewed from a path on the left bank, is Torksey Castle, a castle only in name but nonetheless an impressive ruin, built as a manor house by the Jermyn family in c1560. It was occupied for less than a century, until the Civil War, when after being taken and fortified by a Parliamentary force in 1645, it was retaken by Royalists but burnt by them to deny it to their opponents. It was never rebuilt, and served as a quarry after that, but the standing ruins are more extensive than might have been expected. The remains comprise the west front and part of the rear wall and the former is shown in the photograph above, taken from the left (west) bank of the River Trent. The high ground floor, with four towers, was of stone and it was continued upwards in the same form but built of red brick with ashlar dressings at corners and windows.

On leaving Torksey Lock, Fossdyke cuts first east, then south-east, then east again to arrive at the village of Saxilby; aerial views show it passing between extensive cultivated fields, drained by a network of ditches, and pumps that lift water into the River Trent, even when the water-level in the tidal river is above the fields. Fossdyke, the railway, and the A57 trunk road all skirt the south of Saxilby, but its most memorable feature is a long road with houses and shops on the north side and Fossdyke on the south, c9m wide here. The photograph looks west, with the village street on the right. Just to the east at Odder Bridge the River Till joins Fossdyke on the left bank, though it can as well be argued that the Fossdyke joins the canalised River Till which then flows 7km to meet the River Witham in Brayford Pool. With this inclusion, the River Till is 28km long, flowing generally south from the outskirts of Gainsborough.

Accepting that Gainsborough, interesting as it is, falls outside the remit of this account, the River Till shall not detain me for too long. Its source is below the 30m contour, and it collects water from small streams and field ditches, but is no more than a streamlet as it flows past Sturgate Airfield, conceived as a bomber base in the 2nd World War, but completed too late, and put to various uses since then, without finding a lasting role. The river changes almost imperceptibly as it moves south, firstly by acquiring water and widening, and secondly in relation to the surrounding farmland which gradually drops below its surface, necessitating the provision of flood defences and pumping engines to lift water from the field drains. It should be no surprise that there is no trace of a watermill along the River Till; the head of water required is not available. It has clearly become a fenland river, by the time it passes east of the village of Stow which is certainly the most noteworthy place near its banks.

Now a quiet backwater, it was an ecclesiastical hub more than a thousand years ago, though it can be difficult to separate verifiable facts from legend. It is alleged that the first church was built in the 7th century, as the cathedral of a diocese of Lindsey. The church was destroyed during the Danish invasions of the 9th century and the diocese was reduced to a nominal entity, merged with that of Dorchester in Surrey, while the Danelaw extended over the East Midlands. As the Danish tide receded for a time, the present church was begun in 975 by the then Bishop of Dorchester, Aelfnoth, as a Minster with secular canons who would administer the Lincolnshire portion of what had become a very large diocese. The lower parts of the transepts and crossing of this church survive, but most of it was destroyed by fire and rebuilding had to begin in the first half of the 11th century. After the Norman Conquest, the bishop's see of the re-established eastern diocese was transferred by a Bishop Remigius to Lincoln, but he continued the rebuilding at Stow, intending to site a Benedictine Abbey there. This plan saw an enlargement of the chancel, but came to nothing before any claustral buildings might have appeared, and the church has since been a more lowly Parish Church of St. Mary. Thereafter, downsizing to suit a smaller congregation was necessary; a smaller cross-tower was added and the high Saxon roof was lowered, in the 15th century. Still oversized, the church declined, but it was restored in the 19th century and brought back nearer to Saxon dimensions. The photograph, taken from the south-west, conveys the height of the church with small windows characteristic of Anglo-Saxon churches, and shows the Norman doorways, but confuses because nothing can be seen of the large chancel, hidden by the south transept, (I found no viewpoint from which the whole church was visible).

The conjoined Fossdyke and River Till continue eastwards to Lincoln alongside the A57 road, arriving at the modern Burton Waters development on the left bank, c3km west of Brayford Pool and comprising houses, shops and a marina, with more than a hundred moorings. A short distance further, and the canal passes under the A46 Lincoln bypass, and then over an aqueduct, crossing the Catchwater Drain, which is also on its way to the River Witham. A few hundred metres further and Fossdyke widens out into Brayford Pool, where it meets the River Witham at the conclusion of its 18½km passage from the River Trent.

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Downstream from Lincoln, the river itself is inseparable from the River Witham Navigation, of which I shall give an account when I reach the lower reaches near to Boston. An aspect, which I shall mainly take as read along the remainder of river's course, and along parts of its tributaries, is the role of the river as a major fenland drain, at the centre of an intricate web of channels, stretching far from its banks, which feed into the river by way of pumps and sluice gates. However, on a historical journey, I cannot pass by the village of Washingborough, a short distance from the right bank, without drawing attention to one such channel, a short distance to its east, Car Dyke.

Common references to a ditch built by the Romans seem to trivialise a channel which was between 12 and 17m wide and of depth up to 4m. It once ran along the western edge of the Lincolnshire fens, for a distance of 92km to reach Peterborough. The water channel might have been cut in c125AD, at much the same time as another great Roman engineering project, Hadrian's Wall, was conceived. As with other artefacts left by the Romans, including the said wall, there is no certainty as to its exact function(s), not least because it survives only as shortish sections, including that at the northern end shown in the photograph, and otherwise is either filled-in or built into later drainage arrangements. It is undeniable that such sections might have assisted local drainage, but as an entity Car Dyke lacks a gradient which would have sustained long distance transport of water. It has been suggested that it served as a canal, though its route between Lincoln and Peterborough is hardly direct. However, there is some evidence, provided by archaeologist's discoveries of remains of cargoes such as coal, that segments were used in this way. My own favoured explanation is that it was primarily a boundary marker/obstacle with some defensive capability, built to curtail and monitor access to and from the fens, which were the haunt of outlaws, and rebels, but also a source of valuable commodities during the Roman occupation, just as they have been in other historical periods. If this is correct, it would align with the approach of Emperor Hadrian to other frontiers of the Empire, across Europe.

Though an old settlement with stone cottages and a church with a Norman tower, Washingborough, and the contiguous village of Heighington, now house mainly commuters working in Lincoln. The next stretch of the river veers to the south-east and near its left bank, where the land is higher, if only by a few metres, there were a number of medieval monasteries, though the visible remains of most are now scanty. The first to be encountered, just north of the cusp of the bend and 12km east of Lincoln is Barlings Abbey. Here, all that remains apart from earthworks is a portion of the nave wall of the abbey church shown in the photograph, taken unfortunately on a very dull and wet day. An 18th century engraving shows that the church crossing still stood then, as apparently did the cloisters. The Premonstratensian House was founded in 1154, moving a short distance to its present site a few years later. The establishment was a daughter house of Newsham Abbey, close to Grimsby, the first of the order in England. The abbey housed 13 canons initially, but these numbers grew in stages until there were 27 in 1412; thereafter numbers declined somewhat, but

there were still 20 canons in the 1530s. At the time of Dissolution the occupants of the abbey resisted its closure, playing a part in the Lincolnshire Rising which began in October 1536 in the town of Louth, in the east of the county; it has been suggested that 40000 people may have been involved, though I suspect that is an over-estimate given that the whole population of England was c4 million then. At any rate, the protesters marched on Lincoln and occupied the cathedral before they dispersed under the threat of deployment of the King's armed forces against them. Afterwards, the leaders were hunted down and the Abbot and 6 canons from Barlings were executed; when the abbey was suppressed in 1537, the remaining canons were turned out without compensation. Charles Brandon, Duke of Suffolk, who had put down the Rising, was rewarded with the property of the monastery and converted the claustral buildings into a mansion, which like most of the abbey, has vanished.

There is even less to be seen of the next abbey to be encountered, Bardney Abbey, also on the left bank of the River Witham, just north of the village of Bardney, and 14½km south-east of Lincoln. However, there were extensive excavations on the site in the first third of the 20th century. Foundations and lower parts of the whole complex, including the church, claustral buildings and a gatehouse were exposed, but covered over again to preserve the masonry, so that only earthworks can be seen now. The abbey had two incarnations both within the Benedictine order; the first foundation was in the late-7th century, after which it became a noted pilgrimage centre, because it held the body of King (St.) Oswald of Northumbria, a Christian, killed in battle by the heathen King Penda of Mercia. The abbey was destroyed by Danish invaders in 870, and many of the incumbents were killed, but it was re-founded in the late 11th century, as an alien priory (dependent on an abbey in Normandy). Shortly afterwards, it became independent of foreign control, and during the next 4½ centuries housed c20 monks, and a mitred abbot entitled to be summoned to medieval Parliaments. The abbey was suppressed in 1538 but only after resistance, as 6 of its monks were executed for involvement in the Lincolnshire Rising, though the majority remained docile and were granted pensions. As frequently occurred, the purchaser of the property then, Sir Robert Tyrwhit, used the abbey precinct as a quarry, hence its destruction above ground level.

A short distance further along the river valley, still near the left bank of the River Witham, is Tupholme Abbey, beside the B1190. Another Premonstratensian house, it was founded shortly after 1155, with a complement of 13 canons; their numbers varied, eventually falling to 8 in the 1530s. The abbey was suppressed in 1536, and a family by the name of Willoughby built a mansion based on the south range of the claustral courtyard, essentially the abbey refectory, with a vaulted undercroft below it. All the other buildings including the church were speedily demolished, no doubt acting as a quarry for the new house and other local building projects. Later owners built a new mansion in the 18th century, leaving the ruined south wall of the abbey refectory cum original mansion as a landscape feature. The photograph above shows the ruin, with remains of a farmhouse which had been added later, on the left.

Stixwould Priory is 2km to the south-east, on the western edge of a village of the same name. The only visible remains of a Cistercian House, founded in 1135, for 30 nuns, are earthworks, contained by moats, although an old farmhouse on the site incorporates masonry from the priory buildings. Only 12 nuns were in residence by the 1530s, and its history in that period is strange. It was suppressed in 1536, but the buildings were made over to the Benedictines, and populated with nuns who came mainly from yet another nearby priory at Stainfield, which has left little trace. The new occupants were themselves evicted in 1537 to make way for Premonstratensian canonesses, but the latter fared little better as the final suppression took place in 1539, though they received pensions. On the right bank, 9½km from the river, and 13km south-east of Lincoln, was Nocton Park Priory, a small Augustinian House, founded in c1145. There were never more than 10 canons, and by the time of the Dissolution in 1536, there were only 4. No masonry survives, and it is possible that earthworks visible on the site are evidence of a later private house, rather than the priory.

Just to the south is the large village of Woodhall Spa, well known to many golfers as the location of one of the finest inland courses in the country. Originally founded as a 9-hole course in 1891, the club acquired 18 holes in the present location, in 1905. My own experience is limited to a couple of rounds in the 1970s, but I remember it as living up to its reputation, with its heathland turf, tree-lined fairways and a profusion of sand-traps. A second golf course has been acquired since then, and the English Golf Union is now based there. Close to the golf course and at the west end of the village, is its only very old building, Tower on the Moor, though in truth it is only the remnant shown in the photograph. It is most of a stair turret which served a tower built, probably as a hunting lodge, for Ralph, 3rd Lord Cromwell who was Lord Treasurer of England from 1433 to 1443. The building was of 3 storeys, but did not survive long as it was dismantled and scavenged later in the 15th century, to provide bricks for repairs to Tattershall Castle, a later port of call. There have never been coal mines in the neighbourhood of Woodhall Spa, but paradoxically the fortunes of the Victorian settlement were made as a result of a failed attempt to find the mineral. When bore holes were sunk in 1824, a spring was discovered and it was soon realised that the water had medicinal properties, at least according to the wisdom of the time. The usual ancillaries like a pump room, baths and pleasure gardens appeared, and the village grew quickly, acquiring two churches and many substantial houses. I visited again recently, and apart from an over-abundance of cars, a slightly ‘old-world’ air persists, with several shops which appear to be independent and perhaps ‘up-market’, gathered in the centre.

On the south side of Woodhall Spa is the older hamlet of Kirkstead, and here was to be found the furthest downstream of the River Witham cluster of monasteries, Kirkstead Abbey, but once again the remains of a large complex are insubstantial. The Cistercian Abbey was founded in 1139, as a daughter house of Fountains Abbey in Yorkshire but at an unknown site; the move to the present location took place in 1187. There were 29 monks in the late 14th century, and as was normal because of the intensive farming practiced by the order, a greater number of lay brothers, but there were only 16 monks by the 1530s. The Dissolution

was resisted, but the only tangible result was that the abbot and 3 monks were executed for their part in the Lincolnshire Rising of 1536, and the following year saw the suppression of the abbey. The main complex was demolished in the following years, leaving only the crag of masonry shown alongside, which was once at the south-east angle of the south transept. Extensive earthworks cover the foundations of the rest of the abbey church and the claustral buildings, and traces of a surrounding moat can be seen. A more complete survival, c300m south of the masonry crag, is St. Leonard's Chapel shown in the lower photograph. It was built in the early years of the 13th century, not long after the abbey was founded. Its function is unclear, but it may have served visitors or local parishioners. Its austere design much admired by Pevsner, contrasts with what can be seen on the more ornate surviving portion of the abbey church. Altogether, 9 abbeys and priories were founded in relatively close proximity in the late-11th and early-12th centuries, 6 on the left (east) bank and 3 on the west bank of the River Witham, defying the normal custom of selecting sites isolated from population centres of all types including other monasteries. The presence of the river may provide at least part of the explanation, since trade in wool from sheep farmed on monastic properties funded most abbeys in the period, and much was sold to Europe; the easy shipping route, down to Boston and across to the Flemish weaving cities, must have been very attractive. Fenland is not obvious sheep-farming country, but the monasteries owned properties distributed round the country, so the abbeys and priories will have served more as collection points than farming enterprises.

My journey downstream continues to favour the left bank of the river where the slightly increased elevation makes for a varied landscape with villages and woodlands separating patchworks of fields, whereas on the right bank, larger fields occupy almost all the drained fenland, apart from scattered hamlets and water channels. The next settlement of note is Tattershall, dominated by its castle. The first on the site was of stone, built in 1231; it was of enclosure type with inner, middle and outer wards, a moat and curtain wall with towers around the former, and a gatehouse. Ralph, 3rd Lord Cromwell, encountered already as builder of 'Tower on

the Moor', undertook a complete reconstruction in red brick, with decorative stonework, during the two decades prior to 1450, when he was a figure of great influence in the court of King Henry VI. Although the castle built in turbulent times, was double-moated for protection, and given other defensive features, it was more a palace signifying wealth and power, than a strong fortification; it was never assaulted. After Cromwell's death, its history was rather downbeat as it changed hands between families, including the Clinton, Earls of Lincoln, and Fortescues. By 1910, it was roofless, and in total disrepair. After an auction, its new American owner began to rip out furnishings including medieval fireplaces with the intention of installing them in his own home. The Marquis Curzon intervened at this point, purchasing the castle, regaining the fireplaces, and renovating the castle thoroughly, before presenting it to the National Trust. Curzon had a distinguished political career in the early 20th century, holding such offices as Viceroy of India, and Foreign Secretary, and he failed narrowly to become Prime Minister, in 1922, but he most deserves the gratitude of his country for his role in creating the heritage environment which has allowed the preservation of great numbers of historic buildings. The spectacular tower, shown in the photograph below, is 40m high and c20m square; none of the 4 storeys above the basement was partitioned, and the upper 3 were state rooms, namely a hall, an audience chamber and a lord's private chamber, all with large fireplaces. Other survivals are the foundations of medieval kitchens in the inner ward, and from the middle ward, a guardhouse through which entry is obtained.

Tattershall Collegiate Church of the Holy Trinity, to the east of the castle, was another product of the ambitious plans of Ralph, 3rd Lord Cromwell, and once again necessitated the demolition of a predecessor occupying its intended site. The college was founded in 1439, for 7 secular priests, 6 lay clerks and 12 choristers, and attached to it was an alms-house to accommodate 13 needy people. The church, viewed from the south below, which was built between 1470 and 1500 is a coherent building, wholly Perpendicular in style, and very large; it appears cavernous to anyone standing in the nave. The college buildings, arranged in a cloister to the south of the church, provided domestic and service accommodation for the members of the college, but were largely destroyed after its suppression in 1545. The alms-houses remain, but they have been subject to much rebuilding since the 15th century.

Lord Cromwell also provided a school for the choristers, and its ruin survives beside the market square of Tattershall, where there are also a 15th century buttercross, and a public house of similar vintage. No longer a market town, the village has a population of less than 3000, housed for the most part in pleasant modern detached and semi-detached buildings, amongst enough trees to convey a rural ambience. The last stretch of the River Bain before it joins the left bank of the River Witham, separates Tattershall from the slightly larger village of Coningsby to the east. It is another settlement of largely modern houses, but there is an old church part-dating to the 12th century, which has a tower which carries a 17th century clock with only an hour hand, apparently a normal arrangement at that time. Immediately to the south is Coningsby Airfield, opened as a Bomber Command station in 1940; famous squadrons of heavy bombers, including No. 617, 'the Dambusters', were stationed there later in the war. Post-war, many aircraft types have flown from Coningsby, including Mosquitos, Canberras, Phantoms, Tornados, Jaguars, and now Typhoons. Since 1976, the Battle of Britain Memorial Squadron, which flies iconic aircraft like the Spitfire, Hurricane, and Lancaster, at national events, and otherwise displays them to the public on the ground, has been based at Coningsby. Benjamin Disraeli, later of course Prime Minister, chose the name of the village for the lead character in his novel

published in 1844, ‘Coningsby or The New Generation’, but novelists can make such choices without having any deep connection with the place selected, as in this case. The novel’s merits are argued over, and I am no great fan, but it provided the author at the age of 40 with a platform to set out his political views, though they were to change quite a lot in 23 years of considerable frustration before he finally became Prime Minister.

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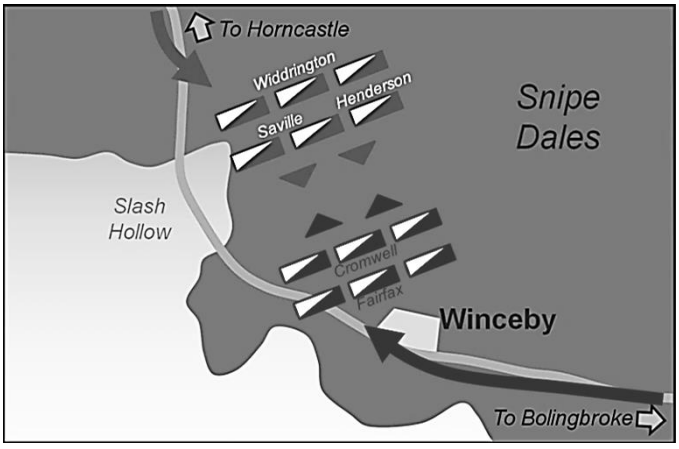
Having reached the mouth of a significant tributary, the River Bain, I shall follow my usual practice, and track back c44km to its source to follow it downstream from there. The river rises at Grid Point TF 188 886, just west of the village of Ludford Parva, 9km east of Market Rasen, and at a height above sea-level of 120m. The early course, first generally east, and then southwards, is in the Lincolnshire Wolds, and aerial views show a patchwork of fields, both arable and of pasture. The photograph gives a further impression of the landscape here, and it should be added that the upper reaches of the River Bain are a chalk stream, with clear alkaline water. There are several villages along this stretch, Burgh on Bain, Donnington on Bain, Goulceby, and Hemingby, to name a few, but pleasant as they are, they have no special features to demand attention. A number of place-names end in ‘by’, which denotes an early Viking settlement, and the theme is picked up by the passage through the area of the Viking Way, a modern long-distance path, following a near-250km route through Lincolnshire and beyond. There were 7 water mills upstream of Horncastle and in the town itself, the first at Burgh on Bain; some of the buildings have been converted into houses. Although there is a paucity of information about them, it is reasonable to assume that they all ground corn, mostly in the 18th and 19th centuries, though there were doubtless much earlier mills in the area; the former are located in Table Wi1.

Horncastle sits astride the River Bain where it is joined by a smaller left bank tributary, the River Waring; the confluence created a horn-shaped piece of land on which the settlement was built, and from which the first part of its name derives. There was probably a fortified manor in the town for a period after the Norman Conquest, but it is more likely that ‘castle’ refers to the walls built around the Roman settlement, bits of which still survive, including a fragment encased in glass in the town library. The place has had no very prominent role in history, though it was caught up in the Lincolnshire Rising of 1536, after which a few residents were executed. A market charter was awarded in the 13th century when a great horse fair was first held, an event which took place until the mid-20th century. Still a market town, Horncastle is a bustling place, with a rather cramped centre, and c8000 residents. I used to visit the town quite regularly, largely because there were once 4 second-hand bookshops. In general, these establishments seem to be organised along a spectrum ranging from well-ordered and accessible, but sometimes soul-less, presentations of their wares, to total disorder,

where a good deal less than half of the stock is visible, and where touching a book seems to risk the collapse of a tottering pile possibly triggering a domino effect. I often left one in the latter category, feeling that if only I could have found it, there was a book I should have liked to buy. For long, there was one premises in Horncastle which was well towards this chaotic extreme, but the owner has now restored enough order to make a visit worthwhile, as I confirmed recently.

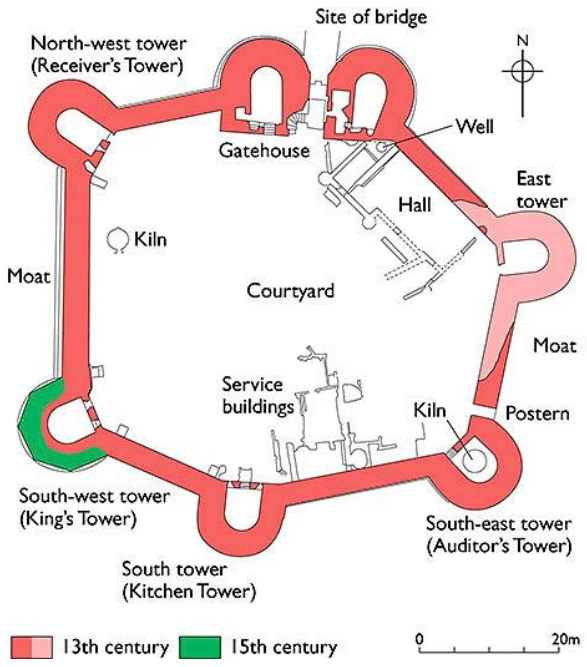
Horncastle is at the southern edge of the Lincolnshire Wolds, where they meet the fens and the River Bain drops below the 30m contour as it leaves the town. It does so in the company of the Horncastle Canal which linked a quay in the centre of the town with the River Witham at Tattershall, opening in September,1802. The driving force behind its construction was Sir Joseph Banks, who owned the estate of Revesby Abbey a short distance north-east of Horncastle. Making his name as a naturalist when he visited Australia with Captain Cook, Banks became very influential in science, as President of the Royal Society, and also as an advisor to governments on colonial policy; he even appears as a spymaster in the 'Aubrey' series of novels written by Patrick O'Brien. Although Banks lived mainly in London, he was just as prominent in Lincolnshire as an 'improver' of his own estate and supporter of schemes intended to increase the prosperity of the area. Two great engineers were involved with planning the canal, William Jessup and John Rennie, and it was following their advice that it became a combination of new cuts, canalised sections of the River Bain, and an existing short canal at Tattershall. Maps present quite a confusing picture with the canal, the river, and the old river course in close company, with channels sometimes intersecting and vanishing for a stretch. The canal was 18km long with 11 locks of dimensions 22 X 4.6m, which enabled it to take all boats using the River Witham Navigation. Its main cargos were coal going to Horncastle, and corn and wool going in the other direction; profits were made and dividends paid, for 60 years until 1873, but as with many canals competition from the railways killed it off. One drain on the profits had been an agreement to pay compensation to owners of mills at Kirkby on Bain, Fulsby, Tattershall, and Dogdyke, when the canal took too much water from stretches of the river. It was formally closed in 1889, though parts remained in use into the 20th century; access from the canal to the River Witham is currently blocked by a sluice-gate, but efforts are currently being made to restore access and reopen the canal as a leisure resource. At Fulsby Lock just upstream from its junction with the River Witham, the mean flow rate in the River Bain is 16722 gallons per minute



Before resuming the journey along the River Witham, I shall allow myself to stray to the east of Horncastle, to visit 2 historically important sites, still within the River Bain catchment. The first is beside the hamlet of Winceby, 5km east of Horncastle where a battle was fought on 11th October 1643. The Royalist commander, Sir William Widdrington was attempting to relieve a Parliamentary siege of Old Bolingbroke Castle, with soldiers brought from Newark. The battle occurred when the Parliamentary force interposed itself to the south-east of the Royalist force coming from the west, as shown in the sketch-map, adapted from that on the Battlefields of Britain website; only cavalry

and dragoons were involved to the number of c3000 on each side. It was the first time that Oliver Cromwell and Sir Thomas Fairfax were involved together on a battlefield, both under the command of the Earl of Manchester. Looking at different accounts, the common game of trying to allocate credit preferentially to one or other of Cromwell and Fairfax has made it difficult to understand fully the sequence of events; the former led the first line of Parliamentary cavalry, had a horse shot under him, and certainly damaged the Royalist horse. His partisans suggest that the battle was won before Fairfax led his second line forward, and that the latter did no more than pursue a beaten enemy, but other military historians suggest that it was Fairfax's attack on the right wing of the enemy that actually broke them and started a rout. At all events the battle cost the Royalists at least half their force, while Parliamentary casualties were only in the order of a hundred. Bolingbroke Castle fell, and for a period thereafter Parliament dominated Lincolnshire. Arguably, the battle was a harbinger of a change of fortunes, after the early part of the Civil War which had seen Royalist domination. The evocatively named Slash Lane (B1195) follows the intended Royalist route towards the hamlet of Winceby, where an unobtrusive monument can be found.

Mention is made of Old Bolingbroke, another 4½km to the south-east, and here is sited the ruin of Lincolnshire's most renowned fortalice, Bolingbroke Castle. The site was probably fortified in the 6th or 7th century, and there was a motte and bailey castle in the 11th century, but the ruins visible now relate to a castle constructed around 1220-30, by Randulph de Blundeville, Earl of Chester (and Earl of Lincoln from 1217). The enclosure castle was built to the plan in the schematic alongside, and the photograph below shows the extent of the largely low-level masonry survivals. The curtain wall up to 5m thick, formed an irregular polygon and there were 5 D-shaped towers and a gatehouse, all built of what has proved to be not very durable porous limestone. The castle was surrounded by a deep moat, 31m wide but there was never a keep. The limited ruins of the service buildings and hall are explained by their being timber framed. The most impressive features of the ruin for me when I visited were its scale (c60m across) and the thickness of the tumbled-down walls. A large earthwork in the centre of the rout yard (used for jousting practice), beyond the moat to the left of the field of view of the photograph, is almost certainly post-medieval, and probably part of a fortification built to help to defend the castle during the siege of 1643, which was ended by the Battle of Winceby. During the centuries after its



construction, the castle had a number of owners before becoming, as so many did, a possession of John of Gaunt, Duke of Lancaster. He and his wife Blanche, who had brought him the castle, in which she had been born, lived there until her early death and their son Henry - later King Henry IV - was born at Bolingbroke Castle in 1366. It became a royal castle on his accession, but played no part in the Wars of the Roses, gradually becoming a backwater and by 1600 only the gatehouse and the King's Tower were still in use. It was sleighted after its involvement in the Civil War, and thereafter continued to decay until placed in state guardianship in the 20th century.

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The River Witham is joined by a right bank tributary, the River Slea, 1½km downstream from the confluence with the River Bain, at the hamlet of Chapel Hill. The River Slea, which in its lower reaches has the name, Kyme Eau, flows mainly east for 36½km to its junction with the parent river. Its source is a spring at Grid Point SK 959 422, just south of a hamlet called West Willoughby, and 3km south-west of Ancaster. The tributary rises only a little over 3km east of the River Witham, far upstream at Barkston, and it is worth repeating that the said parent river flowed east along the valley here before the last Ice Age, short-circuiting much of its present course. The landscape is a patchwork of fields, some pasture, some arable as the river falls through 50m to the 20m contour in its first 10km, at which point signs of fenland emerge, near Sleaford.

The first substantial settlement on the river is Ancaster, a village of less than 2000 inhabitants, but as its name suggests with a history going back to Roman times, when it was a junction on Ermine Street, the road between London and Lincoln. There is no striking monument from those times, but traces of Roman town walls remain, and excavations have furnished more evidence of the occupation. The church of St. Martin which has substantial Norman elements is thought to stand on the site of a Roman Temple. Quarries here and near the next village downstream, Wilsford, produce a building stone, Ancaster oolitic limestone, which is prized for its creamy white appearance, its durability, and the ease with which it can be cut and shaped (oolitic refers to the fossilised small marine animals which abound in the sedimentary rock). There was a dukedom of Ancaster throughout the 18th century, though their seat was at Grimsthorpe Castle, c15km to the south-east; the family name was Bertie, and at least on the male side, their rise from lowly origins was unusual and fast; the progenitor was a household servant in the mid-16th century who married his employer. Discretion about strongly held religious views as much as social norms compelled residence abroad for a while, but the couple were accepted into the upper ranks of society on their return and their descendants, were Earls of Lindsey by 1626. They suffered during the Civil War, in which the then earl was a senior Royalist commander, but benefitted afterwards from their loyalty to the crown, and from the marriage of a daughter to the much-maligned but influential Earl of Danby, later Duke of Leeds. The Ancaster dukedom was granted in 1715, and was held until the male line failed in 1809; the earldom, of Lindsey is still with the family.

Sleaford is 8½km east of Ancaster and its population of over 17000 makes it the largest town in the area by a margin. Though settled in Roman times and probably earlier, its documented history begins after the Norman Conquest, when it became a possession of the Bishops of Lincoln. During the 1120s and 1130s, they built Sleaford Castle, west of the centre of the town on land between two streams flowing into the River Slea. It was of enclosure type with a keep, towers and a gatehouse, surrounded by a substantial moat. Beyond were

an outer courtyard and outer bailey, again protected by moats and gatehouses. Any suggestion that the castle was not well set up for defence seems wide of the mark. It was habitable until the mid-16th century, but was stripped of its roof then, and quickly became ruinous. Now there is said to be one small huddle of masonry on the site, though in truth I never came across it in my wanderings amongst the earthworks shown in the photograph alongside, a view looking south-east.

As might be expected, in a town with its ecclesiastical connections, many disapproved of the Reformation, and the Lincolnshire Rising of 1536 attracted support. This event has been referred to a few times in this account but a little more can be said here. It began in October 1536 at Louth with the rough treatment of commissioners sent by Thomas Cromwell to start the process of suppressing the religious house there. Disaffection soon spread to nearby towns including Caistor and Market Rasen, and the protesters, led by senior churchmen and some of the local gentry demanded a halt to the suppression of the abbeys, marched on Lincoln, and occupied the cathedral. At this point, threats from the government proved enough to end the protest, the thousands involved dispersed, and the authorities identified and imprisoned the leadership. Over a hundred were executed, including a number of abbots, and the ripples spread widely. Sleaford was hardly involved, but the most distinguished resident, Lord Hussey of Sleaford, a long-time royal courtier to King Henry VIII, was caught up in the events. He took no part in the Rising but failed to take the actions expected of a local magnate to oppose it, and he made indiscreet remarks which could be construed as supportive. He was over 70 years old at the time, but his age did not save him, and he was beheaded in Lincoln in late 1536. The family never recovered fully, in spite of later efforts to reclaim the barony, and all trace of their substantial residence in the town has disappeared.

In the 18th and 19th centuries, Sleaford became something of a transport hub, and a major part of that was the creation of the Slea Navigation which opened in 1794. The development took place at the same time as the building of the Horncastle Canal, and some who featured in connection with that project, like Sir Joseph Banks and William Jessup, had similar roles here. The navigation was 20km long, and the first part, leading from a wharf in Sleaford, to Haverholme Priory was a new cut, but downstream from there the river, which had taken the name Kyme Eau was canalised. The photograph of this latter stretch, which is thought to have been navigable from the 14th century, was taken in the village of South Kyme. The canal operating company was sufficiently prosperous during the first half of the 19th century, for consideration to be given to extending the

canal westwards, firstly into the centre of Sleaford, and then as far as Grantham. Perhaps fortunately, this did not happen, because the opening of a railway between Grantham and Boston, by way of Sleaford, in the 1850s, soon made the canal unviable, and it was officially closed in 1878. However, most of Kyme Eau remained navigable well into the 20th century, and the connection to the River Witham, which had been blocked by a sluice, was restored in1986, so it is again accessible to river cruisers and barges.

Though the main roads, (A15 and A17) now bypass Sleaford, it has retained railway connections, and is busier than many larger towns. It has retained a working watermill, Cogglesford Corn Mill; the present set-up dates from the 18th century, but there is evidence of predecessors dating back a thousand years. On that theme there were mills downstream on the canalised river course, at Holdingham, and Leasingham Moor, the former a corn mill the latter a paper mill. Haverholme Priory, mentioned above, and 5½km north-east of Sleaford, has had an unusual history; It was originally colonised from Fountains Abbey by Cistercian Monks in 1137, but they decided to move to Louth; re-founded in 1139, the priory became a large Gilbertine Double Monastery with 100 nuns, 50 monks, and it seems, only a small income. However, it survived until it was suppressed in 1538, and was bought by the Finch-Hatton family, who later acquired the title, Earl of Winchelsea. They built a succession of mansions on the site, the last in 1830, shown in the photograph above. It would be surprising if any priory buildings remained by then, but no doubt some of the masonry will have been re-cycled. In the 1920s the property was sold to an American lady, who had the latest mansion dismantled for reassembly beside her home in the USA. Some at least of the carefully numbered stones had reached Liverpool for transhipment across the Atlantic, when it was learned that the new owner had died in a train crash, so they were sold again for more mundane use as building material for new docks. A distinctive if much reduced ruin on the right bank and a decorative 19th century bridge over the river, survive but neither had anything to do with the erstwhile priory. A short distance further downstream the canalised river swings from east to south, following the line of Car Dyke for c600m, and then swings east again, to enter South Kyme which is 10½km north-east of Sleaford.

The population of the village is only a few hundred, but it housed both a priory and a large fortified house from which a tower survives. South Kyme Priory is on the west side of the village, beside the B1395. The Augustinian house was founded in the reign of Henry II, before 1169, and dedicated to the Blessed Mary, housing a prior and 12 canons. When the priory was suppressed in 1539, there were 9 canons. The present parish church of All Saints is viewed from the south-east in the photograph; it was originally the south aisle and part of the nave of

the much larger priory church, greatly altered and partly rebuilt in 1805. It is chiefly in the Decorated style, but has a Norman doorway in the south wall. None of the claustral buildings survive above ground.

South Kyme Tower is immediately south of the priory church. The property was moated, with water drawn from Kyme Eau which passes immediately to its south. The surviving tower was built in the mid-14th century by Gilbert Umfraville, as part of a larger house, which certainly incorporated a hall block, and maybe another like-tower. Little is recorded of its later history, apart from the ownership, and it became a possession of the Duke of Newcastle in the early 18th century. The future prime minister may have demolished the hall. The photograph is a view of the south face, showing the stair turret to the right, and the beam-slots for the demolished hall block. The tower was 23m high, 8.8m square over walls 1.5m thick, and ashlar built of Barnack stone. It had a vaulted basement, and above were 3 other floors reached by a staircase in the aforementioned turret. The building is unroofed, and no floors survive above the first, so the internal arrangements are unclear. After leaving South Kyme, the canalised River Slea, still under the name of Kyme Eau travels mainly north to meet the River Witham.

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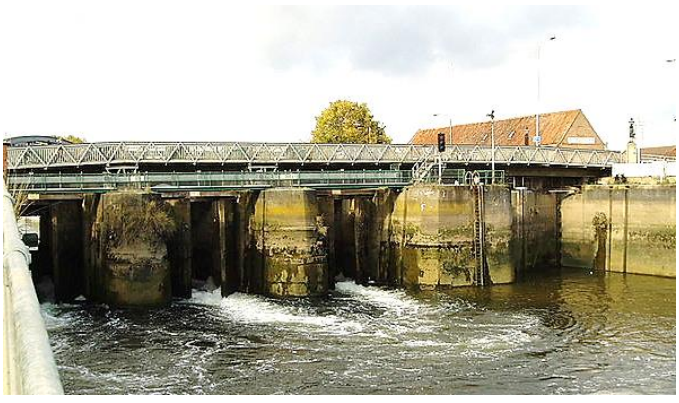


Having reached the lower reaches of the river, it is appropriate to consider the measures which have been taken to improve navigability, between Lincoln and the sea. The Romans utilised the river for transport, but apart from dredging may not have carried out engineering work. In the 12th century, it is believed that the first sluices near the mouth were installed, to maintain water levels upstream, and to control silting in the downstream channel by facilitating flushing. Measures were taken throughout the medieval period to make boat travel on the river easier, before major improvements were made in the 18th century. Engineers, including John Smeaton, built upon schemes developed early in the century to produce a plan which was implemented in the 1760s. Several steps were taken, including the provision of the Grand Sluice near Boston, (shown in the photograph above), which performed similar functions to the medieval sluices, by maintaining upstream levels and allowing flushing away of silt. A new cut was dug which straightened out the meandering course of the river, and 3

locks were installed at Stamp End, Kirkstead, and Barlings, (the first in the south-west of Lincoln, the others near ruined abbeys, already located). The Act of Parliament which allowed the work to proceed also created the Witham Navigation Commission which continued to develop improvement schemes directed towards drainage and navigation. As mentioned earlier, John Rennie was employed in the early 19th century, and his work led to further changes being made, though thankfully his proposal to demolish Lincoln High Bridge to facilitate the passage from the lower River Witham, through to Fossdyke and the River Trent, was rejected, and schemes to connect with the River Axholme did not go ahead. It is important to appreciate that drainage of large areas of the fens was actually the more important and expensive element of the scheme, (£70,000 v £30,000), justified by the value of the agricultural land made available.

Investment continued at a healthy level, until in the late 1840s, the Great Northern Railway took over the Witham Navigation, and opened the Lincoln to Boston line which followed a route along the riverbank. At this time, steam packet boats were plying along the river, carrying freight, especially coal, and passengers, but inevitably the competition from the railway could not be withstood. By the 1860s the railway company was probably regretting its commitment to maintain the navigation, but although passenger transport along the river had ceased by then, freight traffic continued at significant levels into the 20th century (c20000 tonnes per annum in the first decade), though river transport of goods had more or less ceased by the 1950s. The Navigation passed into the hands of British Waterways, a nationalised body in 1962, and then to the Canal and River Trust in 2012. The navigable waterway is entirely a leisure facility now, and is maintained as such between Boston, Lincoln, Fossdyke and the River Trent. The connection to the Sleaford Canal has been restored, and plans are afoot to do the same for the Horncastle Canal, by which time there will be a network of rivers and drains comparable in scale to the Norfolk Broads, though the scenery is surely less attractive.

Reference to the map of the stretch of the river between Lincoln and Boston alongside, makes that point by showing the plenitude of the 'blue' drainage channels, which lead water by way of canals and sluices into the River Witham, (the river flows from the top left to the bottom, centre-right). By this means, the fens have been converted into fertile agricultural land in a process which has been ongoing since early medieval times. It is easy to underestimate the scale of the enterprise, and to assume that drains and dykes shown on maps are really just ditches and narrow channels. In fact, those which connect directly with the River Witham, like Hobhole Drain, East Fen Catchwater Drain, West Fen Catchwater Drain, Medlam Drain, West Fen Drain, Newham Drain, and South Forty Foot Drain, can pass at first sight for substantial rivers, though closer observation makes it clear that flows are to say the least, usually lazy. Many of the drains are navigable, at least in the summer months, when they are

maintained at a higher level than in winter. The photograph of West Fen Drain, with the tail end of a barge in shot demonstrates the points about scale and navigability, though not all the channels are nearly as wide as this. Indeed, the internet yields a few accounts of over-ambitious attempts to journey along channels that are ditches rather than canals. My brief account can be amplified by published histories of the River Witham Navigation, and of the engineering work which drained the fens, while the aforementioned present-day internet blogs describe voyages of discovery in boats.

According to most authorities, Boston owes its existence to a storm in 1014 which shifted the mouth of the River Witham, 13km north-eastwards from Bicker Haven to a tidal inlet, called simply 'the Haven', where the town in question now stands. After the change, the outflow through Bicker Haven was drastically reduced so it became a tidal inlet which silted up during the middle ages, allowing the area to be reclaimed as farmland. Bicker is now a small village beside the A52, 13km from salt water in the Wash, though Bicker Haven is still remembered, in the name given to the area between the village and the River Welland. There have been significant changes to the surrounding landscape since then as a result of the interplay between build-up of silt, erosion and submersion of low-lying marshland, and drainage and reclamation, but the River Witham has not altered substantially in its course again.

The first port on the Haven was downstream from the present centre of Boston at Skirbeck, now a southern suburb but then the main centre of population, and the name Drayton was carried over from beside Bicker. However, the centre soon moved upstream to the present centre, which could be reached over drier land, and the name Boston with its connection to St. Botolph took over. Growth was rapid in the following centuries, with the port well-placed to trade with Europe, especially the Hanseatic ports, and with good links to the hinterland, not least by way of the River Witham. It became a staple port for the export of wool in the 14th century, and other important exports were salt, grain, and Derbyshire lead. However it was hard-hit by the decline in those trades, and although its burgh charter, first awarded by King John in the early 13th century was renewed in 1545, the Dissolution was another blow as friaries in the town were suppressed. On that matter, feelings must have been mixed given that religious dissent became endemic here, thanks in large part to connections with European centres of reformed religion. The roles of townspeople in the religiously motivated emigrations to North America of the 17th century are well-known, with the name of the great New England city of Boston a potent reminder.

The drainage of the fens, along with the improvements to the River Witham waterway, followed by its connection to the railway network led to an upturn in the town's fortunes during the 18th and 19th centuries, as it became a processing and transhipment centre for agricultural products, a role it still fulfils. The wharves on the Haven remain an important if small port, though the absence of river activity in the photograph, repeated in the less-visible stretch downstream suggests that it is no longer a busy one. I should add that here were mills and a foundry in the town at the end of the 19th century; they were near the river but powered by wind or steam.

The present population of the town is estimated to be 45000 (2017), and it has risen quite steeply in recent years, with immigration from the EU, a significant contributor; a situation not met with approval by all of the townsfolk, as was demonstrated in the 2016 Referendum. Very much a local centre, with two market days each week; most of the large open area at the centre of the town is filled with stalls then, and parking near the centre of town becomes difficult. Interesting buildings, dating to the medieval period, include St. Mary's Guildhall which was built of brick in the 1390s, a century after the guild had been founded by the town's merchants. The guilds were a casualty of the Reformation, but the corporation which succeeded to many guild functions took over the building which was also used for court sessions. In recent years the Guildhall has become the town museum. Also near the centre of the town, on the left bank of the River Witham, is Hussey Tower, shown in the photograph above. It too was built of brick, as part of a larger complex by a town official called Bennington in the mid-15th century, and came into the possession of Lord Hussey, a royal courtier, encountered earlier because of his stronger association with Sleaford. His downfall after the Lincolnshire Rising of 1536 led to his execution at Lincoln, and the sleighting of his tower in Boston. Now it is a 3-storey roofless ruin, while associated buildings like a hall block and a gatehouse have vanished totally.

There were 4 friaries in Boston, before the Dissolution, namely the Dominican (Black), Augustinian, Carmelite (White), and Franciscan (Grey), but only the first has left any trace. The survival is a building, on the left bank of the River Witham, in the town-centre, shown in the photograph which is thought to have been the south range of the claustral square, probably housing the friars' refectory on the upper floor. It has been restored as Blackfriars Arts Centre. The Dominican Friary had been founded before 1288, when most of the buildings were burnt during a riot. Rebuilding, aided by a gift of timber from King Richard II, took until the early 14th century; there were c30 friars then, though numbers fell thereafter, before its suppression in 1539.

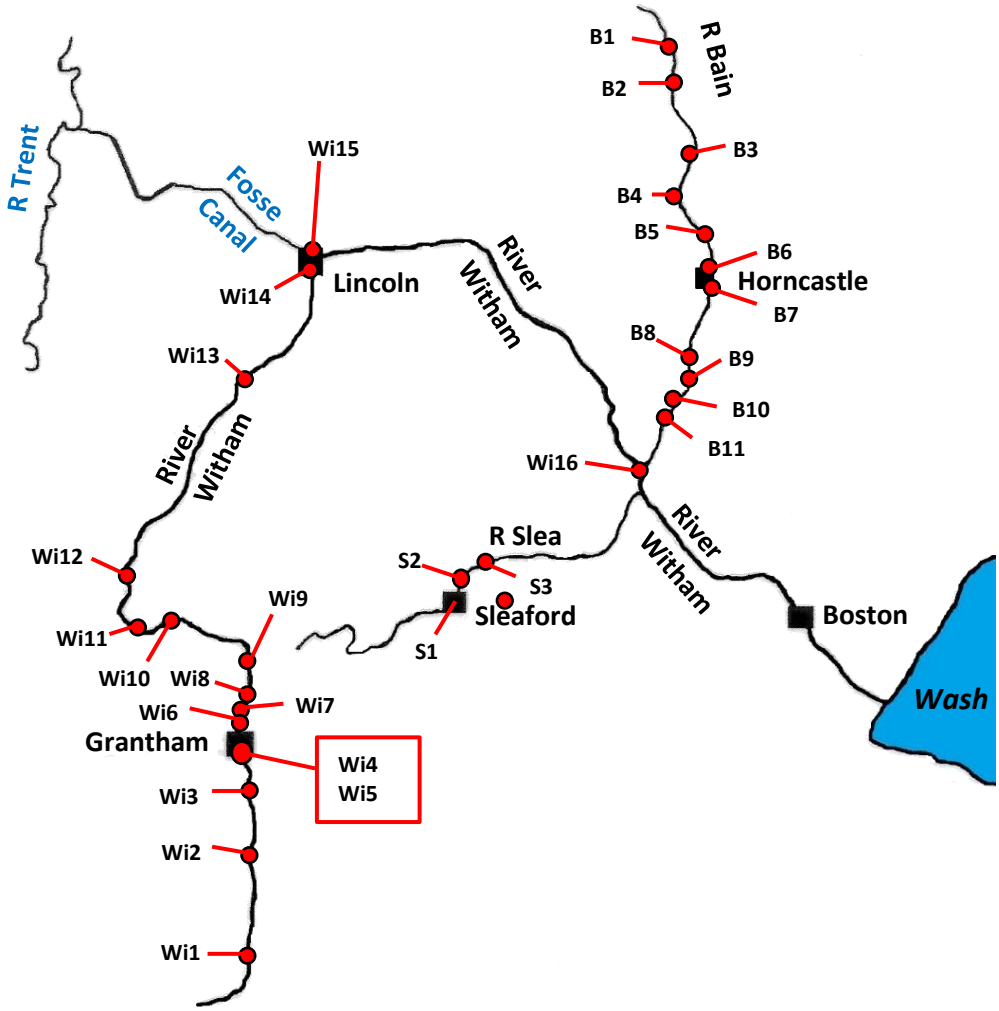
There are other interesting buildings in and around the town, but all pale into insignificance beside the monumental tower of St. Botolph's Church, the Boston Stump, viewed from the west, across the River Witham, in Mr. Hitchborne's photograph alongside. (I was unable to obtain my own, because my last two visits to the town have found the tower festooned with scaffolding; certainly, a sight to behold with more than 25 open platforms reaching up to the very top, but not the view I wanted.) The highest point of the octagonal lantern tower is 83m above ground, the highest in England, though there are more vertiginous spires. There was a Norman predecessor on the site, but work on the east end of the present church is thought to have begun in 1309. Construction of the tower started a century later, but it may not have reached full height until the early 16th century, hence the style change from Decorated to Perpendicular, most obvious from the windows. Other dimensions of the church are proportionate in size, making it one of the largest English parish churches. This is, of course, a reflection of the wealth of the town in the period when it was built, but like the other stand-out parish church encountered along the river, St. Wulfram of Grantham, it was never raised to higher status, though the chapel and priests installed in the church by St. Mary's guild were a chantry in all but name. The exterior has hardly changed since the Reformation, but the interior reflects more recent restoration projects. Many accounts make much of how the

Stump can be seen from great distances in all directions, but my own experience is that it stands out less than might be expected, and unless near the town, one has to know where to look; in that regard it does not compare with Lincoln Cathedral.

Leaving Boston, the River Witham flows by way of the Haven, curving gradually eastwards until it meets a similar channel formed by the River Welland in the western corner of the Wash. The rather extraordinary photograph was taken by a Mr. Paterson from a position close to the end of the tapering spit of land, on the right bank of the River Witham, and the left bank of the River Welland, as they join. The view is looking upstream (north-west) with the River Witham to the right and the mudflats of the Welland estuary to the left. This is one photograph I shall not attempt to duplicate, as the footing on seaweed looks hazardous, and may well be submerged for at least some of the time. Here, the river completes its 132km journey to the sea from Cribb's Meadow, near South Witham, though because of its unusual course, its mouth is only 53km from its starting-point. I should have liked to provide an estimate of the mean flow rate here, or at least somewhere in the lower reaches of the river, but have not been able to find such information. Perhaps the variability imposed by the sluices which control the inflows from the drains and the control exerted by the Grand Sluice would make this a rather meaningless measurement, but I would certainly like to know the rate at which water is taken off the fenlands.

When I began this project, I expected to find that the River Witham, like most other major English rivers had been the subject of at least one modern 'source to sea' account. I was surprised to find that this was not the case. I certainly do not regard my efforts as entirely filling the gap; I deal as the title indicates, with the history of the river as expressed by the buildings on each bank and a few of the more notable people associated with them. I do not deal with the natural history of the river, or with leisure pursuits like fishing and boating. I could probably have doubled the length of this account by attempting a full treatment of the city of Lincoln, and still not have done it justice, but I settled for sticking narrowly to the passage through the city of the River Witham and Fossdyke, together with following some associated artificial channels. Many authors have focussed on the history and buildings of Lincoln, and I could add little to their work. The schemes which made the river and some of its tributaries navigable are treated briefly, because there are other sources of information, and the massive role of the streams in drainage of the surrounding fens, which has created prime agricultural land, though at the cost of destroying a large part of the wetlands habitat, are mainly left to specialist accounts. Perhaps the paucity of accounts of the River Witham is explained by a complete absence of the spectacular, along its length, excluding of course man-made artefacts; there are no waterfalls, or gorges, and an artificial, man-made landscape has been imposed on long stretches. The very real interest that I have found is not on the river but in the buildings, many ruined, behind flood defences at a distance from it.

Table Wi1. Water Mills on the River Witham and its Tributaries



River Witham					
	Mill	**Type**		**Mill**	**Type**
Wi1	Colsterworth	Corn	Wi9	Barkston	Corn
Wi2	Great Ponton	Corn	Wi10	Marston	Corn
Wi3	Houghton	Paper	Wi11	Long Bennington	Corn
Wi4	Grantham Spittlegate	Corn	Wi12	Claypole	Flax then Corn
Wi5	Grantham	Slate	Wi13	Aubourn	Corn
Wi6	Harrowby.	Corn	Wi14	Lincoln (1)	Flour
Wi7	Manthorpe	Corn	Wi15	Lincoln (2)	Saw
Wi8	Londonthorpe	Corn	Wi16	Dogdyke	

Tributaries

River Bain

B1	Burgh on Bain	Corn
B2	Donington on Bain	Corn
B3	Ranby	Corn
B4	Baumber	Corn
B5	Thimbleby	Corn
B6	Victoria (Horncastle)	Corn
B7	Horncastle	Corn
B8	Red	
B9	Kirkby on Bain	Corn
B10	Fulsby	Corn
B11	Tattershall	Corn

River Slea

S1	Cogglesford	Corn
S2	Holdingham	Corn
S3	Leasingham Moor	Paper

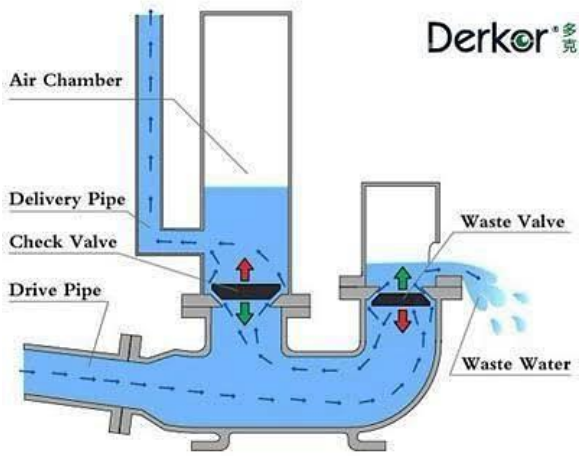
Notes:

1. Our investigations suggest that there have been in recent times, (since 1700), a total of 16 watermills powered by the River Witham, together with 14 more on its tributaries, the Rivers Bain and Slea. Given the combined length of the streams, this is not a large number (30), and reflects the fact that for substantial parts of their courses, the rivers are fenland, and cannot supply useful power.

2. Of the 30 mills identified, 24 ground corn, 2 produced paper, one was a saw mill, one treated flax, and one may have been a slate mill, though there are doubts. There are 2 about which it is impossible to be sure, though it would not be surprising if they were corn mills.

3. There is no doubt that in places like Lincoln and Boston, there were mills which operated on steam power, so the apparent absence of mills carrying out industrial processes is suggestive, but not conclusive.

Appendix1 – Hydraulic Rams



I am indebted to a short article in Industrial Archaeological News 93, authored by J. Milln for some of what follows. The device is a pump without rotating parts, illustrated by the schematic, and it utilises the pressure pulse generated when the water flow (from left to right) in the drive pipe is brought to rest by abruptly shutting the waste valve. The raised pressure opens the check valve and drives water upwards into the delivery pipe. The pressure in the drive pipe then falls, the check valve closes, and the waste valve opens so allowing the flow along the drive pipe to re-start, and the cycle to repeat; the air chamber acts as a damper which smooths the flow as its contents expand and contract. The first practical device was installed by John Whitehurst in a brewery in Cheshire in 1772, but the aforementioned waste valve had to be opened and closed manually, so operation must have been slow. The invention and patenting of an automatic valve in 1796 by Pierre Montgolfier of hot-air balloon fame, speeded things up, typically to 50 cycles per minute, and eliminated the manual element so opening the way to commercial exploitation; a number of British companies acquired rights to manufacture hydraulic rams from the early 19th century onwards, and a few still do.

A hydraulic ram can be installed wherever a steady supply of water can be diverted into the drive pipe at a level above the waste water exit, (which in turn must be above the check valve); typically the water might be taken off from a river behind a weir, and the hydraulic ram might be positioned to yield a driving head of a metre or more. There is a trade-off between the quantity of water that can be delivered, and the height to which it must be raised, so while 15% of the water supplied through the drive pipe might be raised by 5 X the driving head, it is possible to raise smaller proportions by more than 20 X the driving head. According to Milln a unit that can raise water 100m, and transport it a distance of 3km at a rate of 50000 gallons per day is nothing out of the ordinary. To conclude this discussion, there is a feeling not entirely absent even for a trained fluid dynamicist like myself, that somehow these devices deliver something for nothing; they do not of course, but are a subtle, low maintenance way of extracting energy from a flowing stream, and using it to overcome gravity and transport water upwards. Anyone who has heard water hammer in central heating pipes has experienced another manifestation of the effect which drives hydraulic rams.