Chapter 1

Bridgewater 250: Researching the Archaeology and History of the First Industrial Canal

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"But so unbounded have the speculations in canals been, that neither hills nor dales, rocks nor mountains, could stop their progress, and whether the country afforded water to supply them, or mines and minerals to feed them with tonnage, or whether it was populous or otherwise, all amounted to nothing, for in the end, they were all Bridgewater Canals. His Grace's canal had operated on the minds of canal speculators, much in the same manner as a large lottery prize does upon the minds of the inhabitants of a town, which has had the misfortune to be visited with such a calamity."
John Sutcliffe, *A Treatise on Canals and Reservoirs.* (Rochdale, 1816).

Introduction

Anniversaries are an occasion for reflection and re-assessment as well as celebration. Friday, 17th July 1761 marked the beginning of the Canal Age. The date may not be as well remembered as the 15th September 1830 but the opening of the first section of the Bridgewater Canal, including the remarkable stone aqueduct across the River Irwell at Barton, can be regarded as a turning point in the transport history of Britain. By the beginning of the nineteenth century the Bridgewater Canal was already recognised as one of the key developments in what would eventually be referred to as the Industrial Revolution. Bridgewater, the aristocratic entrepreneur, and Brindley, the empirical engineer, had demonstrated the potential of a new transport infrastructure in an increasingly industrial and urban economy. The Bridgewater Canal was to become as much a landmark in the technological history of the eighteenth century as the spinning jenny and the steam engine, even though it relied on older proven technologies rather than modern ones. But familiar as Bridgewater and his canal are to archaeologists and historians – the literature on both is considerable (see the Bibliographical Note at the end of this volume) – there are still, as a number of the essays in this volume suggest, under-explored aspects of the industrial archaeology and economic history of the canal.

Canals, like the railways, have a long pre-industrial history but the significance of the Bridgewater Canal was that it transformed water carriage, making canals an integral element of an expanding industrial economy. It demonstrated that water transport no longer needed to be thought of in terms of improving the navigability of existing rivers. Above all, it showed to even the most sceptical of businessmen and investors that canals had distinct advantages in creating new markets as well as improving the efficiency of existing ones, especially when carrying heavy, bulky, low value goods such as coal.

The Bridgewater as a Tourist Attraction

As soon as it opened, the Bridgewater Canal became a place to visit and admire. Numerous visitors recorded their impressions in letters and diaries, although, somewhat surprisingly, these contemporary accounts have not been studied systematically by historians.[1] Neither has any explanation been offered as to why the Duke, often depicted as a secretive person, allowed visitors inside the mine. Arthur Young's detailed description of the canal, discussed by John Aldred (Chapter 3) is one of the accounts most frequently quoted by contemporaries and historians.[2] When first built the canal, especially the aqueduct, impressed, sending shivers of excitement through onlookers as they watched barges crossing the aqueduct at the same time as boats passed underneath. For other visitors it was the coal mines that made the strongest impression, travelling through unearthly, shadowy spaces where they experienced a

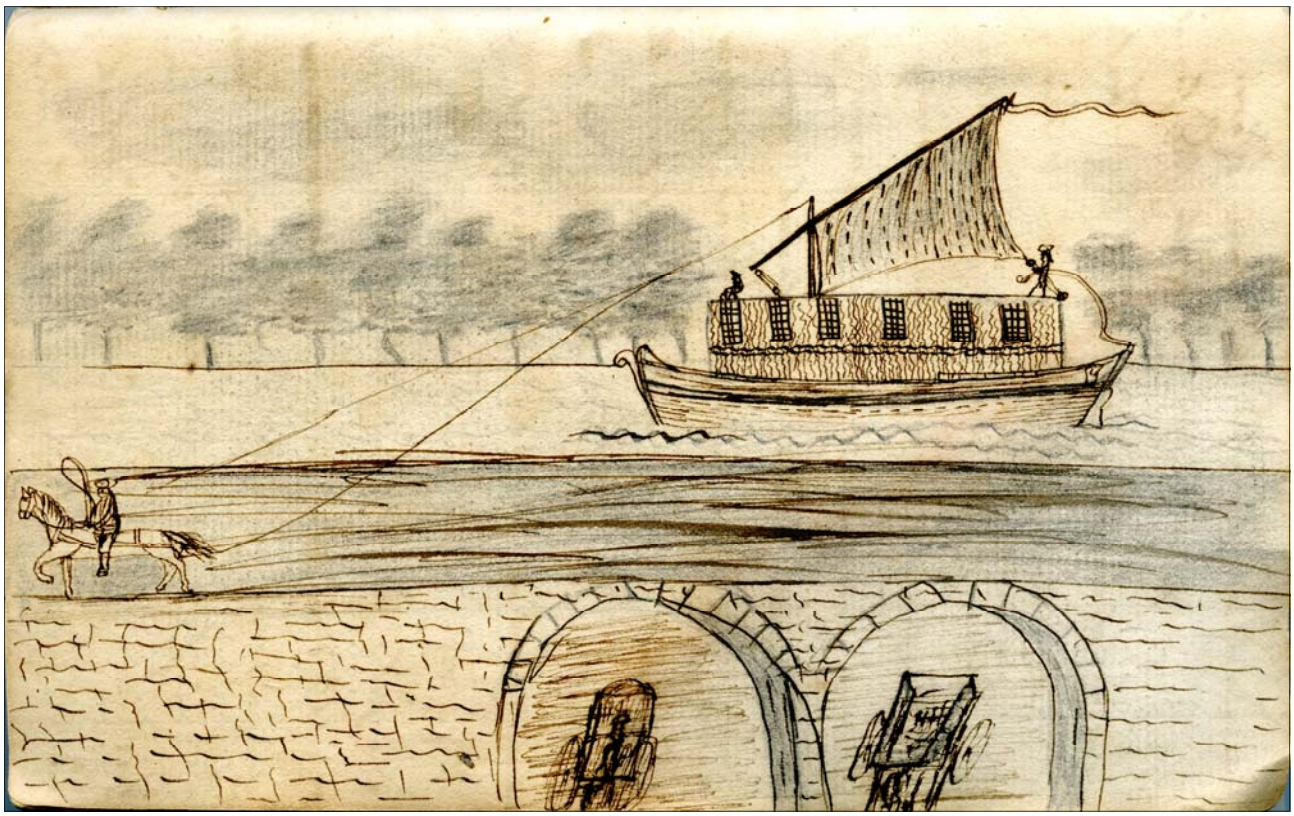


Fig 1.1: Fisher's sketch of the Barton Aqueduct (courtesy of Friends Historical Library, Swarthmore College).

thrilling terror. Jabez Maud Fisher, son of a Philadelphian merchant family, travelled on the canal for the first time in October 1775. Having noted the industries clustered around the basin at Worsley and what was to him the novel method used to construct the mill dam, he entered the mine:

'We got into a boat of great Length but narrow and went up a Passage above 1,000 yards cut out of solid Rock above 100 feet below the Surface of the Ground. In some places where the Rocks are loose they are supported by a Brick Arch just sufficient to let our heads go clear as we sat in the boat. After going up these 1,000 yards we got out of the boat and took a walk 160 yards to where the People were at work. This Passage is on a right Line and goes several Miles further than we chose to venture. We took Candles to light us up this dark and gloomy road as not a single ray comes from without.'[3]

Other visitors examined the canal and mines more closely (Fig 1.1). John Rennie was only one of a new generation of engineers to do so.[4] Later aqueducts – the Pontcysyllte in Wales and the Avon in Scotland – were to be longer and higher, but their construction depended upon what Brindley and Gilbert had dared to do at Barton. One visitor who described the canal basin at Worsley as '…like a little Amsterdam filled with barges, timber yards, and limestone which is brought from Wales…', went on to note that 'I saw a manufactory of machines, or buckets, which my modesty would not let me examine minutely, for the men stared as if they took me for a French spy…'.[5]

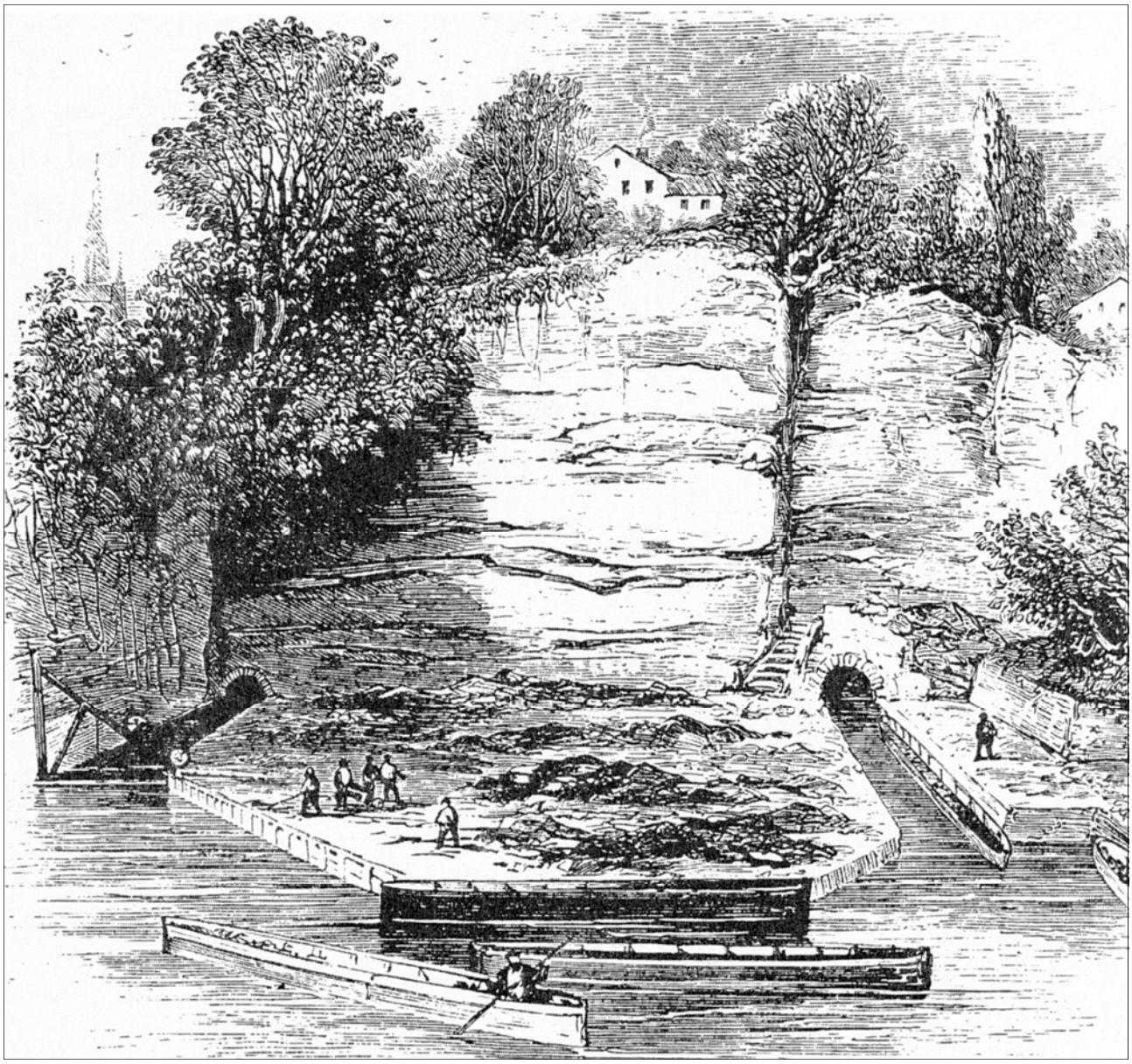
Industrial espionage became a concern as new technologies were innovated in eighteenth-century Britain. The number of foreign visitors wishing to see the canal surprised Arthur Young.[6] Foreigners found themselves under particular suspicion, and, perhaps, not without reason. The investigations of the French mining engineer Gabriel Jars into European mining were supported by his government, keen to discover and innovate new technologies. Worsley was one of the collieries Jars visited in England, where he noted details of the galleries and coal seams that were not to be found in the descriptions left by ordinary visitors who tended to recall the thrill and fear of travelling underground with only the light of a taper to identify the shapes and sounds of their route.[7] Johann Ludwig Hogrewe, a German engineer and cartographer, was another conscientious observer who left a detailed record of the canal, including one of the earliest plans of the Castlefield and Runcorn basins.[8] This interest of foreigners in the Worsley mines (Fig 2.2) continued into the nineteenth century, and it was two French engineers, Henri Fournel and Isodore Dyévre, who were to provide in their *Mémoire sur les canaux souterrains et sur les houillères de Worsley prés Manchester* (Paris, 1842), one of the most complete published descriptions of the collieries and underground canals.[9]

When the canal finally reached Manchester in 1765 it also attracted visitors. The bustling scene on the Duke's Quay at Castlefield caused one unidentified visitor from Worcestershire to return a second time

to confirm his initial impressions: '…for it is astonishing for a person who never sees anything of the kind to see the Business that's going on here. There's such Quantities of Slate, Timber, Stone & merchandise of all sorts. The warehouses are very Extensive, but they are pretty filled with one thing or other. There's not less than 30 or 40 thousand Bushels of Corn in them at this time & large quantities of flour &c.'[10]

Single-handedly, the Duke had put Manchester on the map. Long before the town's steam-powered cotton mills and engineering works were built, the canal was attracting the industrial tourist. In 1784 the town's first guidebook, *A Description of Manchester,* was published. Its author, James Ogden, catching the spirit of change in the place, chose to ignore the conventions of existing town guides and began with a paean to the Duke and his canal, encouraging strangers to begin their visit by going to see the canal basin at Castlefield. That the canal was seen as a spur for the region's quickening growth in John Aikin's *Description of the Country from Thirty to Forty Miles Round Manchester* (1795) is hardly surprising, given that Ogden was responsible for most of the much-quoted Manchester section of the book. The illustration on the title page – a single arch aqueduct spanning a river estuary – was a pictorial proclamation of the achievement that was the Barton Aqueduct and the possibilities it had unleashed. Not that Aikin needed to be convinced. Although no longer a Manchester resident, in the early 1770s he had written a moral fable prompted by the canal, in which he imagined the 'Genius of the Canal' bursting out of the celebrated aqueduct, carrying surveying instruments and a pick-axe: 'Behold my channel thronged with capacious vessels for the conveyance of merchandise, and

Fig 1.2: Early nineteenth-century sketch of Worsley Delph showing the two mine entrances (courtesy of Salford City Archive, The Mullineux Collection, T1682).



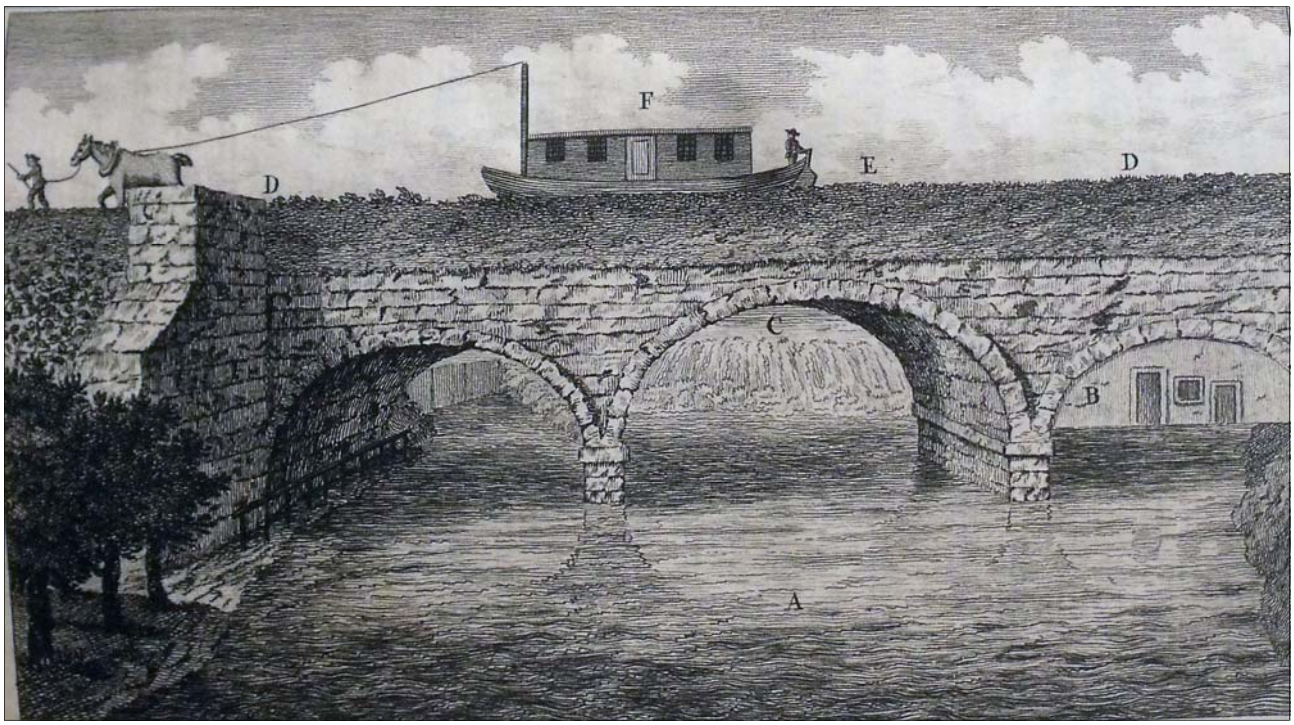


Fig 1.3: Arthur Young's drawing of the Barton Aqueduct around 1769 showing a passenger boat (Young 1770). Key: A - River Irwell; B - cabin; C - weir; D - towpath; E - canal; F - barge (Courtesy of the Portico Library).

splendid barges for the use and pleasure of travellers; my banks crowned with airy bridges and huge warehouses, and echoing with the busy founts of industry. Pay then the homage due from sloth and obscurity to grandeur and utility…'[11]

The Press also played its part in boosting the canal, the London papers re-circulating news from their provincial cousins. New developments on the canal – the introduction of a passenger boat service (Fig 1.3), the plan to use cast-iron barges, the experiments with steam power – were all reported, whilst any crumb of information about the canal's freight and revenues was served up to an eager readership.

The Bridgewater, Coal and Manchester

A desire to exploit the coal deposits on his Worsley estate was the reason why Francis Egerton, third Duke of Bridgewater constructed what was to be the first arterial and the only eponymous canal of the Industrial Revolution. Coal had been mined at Worsley for centuries, though whether Bridgewater had an accurate idea of the extent of the mineral wealth on his estate is doubtful (Fig 1.4). More important to the Duke was the existence of an urban market hungry for coal.

That the Bridgewater Canal halved the price of coal in Manchester is one of the most repeated statements in the historiography of the industrial revolution. Yet, our knowledge of the Manchester coal market in the eighteenth century is slight, not least the impact that Worsley coal had on the price of coal supplied from other local pits. There is much anecdotal evidence such as Eric Svedenstierna who noted when visiting the town in 1802 that 'With such a large demand for coal, it is no small advantage that at even the present high prices, Manchester can have coal at about 50 per cent cheaper than the coal cost a little over 40 years ago, before the Duke of Bridgewater's Canal was finished, from whose coal mines practically the whole of Manchester is supplied'.[12] But long-run data on the price of the different types of coal sold in eighteenth-century Manchester is scarce. One suspects that there is still information on prices to be dug out of institutional archives, local newspapers and the Bridgewater accounts. There is work here for the economic historian, along similar lines to that undertaken by Roger Scola in his exemplary study of food supply in Manchester.[13]

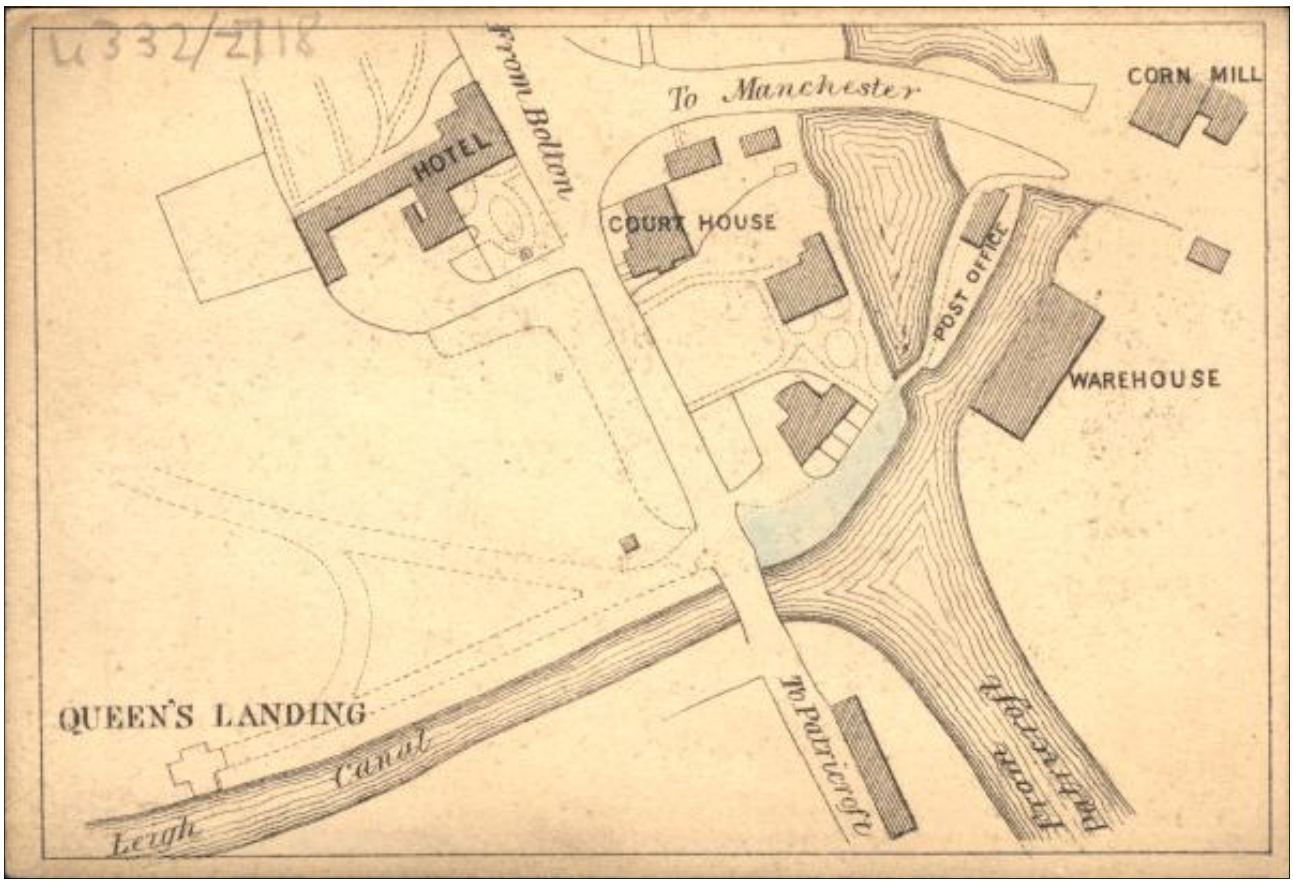
We do not know the extent to which Worsley coal was sold in Manchester before the building of the canal. Indeed, given its importance in the subsequent development of the town, our knowledge of the size of the Manchester market and the number and location of collieries that supplied it is embarrassingly imperfect. Manchester newspaper advertisements in the 1760s mention collieries at Norbury near Poynton and around Ashton-under-Lyne for instance. A colliery pumping engine for one such site, at Park Bridge north of Ashton-under-Lyne, was excavated in 1999. Fairbottom Bobs, as it was known, was working by 1776 on land owned by the Stamford estate and may have been in operation as early as 1765 when there is a manorial record of a colliery

working in the Bardsley area (which included Park Bridge) that 'supplied the greater part of Manchester'.[14] A companion study to Langton's rigorous examination of the development of the south-west Lancashire coalfield is a significant gap in the literature.[15]

In the 1750s households were the main consumers of coal, using it for heating and cooking. Industrial demand came from industries such as the metal trades, brick-making, glass-making and brewing, but these were small in number and size, and one *guesses* that they burned a small fraction of the total coal consumed in Manchester. One contemporary source numbered the township's population in 1758 at 17,101 (making Manchester the largest urban centre in the region), which, accepting Flinn's estimate of annual per capita coal consumption in towns of 2.25 to 2.5 tons,[16] suggests an annual demand in Manchester of between 38,477 and 42,753 tons at the time the canal was being planned. A more reliable local census in 1773-4 recorded the township's population at 24,386, a projected demand of between 54,869 tons and 60,965 tons.[17] Statistics of coal carried on the canal are incomplete but show an increase from around 30,000 tons in 1766-85 to over 90,000 tons in 1796-1805,[18] though interpreting the figures of coal supplied to Manchester are difficult as they do not distinguish the coal carried on the Runcorn branch supplying communities in north Cheshire. Further research will refine these estimates and extend the data on the coal tonnage delivered to Manchester but what is clear is that the Bridgewater Canal was built with domestic not industrial consumers in mind. It is worth emphasising that the town's first Boulton and Watt steam engines were not installed until 1789, to power Piccadilly Mill[19] whilst its public gas works opened in 1818, some thirteen years after the installation of gas lighting in Phillips and Lee's Salford cotton mill.

The rising demand for coal in Manchester from the mid-eighteenth century prompted its businessmen to mine what were often difficult seams closer to the town, such as Bradford Colliery north-east of Ardwick which was opened as late as the 1830s. This appears to have been the case in the appropriately named Wet Earth Colliery at Clifton, the mining project which brought Brindley to the attention of local businessmen in the early 1750s.[20] Another response was the improvement of transport links between the town and local collieries. Investment in improving the roads linking Manchester to communities and coalfields to the north and east was taking place.[21] More ambitious projects, notably the 1737 Act to improve Worsley Brook and the 1753-4 scheme to build a canal linking Salford to Leigh and Wigan, were not realised. An important unanswered question

Fig 1.4: Reverse of a ticket to Queen Victoria's official visit to the Bridgewater Canal in 1851. This shows a plan of the area around the entrance to the mines at the Worsley terminus (courtesy of Salford City Archive, T1702).



concerns the condition of the roads between Worsley and the Irwell and their potential for improvement. The costs and difficulties of road carriage were said to be prohibitive, sufficient to prompt the search for improvements. However, the researches into road transport in the eighteenth century pioneered by Eric Pawson and W. A. Albert, and in the North West more recently by Geoff Timmins, warn against us assuming that all road travel was inefficient and poorly organised.[22] Coal, of course, was expensive to haul over long distances but Manchester was relatively close to Worsley. An advertisement in a Manchester newspaper of 1751 looking to lease collieries in Worsley noted 'This mine within six miles of Manchester, and lies extremely well for sale, and near a Great Road'.[23] The construction of a waggonway to the river, similar to those operating in the collieries of the north-east, would have been another tried and tested way of reducing transport costs.

The Worsley Collieries

Yet, as every student of the Industrial Revolution knows, the Duke of Bridgewater took the momentous decision to build a canal connecting Worsley to Salford. The early eighteenth-century improvements made to rivers in the North West, notably the Sankey Cut, played a part in choosing water transport over improving road transport to move heavy but low cost minerals. Tomlinson in one of the few original contributions about the canal has contextualised the Bridgewater's origins and clarified its chronology, spiking popular tales involving the Duke and the Gunning sisters.[24] That the canal was a high-risk undertaking is evident from the engineering solutions required to ensure its construction and its efficient operation.

Crucially the canal became an integral part of the mining operations. The first and, perhaps, most astounding achievement of the Duke of Bridgewater was to build an underground canal at Worsley (Chapter 5; Fig 1.5). The widening of the existing sough at Worsley to allow barges to enter the mine was a truly innovative strategy. There were few precedents. Any close study of the canal should begin by recognising that much of the Worsley terminus is not visible above ground; the surviving dry docks, storehouse, granary and lime kiln (Chapter 6) were part of a much bigger complex. Over the years

Fig 1.5: View of the main level of the Worsley coal mines, during a mid-twentieth century inspection. The boat being used is an inspection boat (courtesy of Chetham's Library).

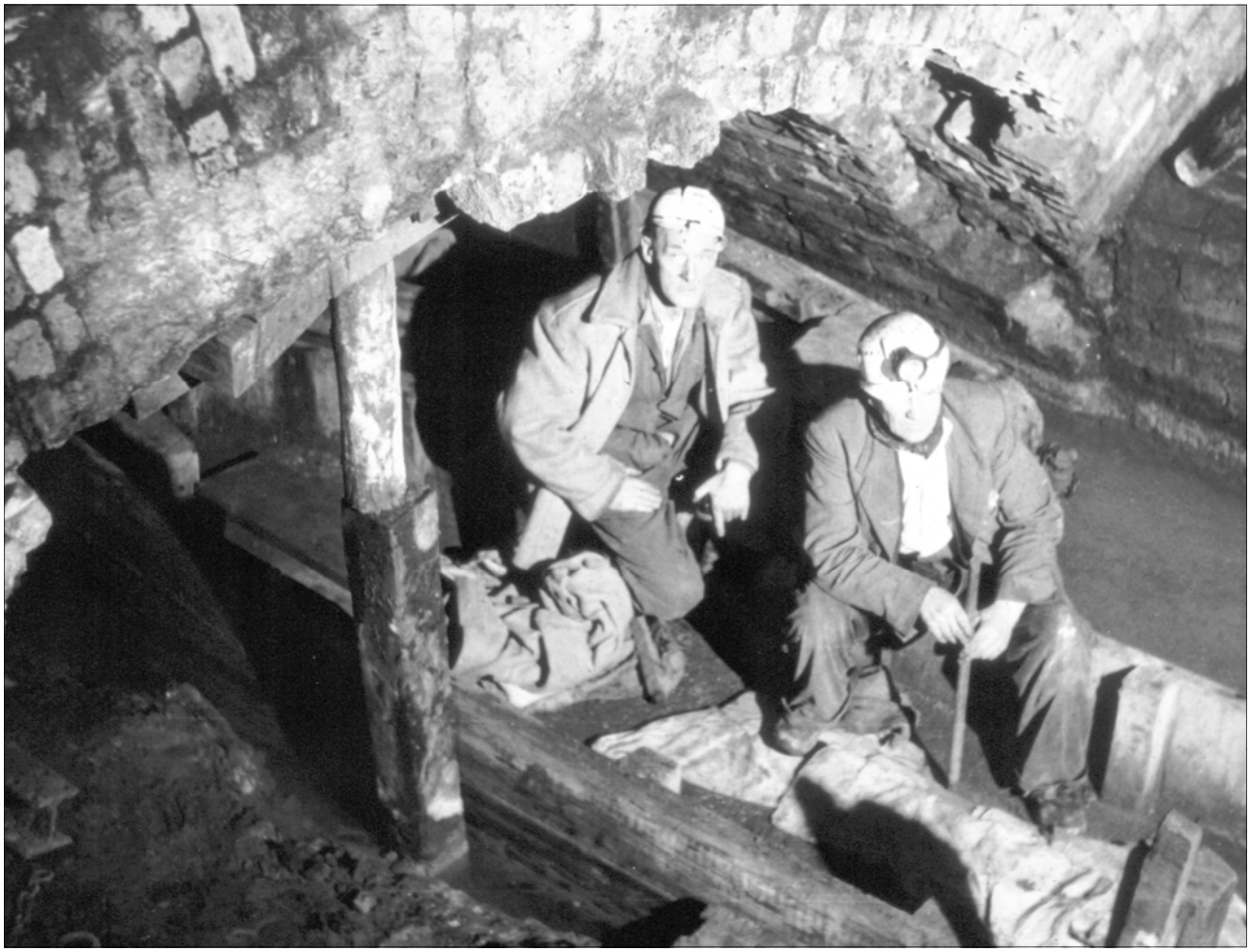


Fig 1.6: Bridgewater coal boats at the Castlefield canal basin in the late nineteenth century. The Duke's Warehouse can be seen in the misty distance (courtesy of Chetham's Library).

the colliery canal tunnels were to become labyrinthine as seams were exploited at different levels and ever greater distances from Worsley Delph. The total length of the underground canal system was in excess of 52 miles. The construction of an underground inclined plane in 1795-7 provided an ingenious solution to the problem of managing transhipment costs inside the mine, as did the earlier idea of loading the coal directly into boxes in the barges. Although we lack a careful study of the three main types of barges used in the different levels of the mine, a subject which a detailed archaeological survey of the underground mines could be reasonably expected to add to (Chapter 4), local historians have admired this early example of containerisation on the waterways. Closed for many years, this subterranean canal system remains one of a small number of major sites of the world's first Industrial Revolution that awaits examination by industrial archaeologists – a detailed study of the famous inclined plane the royal prize.[25]

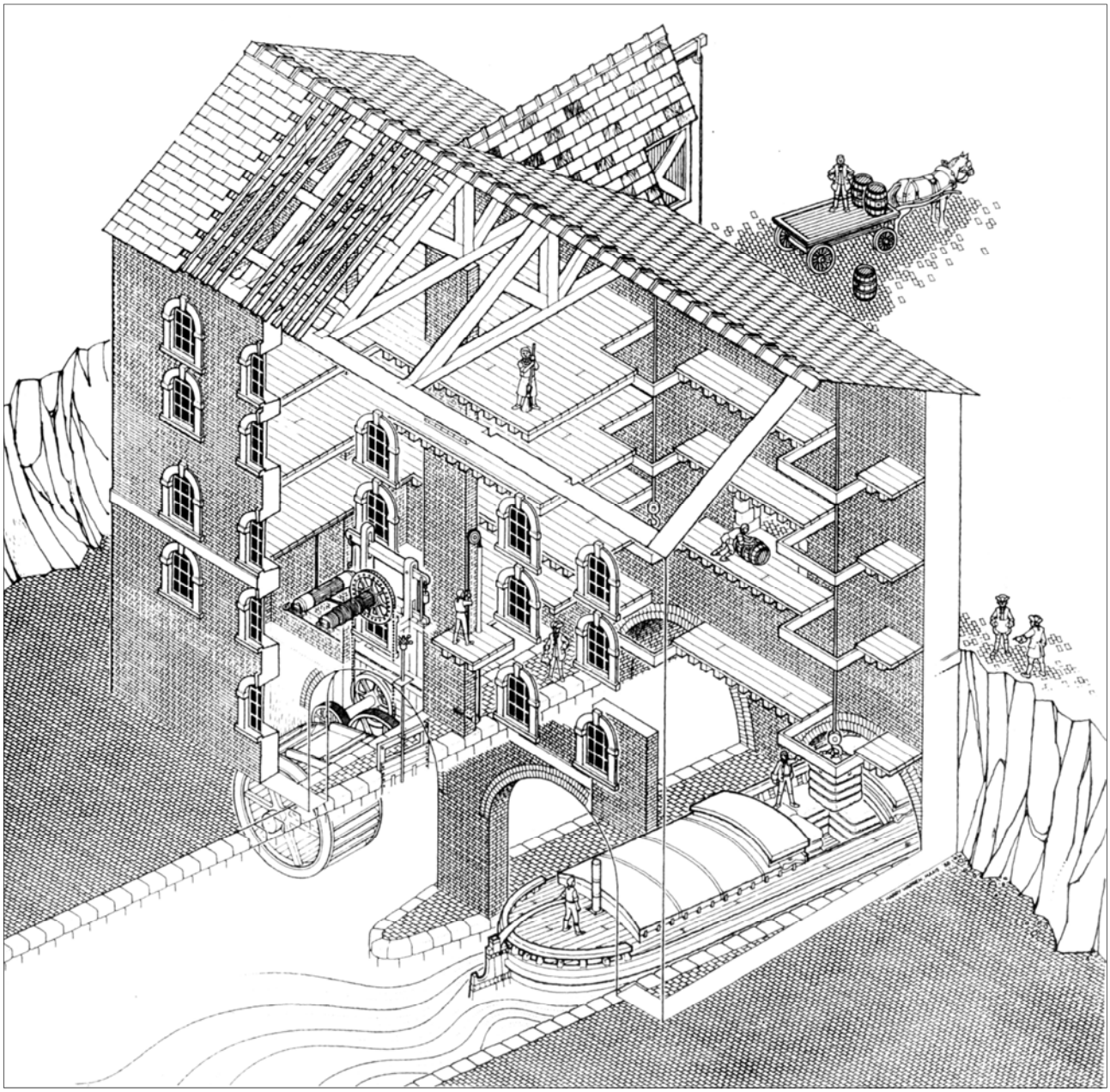
This research will also provide a clearer understanding of the issues surrounding ventilation and the control of water in the mine. Although it is widely believed that the water to fill the canal came directly from the mine, turning what was a familiar hindrance and heavy cost in mining operations into an asset, it should not be assumed that it was the principal supply of water for the canal. The idea that the ground water from the mine fed the canal was one of a number of mistakes and misinterpretations about the canal that Francis Henry Egerton (8th Earl of Bridgewater)[26] felt it necessary to correct in his 'defence of the public character' of his remote cousin, the third Duke, in two letters published in Paris in 1818 and 1820 respectively. Writing in a singularly unconventional style – memorably described by Tomlinson as anticipating James Joyce by over a hundred years[27] – Egerton argued that recent French and English publications had ascribed to the Duke 'facts, which he never did, motives, which he never had, opinions which he never entertained'.[28] Egerton, who had visited the mine on at least three occasions and was the author of an article about the inclined plane published by the Society of Arts in 1800,[29] pointed out that the water supply was one of the most remarkable features of the Worsley coalmines. He asserted that the ground water in the mine was generally insufficient in volume and too irregular to supply the canal, and that contrary to what was to become the popular view, the Worsley mine was unusual in that instead of having water drained out of it, water was brought in to ensure that there was sufficient to fill all of its canals. 'What engineers has, ever, heard of flooding them, purposely?' he asked

rhetorically.[30] Reservoirs were built on Walkden Moor to supply the upper level when water levels fell. No doubt, the drainage of the collieries changed over time but the water supply will be high on the list of questions that industrial archaeologists need to explore when they eventually gain access. This examination of the underground water will direct attention towards those more important feeder streams above ground.

The Choice of Route

Questions also remain over route selection, notably the factors behind the decision to abandon the original line of the canal detailed in the 1759 act. The adoption of the more circuitous route remains puzzling if only because we have no evidence of whether estimates were made of the costs of establishing a canal basin on the Salford side of the Irwell (which presumably might have included a new bridge linking it to Manchester) compared to the construction costs of the eventual route. The answer to the question of what were the advantages of extending the length of the canal, including the many unknown factors associated with the building of an aqueduct across a major river, is usually framed in terms that sees Liverpool not Manchester as the Duke's strategic goal. That the Duke wanted to capture trade from the Mersey and Irwell Navigation Company is understandable, but what is unclear is when this became a priority. However, it should not be forgotten that the

Fig 1.7: A reconstruction of the internal arrangements at the Grocers' Warehouse in the late eighteenth century (courtesy of Michael Nevell).



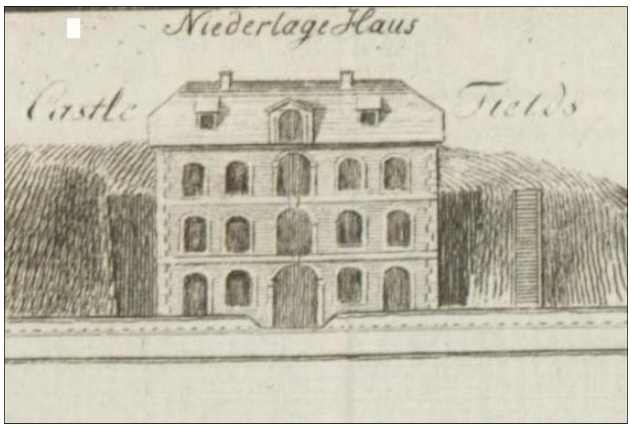


Fig 1.8: Hogrewe's image of the Grocers' Warehouse in 1777 (courtesy of Chetham's Library).

price of coal was fixed under the 1759 and 1760 acts, restricting the Duke's revenues on the Worsley branch. It may also have been the case that competition from other collieries – Aikin identified those at Oldham, Ashton, Dukinfield, Hyde, Newton and Denton as supplying Manchester[31] – meant that Worsley did not have as large a share of the market as had been anticipated.

The adoption of the longer route to Manchester brought with it another set of problems, notably the need to build an aqueduct. Surprisingly for all the recognition the Barton Aqueduct has received as a symbol of the new industrial society (Chapter 8), there has not been a detailed modern study of the construction and engineering of the main and minor aqueducts at Barton. Indeed only the Bollin Aqueduct has been examined in detail by industrial archaeologists (Chapter 10). It is also not widely known, as Atkinson points out (Chapter 8), that the aqueduct was partially re-built in 1823-4. It is also noteworthy that although the construction of the Manchester Ship Canal necessitated the demolition of the main aqueduct in 1893, part of the smaller aqueduct over Barton Lane was saved, an early example of industrial preservation (Chapter 8). Others were also aware that a significant structure was being demolished. Bosdin Leech, who as a city councillor was closely involved in the building of the ship canal, saved some of the stones from Brindley's aqueduct – 'the mason's marks on them just as fresh as when they were inscribed'.[32]

Information is predictably scarce about the men who built the canal and their influence on the new occupation of navigator. Sullivan has identified John Walker as the first known canal navvy, one of the first generation of navvies who learned their trade digging the Bridgewater Canal.[33] This is not to suggest that it was only engineering and labour problems with which the triumvirate had to contend. In early December 1760 the *London Gazette* announced that the King's pardon and a large reward were available to any person who could identify those who had deliberately damaged the canal: '… some wicked and evil disposed persons, at present unknown, broke down the banks of His Grace the Duke of Bridgewater's Navigation at Barton … which were made upon an Arch over a publick highway there; by which means the water was discharged from the said Navigation, and considerable damage done thereto.'[34] No arrests appear to have been made over this incident, presumably at Barton Lane, so the identity and the nature of the grievances that prompted these canal breakers remains unknown. Whatever the circumstances are discovered to be, the attack stands in sharp contrast to those rosy descriptions of the paternalistic moral economy at Castlefield, where ordinary workers came to have their baskets and aprons filled with cheap coal.[35] Though, it should not be forgotten that as with the Duke's donating of monies to the Manchester Infirmary and the local overseers of the poor - monies that came from fines imposed because of damage done to the canal - this generosity was a condition of the Bridgewater canal acts.[36]

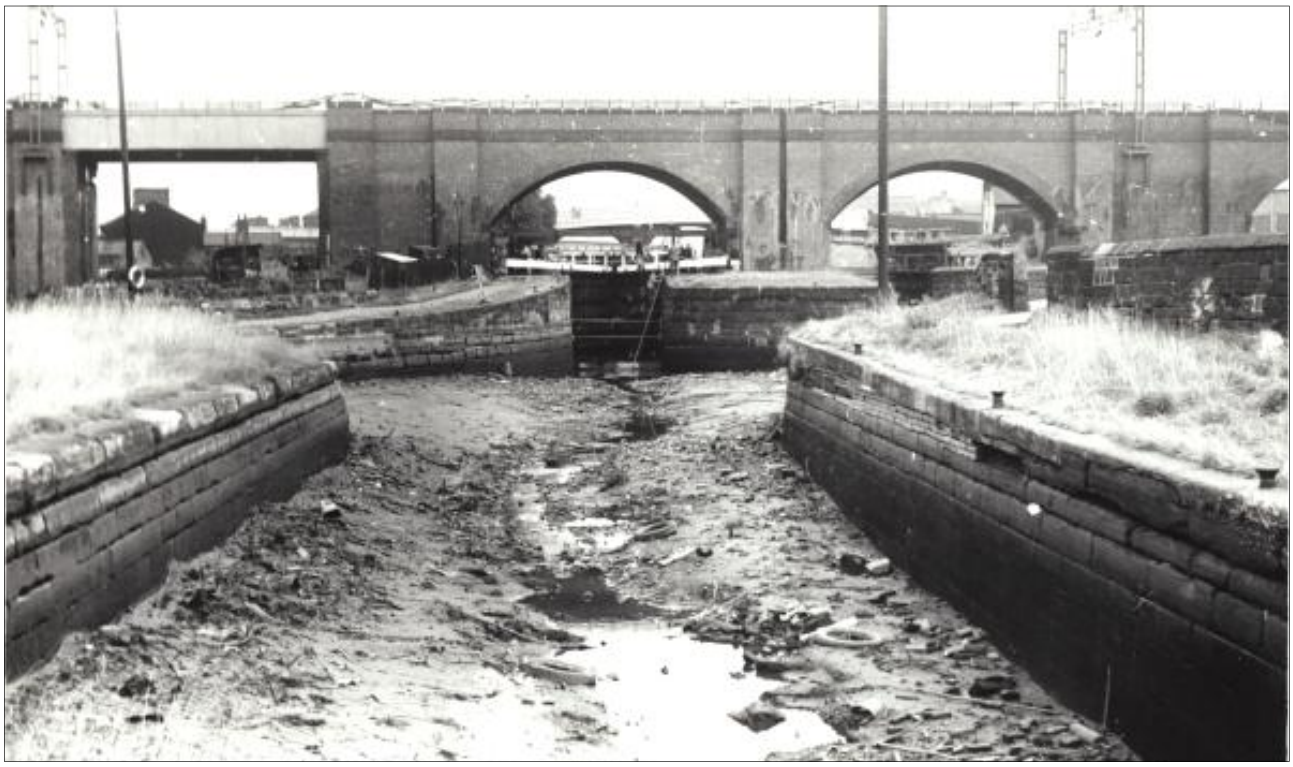
Castlefield (Fig 1.6) was not the preferred terminus for the canal but the clauses in the 1760 act restricting development in Quay Street and on the land belonging to Edward Byrom, both reflecting opposition from the Navigation, added to the problems the Duke faced in establishing a canal basin as close as possible to the built-up area of Manchester. Castlefield was a second-best and challenging site on which to build the terminus. A topography which had provided the Romans with a natural defensive position, on a sandstone escarpment up to 5m high overlooking the flood plain of the River Medlock, seemed hardly suitable for use as a canal basin. There were many problems. First, there was the need to control the Medlock to prevent the basin flooding, though it is not entirely clear just how essential the Medlock was as a source of water for the canal. Second, the height of the escarpment coupled with the absence of relatively flat land at the level of the basin for warehouses which connected directly to the town's road system meant that resources had to be devoted to the raising and lowering of goods and raw materials (Chapter 9). Wharf space required cutting away large quantities of the bedrock sandstone. The Duke's Warehouse was built on the most convenient site in the basin, providing relatively easy access directly on to Deansgate (Chapter 7), but other warehouses were located on less advantageous sites which involved transhipment problems. The Grocers' Warehouse illustrates these problems (Chapter 9; Fig 1.8). It was probably Brindley who devised an elegant solution to the challenges of the terrain, but for all of its technical ingenuity the lifting of coal boxes from barges via a waterwheel could be viewed as a costly, indeed unnecessary, investment,[37] given the alternative of unloading the coal and loading the wagons directly on the wharf. Not for the first time our un-

derstanding, one is tempted to add admiration, of the engineering principles on display and the elegance of the tunnel and hoist wells is far in advance of our knowledge of the financial costs of transhipment. It would be interesting and pertinent to know how long coal was raised by this method. Yet, even though research on many key aspects of the industrialisation of Georgian Castlefield remains to be completed, it is difficult to resist the conclusion that the challenges posed by the site were as formidable as those of extracting the coal at Worsley. One is left wondering, for example, why the Duke was not more determined in negotiating a compromise agreement with the Byrom family – the act did allow him to build within 80 yards of Alport Lane – to develop a basin on a less demanding site closer to the centre of the town. By the 1760s the Byroms were pursuing their own plans, developing their estate into a residential suburb; St John's church was consecrated in 1769.[38] Another point of interest in future research will be the reasons behind the construction of the tunnel to Bank Top in 1787-9, which has strong parallels with Brindley's original coal tunnel design at Castlefield.[39] In spite of all these difficulties, businesses using the raw materials carried on the canal soon turned Castlefield into an industrial complex.

The Runcorn terminus has usually been overlooked in both archaeological and historical studies of the canal. There is more material available on the development of the adjacent Weston Point docks and the Old Quay of the Mersey and Irwell Navigation than on the Bridgewater's access to the sea. Occasional studies have looked at the history of the Hempstones complex and the nearby Sprinch Boat Yard above the top lock at Runcorn but as yet we lack a detailed archaeological and historical study of the western end of the Bridgewater Canal. Yet, this was just as big a feat of engineering as the Castlefield and Worsley termini. As with the Barton Aqueduct the initial works were completed very quickly, the original flight of eight locks and their associated basins, recorded by Hogrewe and published in 1780, being built in just two years, 1771-3; this was at the time the longest run of locks in Britain. The success of this sea link in terms of trade is shown by the building of a second flight of locks and the extension of the docks in the 1820s, the linkage through the Weston Canal to the Trent and Mersey Canal, and the further expansion of the docks into the 1870s. A century of near-continuous expansion produced one of the most complex canal termini in Britain yet little is known historically about the operation of this canal port, and even less about its industrial archaeology.

One reason for the lack of attention to this terminus might be the poor physical survival of the link to the River Mersey; down-graded in importance by the building and opening of the Ship Canal in 1894, it suffered a lingering death with the old line of docks being abandoned in the 1940s and the new line being abandoned and filled in during the 1960s. The warehouses (Fig 1.10) have been demolished and most of

Fig 1.9: The abandoned top locks at the Runcorn terminus, mid-twentieth century (courtesy of Salford City Archive, The Mullineux Collection, T2740).



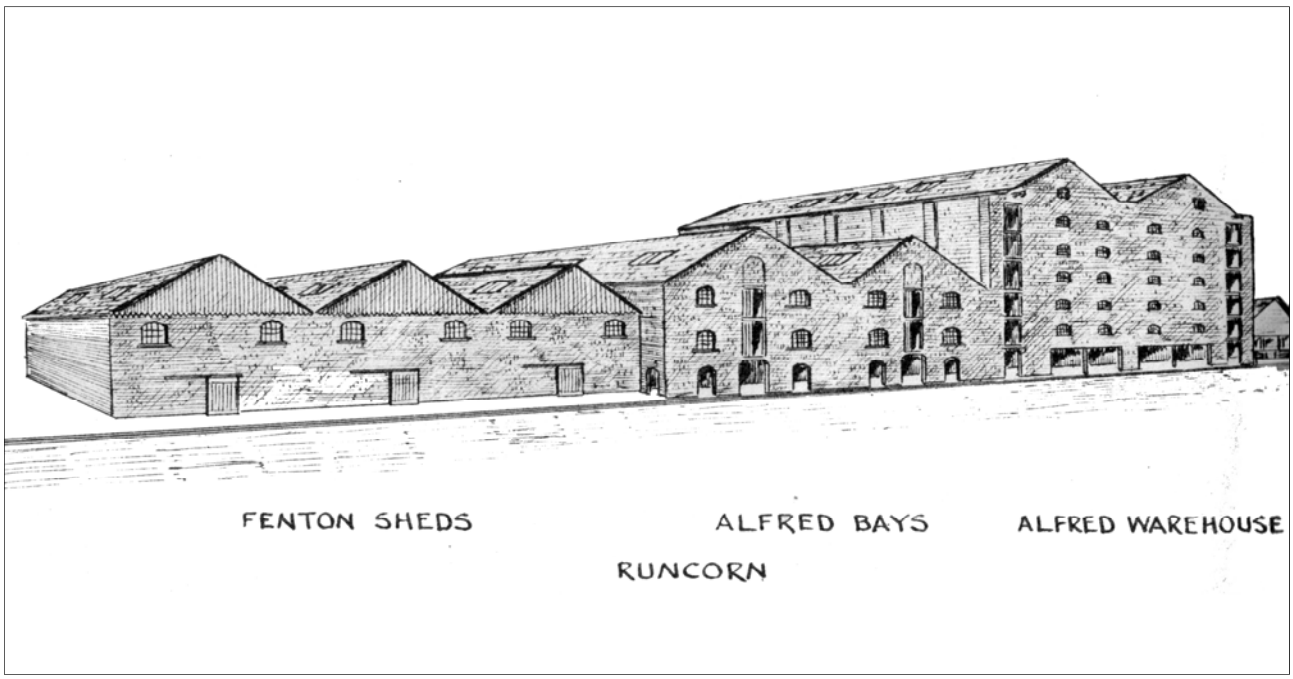


Fig 1.10: Warehouses at the Runcorn terminus in 1943. This range lay on the northern side of the old basin and were demolished in the 1960s (courtesy of John Aldred).

the docks have been filled so that only Bridgewater House, briefly home to the Duke in the 1770s when visiting this end of the canal and later offices for the canal, now survives surrounded by early twenty-first century redevelopment.

In hindsight the extension towards the estuary at Runcorn proved to be commercially a winning strategy, the revenues on this section soon overtaking those on the Worsley arm. It also had a wider, longer -term, landscape impact which has yet to be fully explored by archaeologists; the link to the Trent and Mersey was to be crucial in the development of a canal network in central and northern England, whilst the aqueducts, embankments, tunnel and warehouses along the Cheshire branch were all quickly copied along the growing network. The Bridgewater Canal was also to have an impact on Liverpool where the fear of Worsley coal being landed on Mersey Flats sailing from the canal port at Runcorn helped to keep prices low. The construction of the Duke's dock and its massive warehouse were the obvious signs of the stimulus provided by the canal towards the greater economic integration of the port and Manchester.[40]

Brindley and Gilbert

Thanks to the researches of Hugh Malet and Frank Mullineux we have a clearer idea of the roles of James Brindley and John Gilbert in the project. Gilbert's contribution had begun to be recognised in the nineteenth century[41] but his role as 'resident engineer' is now more widely acknowledged. Even so, Brindley's achievements remain considerable if no longer on the scale popularised at the time. When Jacob Fisher visited the canal in 1776, three years after Brindley's death, Brindley was already identified as 'the principal Contriver' of the project, depicted as 'a poor illiterate Man, who merely from a Sort of innate knowledge of Mechanics and Hydraulics could at once contrive and execute, yet was so much in want of words as to be able to communicate his Ideas…'[42] Samuel Smiles' influential biography of Brindley in his *Lives of the Engineers*, drew heavily on these earlier traditions, presenting him as an exemplar of those disadvantaged working men who owed their success to their own industry and application.[43] Even so, one can argue that a more critical assessment of those much-admired engineering solutions on the canal is required in the early twenty-first century.

Archaeological survey could amplify the historical record for the rebuilding of the embankment at Barton in the 1820s, just as archaeological excavation has highlighted the problems associated with managing the excess water from the Medlock. The latter required the rebuilding of the clover-leaf weir, which archaeological excavation has shown was rapidly silted, and the construction of a long overflow tunnel around the Castlefield basin in the early 1790s; though even this did not solve all of the problems associated with what was becoming more a sewer than a river. The original design of the Bridgewater Canal was therefore not perfect and in order for this linear machine to continue to function, new engineering solutions had to be found by subsequent generations. There are important issues to be interrogated here. A more critical and contextualised assessment of Brindley's and Gilbert's working methods on the Bridgewater Canal is required. There is, after

all, nothing new in one generation discovering that the heroes of a previous one had feet of clay.

The Cost

The Duke of Bridgewater was not the first landed gentleman to take on the financing of a large transport undertaking. A number of river improvement schemes in the previous century – Sir Richard Weston on the Wey Navigation in Surrey – were financed principally by individual landowners. Neither was Bridgewater the first eighteenth-century aristocrat to 'retire' to his estates. Charles Townsend is remembered for leaving the intrigues of high politics to spend his time growing turnips on his Norfolk estate. But how much money did the Duke spend on the canal? Estimates vary. Hadfield and Biddle have suggested £77,500, Ward prefers £301,300.[44] The fragmentary nature of Bridgewater's accounts means that we cannot expect a study comparable to Mather's examination of the finances of the Bridgewater Trust, but perhaps a clearer picture is possible. Edith Malley's pioneering work is the starting point, all the more important because some of the documents she consulted are no longer extant.[45] Important data can be squeezed, as Chaloner's examination of Thomas Kent's 'General Account' of 1791 indicates, from other documents that have survived.[46] An essential part of any new study of the canal must include a more careful analysis of the revenues and expenditures from all of the Duke's estates, if we are to provide a clearer idea of the depth of his different pockets. Worsley, we should remind ourselves, was only one of Bridgewater's twelve estates. No doubt such an investigation will also reveal more about the Duke's all-important lines of credit.

When and on what the apparently frugal Duke spent his money is also only a partially answered question. He did spend money on his London mansion, and plans for building a new house at Ashridge were underway before his death in 1803,[47] whilst his wine cellar was said to be large enough to provide him with a bottle a day for a hundred years.[48] His £100,000 contribution to the Loyalty Loan in 1796 confirmed his position among the super rich. He also found the majority of the £43,000 to acquire the Italian paintings that had belonged to the guillotined Duke of Orleans, one of the most renowned art purchases in the eighteenth century. That some of these expenditures came after the canal was profitable does not necessarily help us understand the financial pressures exerted by the canal project in the 1760s and 1770s.

What is indisputable is that as an entrepreneur Bridgewater was willing to take high risks. Eighteenth-century aristocrats gambled away fortunes playing cards, and the Duke himself was a well-known patron of horse racing. More detailed financial information might alter the conclusion but it is difficult not to regard his canal project as anything but a long shot. The Duke's approach to risk was exemplified in his attitude towards insurance, an attitude that was painfully revealed when his Castlefield warehouse was gutted by fire, leaving him with losses estimated at £40,000.[49] The engineering problems at Worsley and Castlefield, let alone those associated with carrying the canal over the Irwell, the river Mersey and the terminus at Runcorn were formidable. Yet he continued with the scheme, when presumably he might have found a reasonable and certainly less risky return on his capital in agricultural improvements or turnpikes. Fortunately for him and the region's economy his gamble paid off.

Above all we need to recognise that we still have a largely one-dimensional view of the 'Canal Duke'. In addition to the need to clarify questions concerning his wealth, a fuller and more nuanced picture of the Duke's personality and intellect must be the goal of his next biographer. Bridgewater did not spend all his adult life brooding in remote Worsley. Many aspects of his life warrant further investigation, not least for what they might tell us about the management of his estates. His politics, for example, are often glossed over. Yet, in the political crisis of 1783 it was reported that Bridgewater went to the King and offered to lead the government, hardly the action of a detached and withdrawn aristocrat with little involvement in politics.[50] That his canal was important to him is evident from his extraordinary will, but, even so, Francis Egerton was more than the 'Father of Inland Navigation'.

Historians may still wish to argue over whether the Bridgewater Canal was the country's first true canal but what cannot be disputed is that it was the Bridgewater which rooted the idea of canals in the public and commercial consciousness of the eighteenth century.[51] Significant as schemes such as the Sankey Brook navigation were, they were the overture before the main performance. Foreign royalty did not visit them.

It was the Duke's Canal which demonstrated that canals could open up new markets, make existing ones more efficient, and, most importantly, be profitable. Part of the smoke that became such a powerful symbol of industrial Manchester came from coal carried on the Bridgewater Canal (Fig 1.11). Worsley helped provide Manchester with a reliable and cheap supply of coal at the very time when industrial demand was increasing. Manchester did not experience a fuel crisis in the Industrial Revolution.[52] The growth of its industrial sector – cotton, iron-making, engineering, chemicals – would have been checked had coal not been so readily available.

It is to be hoped that the 250th anniversary of the canal and the current essays will renew interest in the

Fig 1.11 Aerial view of the Castelfield canal basin in 2009 looking west showing the later railway viaducts and urbanisation of the area (copyright GMAU).

Duke of Bridgewater and his canal, stimulating research that will enable archaeologists and historians to judge whether he still warrants a place in the pantheon of industrialists and entrepreneurs who made a decisive contribution to the world's first Industrial Revolution.

To do this, old evidence will need to be re-examined, not least in the light of the recent research conducted by industrial archaeologists. No doubt, new evidence, will also come into the public realm, as occurred following the publication of Malet's biography in 1961. By no means all of the extant manuscripts and other documents relating to the canal are in public archives.

The potential of such new material was highlighted at a recent exhibition marking the 250th anniversary of the canal which displayed a number of rarely seen items. Many were from the archives of the Bridgewater Canal Company, held by the Peel Group, but some are now in private hands. This included a previously unknown account book of Brindley's which contained, among other data, details of the names of, and wages paid to, masons and labourers employed in the months during and after the construction of the Barton Aqueduct (1760-62). A close analysis of this data should provide a clearer picture of that first cohort of canal navvies whose anonymity has frustrated generations of historians.[53]

The Bridgewater Canal remains one of the iconic structures of the industrial revolution and a re-assessment of its importance in the economic history of this country is long overdue. For contemporaries it came to symbolize the possibilities of engineering, making it seem that there was no challenge that the new generation of engineers could not meet. Even the English Channel might be bridged. George Bradshaw's canal maps of the late 1820s capture as neatly as any documents can, the extent of the transport revolution begun by the Duke.[54] Bridgewater appears to have taken some remarkable decisions and spent extraordinary sums of money in constructing his canal, decisions that most other businessmen would have never considered sensible. In doing so, he transformed more than Manchester. The scholarly first Earl of Ellesmere's assessment of his relative – 'the history of Francis Duke of Bridgewater is engraved in intaglio on the face of the country he helped to civilise and enrich'[55] – was shrewd and sincere, although, curiously, neither he nor the wider business and political communities in the city chose to raise a public monument to the first Manchester Man (Chapter 11).

Towards a Research Agenda for the Bridgewater Canal

In seeking to promote further study of the archaeological and historical development of the Bridgewater Canal we need to bear in mind the wider context of inland waterways studies. This is a field that has developed alongside industrial archaeology since the 1950s. The first Waterways History Conference, held in Manchester in October, 1997 – entitled 'Defining a New Research Agenda for Waterways History' – was organised by the North Western Group of the Railway and Canal Historical Society with the support of the National Waterways Museum in Gloucester and the Newcomen Society. It explored a variety of archaeological and historical research topics on a subject already forty years old. The aim was to stimulate new research and debate and to foster a 'positive move forward in the research and promotion of waterways history'. Amongst the themes to emerge was the need to broaden research from the factual and technical to include the cultural and economic impact of canals,[56] a desire to move from the conservation of existing structures to the investigation of lost ones, the linking of canal history to local history and archaeology,[57] and the investigation of the wider impact of canals as landscape and transport features.[58] As one speaker commented 'canals provide local communities with an insight into their histories and local people should be encouraged to take an active interest in canal history'.[59] Yet, at the end of the conference doubts were expressed about the vibrancy of canal history given the lack of published academic studies, post-graduate research and enquiries into local canal archives in record offices.

Fig 1.12: Excavations at Worsley Delph in 2004 by the University of Manchester represented a rare opportunity to study the Delph archaeologically. As a whole, the Bridgewater Canal remains under-researched by industrial archaeologists and economic historians (copyright GMAU).

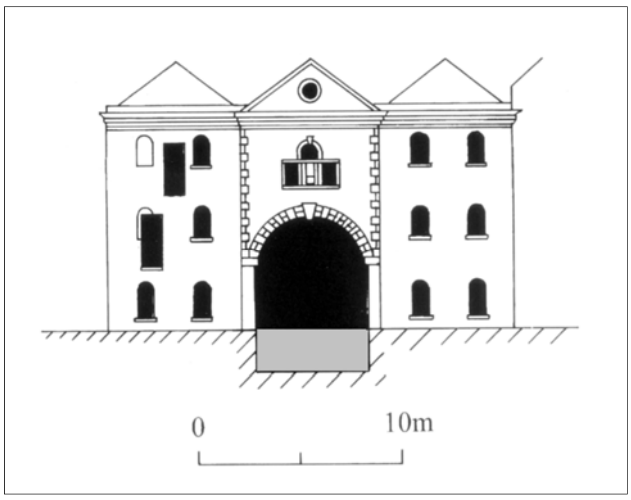


Fig 1.13: The northern elevation of the New Warehouse at the Broadheath Quay (1833), as recorded by the South Trafford Archaeology Group (copyright Michael Nevell).

Since this conference there has been a modest revival in serious academic studies of canal history and archaeology, as reported in the pages of the *Journal of the Railway and Canal Historical Society*, the *Journal of Transport History* and *Industrial Archaeology Review*.[60] Canal archaeology has been highlighted in several of the recent Archaeological Regional Research Frameworks promoted by English Heritage, and canal restoration work has continued. Redevelopment of canal-side locations has also continued, leading to many developer-funded archaeological investigations and surveys of canal fabric (see Bibliographical Note).

Whilst there is no single national canal research agenda a variety of approaches, some old and some new, have been used since 1997, all of which might be applicable to the Bridgewater Canal. Another conference, this time on the archaeology of the Bridgewater Canal held at Worsley Court House in October 2011, emphasised the continuing interest in the canal in its 250th year as a local history subject and as an archaeological monument.[61] Whether this event, along with two exhibitions on the Bridgewater at Salford Art Gallery and the Portico Library, will mark a revival in the research interest of the canal itself remains to be seen. As discussions at the 2011 conference and this introduction indicate, many questions still remain about the construction and

impact of the canal, as well as the role of the Duke. From that day and the essays in the current volume have emerged six areas for future investigation that would help to set the Bridgewater Canal in a wider national and international context.

- The canal as a machine: technological innovation and parallels
- Transporting goods, people and ideas
- Landscape Impact
- Business history of the canal
- Later historical and archaeological development and eventual decline
- Understanding the termini

The fact that these areas still remain to be investigated shows the lack of serious research activity on the Bridgewater Canal, maintained in recent years by the local historians John Aldred and Glen Atkinson and the occasional postgraduate thesis, since Hugh Malet published the second edition of his study of the Canal Duke in 1977. Industrial archaeologists and economic historians still have to provide answers to many questions about the canal (Figs 1.12 & 1.13). Sharing the documentary and physical evidence, their ultimate objective must be to provide a more precise assessment of the long history of the canal, and, more narrowly, its contribution to the quickening of growth in Manchester and the broader development and integration of the region's economy, in those decades when Manchester ceased to be just another Lancashire market town and became the world's first industrial city.[62]

Notes

1) Monaghan A, ed., 1999, *Journeys on the underground canal, 1765-1998,* Salford City Council Heritage Service.

2) See, for instance, Sharp, James, 1774, *Extracts from Mr Young's Six months tour through the North of England, and from the letter of an unknown author, published in the London Magazine for October, 1772, on the subject of canal navigations addressed to the Right Honourable the Lord Mayor, Alderman and Common Council of the City of London.*

3) Morgan K, ed., 1992, *An American Quaker in the British Isles. The travel journals of Jabez Maud Fisher, 1775-1779,* British Academy by Oxford University Press, p. 83.

4) Smiles, S, 1904, *Lives of the Engineers,* John Murray, London, vol. 1, p. 129. Rennie was born in the same year as the Barton Aqueduct opened.

5) London Courant, 25 July 1780.

6) Young A, 1770, *A six months' tour through the north of England…* W. Strachan, London, vol. 3, Letter XIX.

7) Jars, A G, 1774, *Voyages Métallurgiques,* vol. 1 p. 151. On Jars see Harris J R, 1998, *Industrial espionage and technology transfer. Britain and France in the eighteenth century,* Ashgate, Aldershot, 222-37. Identifying those visitors to Worsley who were travelling simply for pleasure must have been difficult, see Scarfe, N, *Innocent Espionage. The La Rochefoucauld Brothers' Tour of England in 1785,* Woodbridge: Boydell Press.

8) Hogrewe J L, 1780, *Beschreibung der in England seit 1759 angelegten, und jetzt gröstentheils vollendeten schiffbaren Kanäle...* Hannover, Tables VII and VIII.

9) The importance of this work was recognised by David Owen in his *Canals to Manchester,* Manchester University Press, 1977, pp. 42-6. A translation is long overdue.

10) Extract from the diary of a visitor to Manchester in 1792 quoted in *Manchester Guardian,* 17 July 1936, p. 13.

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23) *Manchester Magazine*, 12 March 1751, p. 4.

24) Tomlinson 1956.

25) William Chapman's *Observations on the various systems of canal navigation*…I. and J. Taylor, London, 1797 included a detailed description of the Worsley colliery. He dedicated his book to the Duke of Bridgewater 'to whose great example the canals of these kingdoms owe their origins, from which have resulted much of the commercial and political importance of the empire'.

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41) Bridgewater, Brindley and Gilbert were depicted discussing the problems of the canal 'round the humble hearth of the black and white timbered manor-house of Worsley, or the still humbler village inn'. See David Brewster, 1861, 'Engineers and Engineering', *North British Review,* vol. 34, pp. 142-83.
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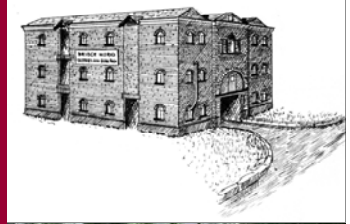
62) See Peter Maw, *Manchester and the Canal Age* (forthcoming, Manchester University Press, 2012).



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Bridgewater 250

The Archaeology of the World's First Industrial Canal

Edited by
Michael Nevell and Terry Wyke

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The Bridgewater Canal was first opened on 17th July 1761. 2011 marked the 250th anniversary of this momentous event. It was affectionately known as the 'Duke's Cut', and was viewed by contemporaries as one the most influential transport monuments of the Industrial Age. The papers in this monograph take a fresh look at the archaeological and historical importance of the 41 mile (66 km) long canal. They range from studies of the Worsley canal village, the underground canals accessing the coal mines, and the barges using the canal, to the Castlefield canal basin, Runcorn terminus and the warehouses along the route. The monograph also summarises archaeological and historical work on the canal over the last 20 years, as well as suggesting a research strategy for the future. From canal boats and aqueducts, to embankments, warehouses and water-management, the Bridgewater Canal was the fore-runner of many of the innovations in transport during the Industrial Revolution, making it a monument of world significance.

Front Cover (top to bottom): Boothstown barges; Broadheath New Warehouse in 1943; Worsley lime kiln excavation; The Barton Swing Aqueduct; Runcorn terminus in 1785; Bridgewater House, Runcorn.
Back Cover: Portrait of the Duke of Bridgewater in later life. An engraving by C Picart from a painting by J M Craig (courtesy of Salford City Archive, The Mullineux Collection, T1647).

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