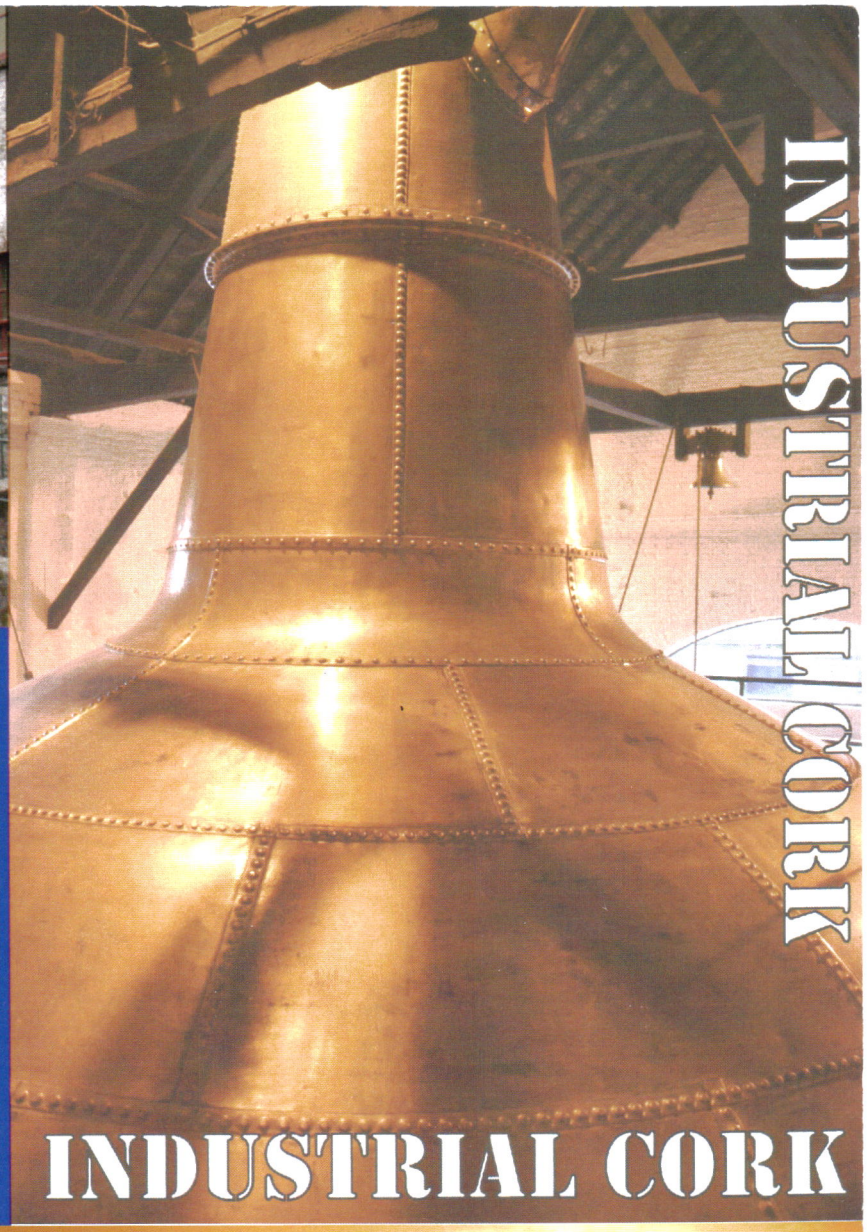
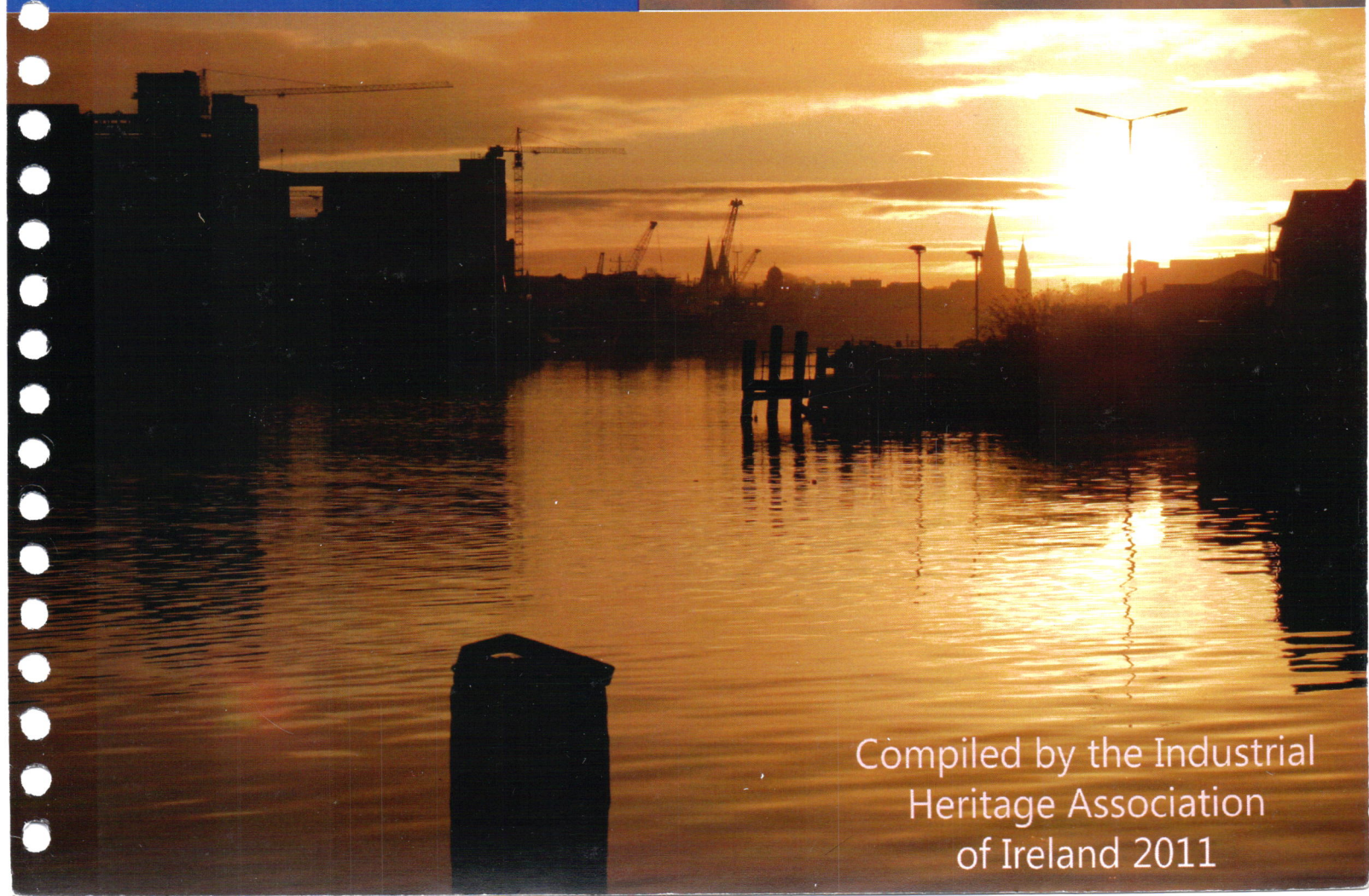


TOUR NOTES FOR THE ASSOCIATION FOR INDUSTRIAL ARCHAEOLOGY'S CONFERENCE IN CORK, 25 August- 1 September 2011



Compiled by the Industrial Heritage Association of Ireland 2011

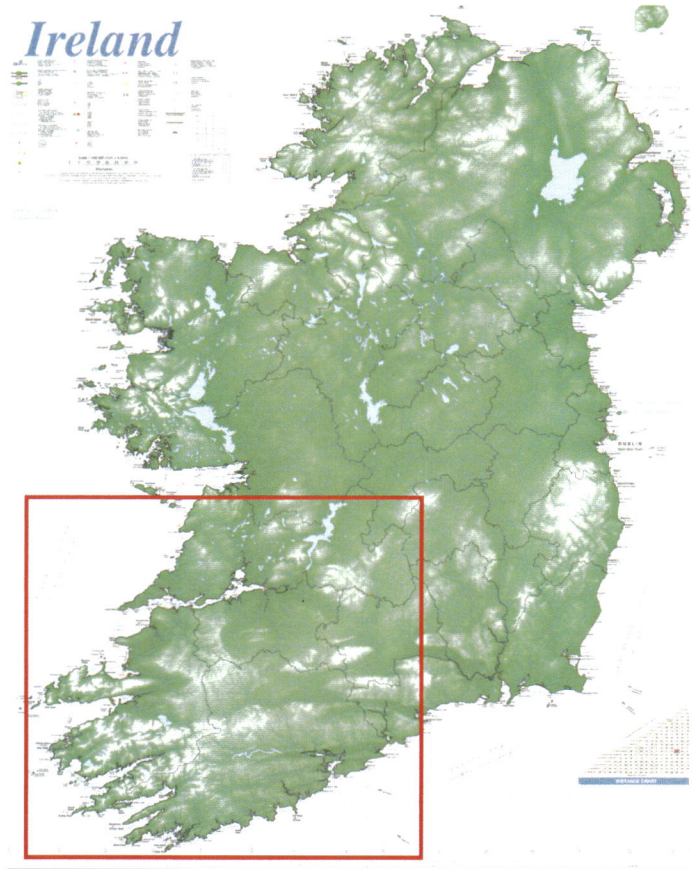
INDUSTRIAL CORK

Tour notes for the Association for Industrial Archaeology's Cork Tour

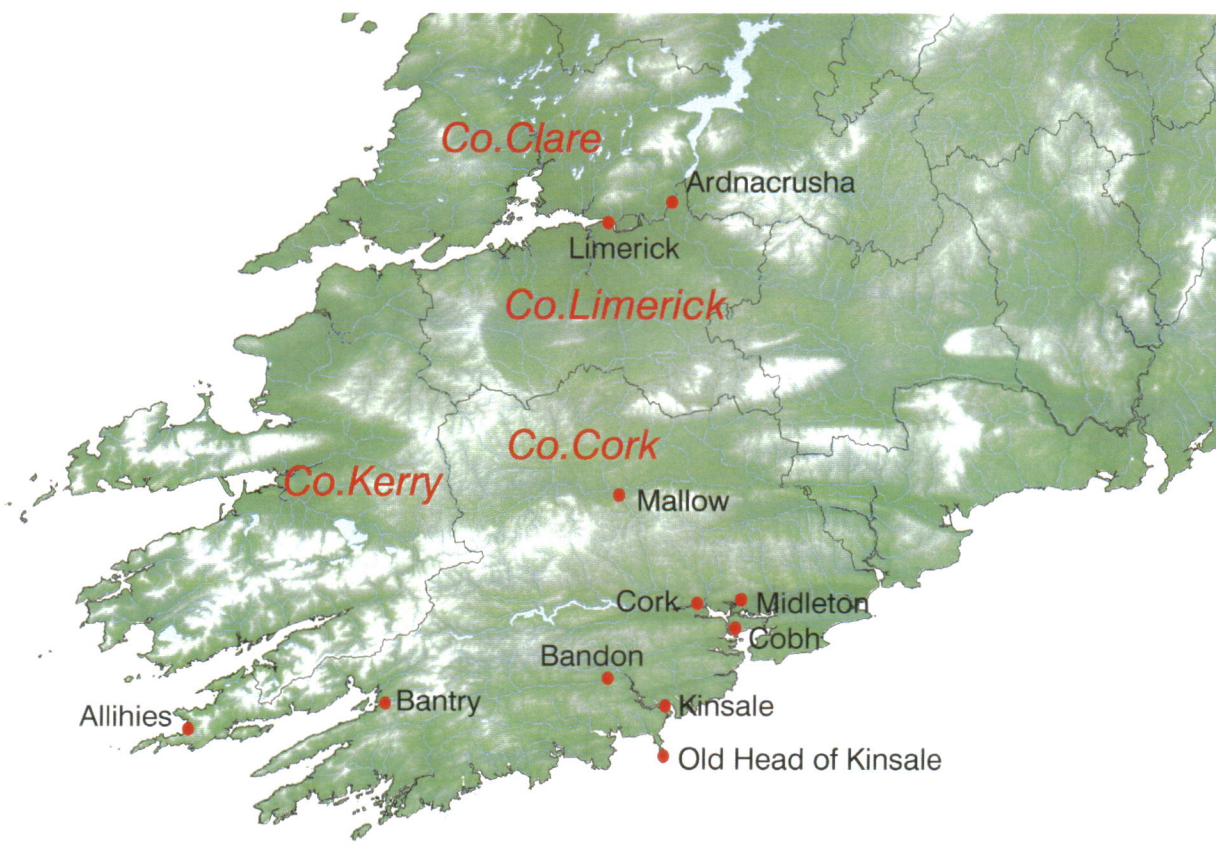
26 August- 1 September 2011

Prepared by

the Industrial Heritage Association of Ireland 2011



Location Maps



Introduction: Industry in Cork, 1750-1930

At the end of the eighteenth century the port of Cork, in addition to becoming Ireland's most important transatlantic shipping, was experiencing incipient industrialization and appeared (at least on the face of it) destined for even greater things. Its future success, indeed, seemed assured. As the second city of Ireland, Cork's burgeoning trade and industrial development had by this period already eclipsed that of its nearest rivals in the south west, Waterford, Kinsale and Youghal. Its main textile industries were of national - and in at least one instance international- importance, while the largest porter brewery and the largest distillery in Ireland had also been established there. The quality of Cork butter was assured by one of the most innovative and rigorously enforced systems of quality control then known in Europe which laid the foundations for what became the largest butter market in the world. Cork's exports of beef and pig-meat were also of national importance, whilst the non-edible by-products of the slaughterhouses provided the raw material for a plethora of allied trades.

Yet Cork's success as a port was too closely aligned with the provision trade. Foreign markets for Irish provisions had already begun to decline by the turn of the eighteenth century, and the establishment of large industrial units within the city and its immediate environs generated too few spin-off effects to provide a firm base for future industrial development. The optimism of contemporary accounts of Cork's foreign trade is laid bare by the subsequent lack of industrial concentration in the nineteenth century. Brewing, distilling, its principal textile industries, sailcloth manufacture, linen and woollens, along with a number of other important local industries such as shipbuilding, engineering and gunpowder manufacture, were to experience mixed fortunes in the period after 1800.

The expansion of Cork's trade in the eighteenth century cannot be simply explained by geographical advantages. Human factors, such as the changing patterns of English and Irish overseas trade, and the military and economic advantages accruing to England from its continued development, are also known to have been important. Nonetheless, Cork harbour was endowed with considerable natural advantages, not least of which was being one of the largest natural harbours in the northern hemisphere. The lower harbour could easily accommodate the larger transatlantic convoys or British naval squadrons. From the American War of Independence onwards, British naval facilities became increasingly concentrated in the lower harbour, and between 1777 and 1779 it was claimed that around £90,000 was spent on improvements and on naval repair work at Passage West. Britain's American war and the later Napoleonic campaigns were a source of considerable financial gain for Cork merchants. Each of these episodes not only tended to concentrate the greater bulk of transatlantic trade on the port of Cork, but further served to underline the strategic importance of the harbour to the Admiralty. The fact that Cork was far enough from Dublin not to be threatened by direct competition from the capital city, while close enough to important markets in Britain was also an important factor.

By the end of the seventeenth century Irish provisions, principally salted beef, butter and pork, had become an important factor in the maintenance of the West Indian plantations. Cork and Dublin had by this time already become the most important Irish ports engaged in this trade. The expansion of this trade was a direct result of the preference of British shipowners for victualling their ships at Irish ports, and then transporting this to the continent and the American colonies. In the eighteenth century the vessels involved were English owned and registered, and these were assembled in important naval centres such as Plymouth to be escorted, under convoy, to their destinations in Europe or in the American colonies. Cork became the seat of the Admiralty's victualling agent in Ireland and its pre-eminence in the Irish provision trade as a whole led to the accreditation of both Spanish and Portuguese consular officials to Cork.

Immediate access to the port of Cork was probably the main factor in the location of industry within the immediate environs of the city during the eighteenth century. Indeed, while certain large industrial concerns such as brewing and distilling were primarily geared towards a localised market, most of the others (particularly the textile industries) manufactured for export. Industries in which a large degree of mechanisation was involved needed power, and this, for the vast majority of eighteenth-century Cork industries, meant water-power. There were, of course, some notable exceptions, principally urban breweries and distilleries established during the eighteenth century, where access to a source of water power was not an important concern, as all of the essential plant could be worked by horse-powered machinery. However, their future expansion could only, as events were to prove, be assured by the adoption of steam-powered primer movers, and Cork's distilleries and breweries became some of the first in Ireland to do so.

By the later 1700s many of the tidal marshes upon which the city had been built were in the process of being reclaimed, and the passage of the River Lee through the city was being increasingly confined to a small number of larger channels. The effectiveness of the water flowing through these channels, and particularly of those flowing through the city itself, provided no great inducement to the establishment of water-powered mills, as the tidal reaches of the harbour extended to (and slightly beyond) the built-up area of the city itself. In the medieval and post-medieval periods a small number of grain mills were built on these channels, and it seems quite likely that many of these were tide mills. A water-powered manufactory, however, required a much larger and more dependable source of water; of a magnitude which the tidal channels of the River Lee could not conceivably accommodate. Thus the water-powered industries which utilised the River Lee within the city were few, and all were sited to the west to extract water from stretches of the river beyond its tidal reaches. In consequence, large units of mechanised industry tended to be sited within the immediate environs of the city adjacent to non-estuarine stretches of the River Lee's main tributaries.

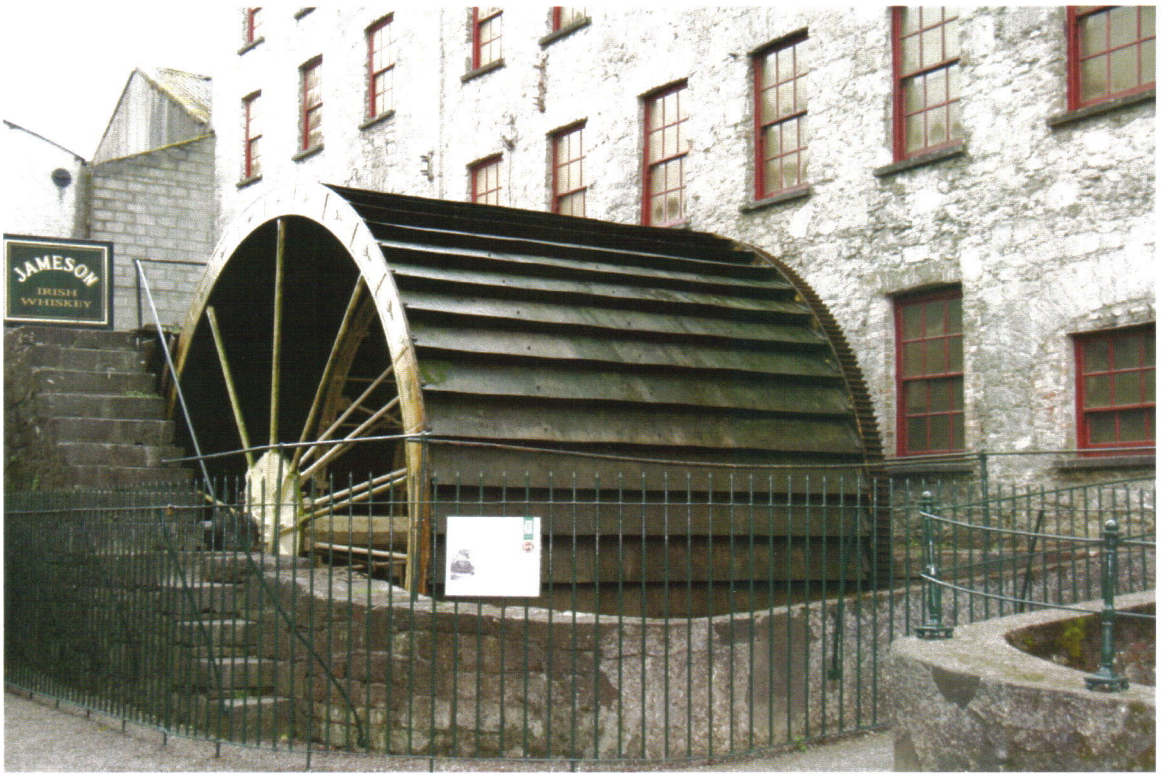
From the second half of the eighteenth century onwards the Bride and Glen rivers (which converged to form the Kiln River in Blackpool), flowing southwards through the northern suburbs of the city, were impounded to power a number of industrial processes. The Blarney, Glasheen and Curraheen rivers to the north-west and west of the city were also harnessed to serve large industrial units. Only with the arrival of steam power in Cork, in the late eighteenth century, did the location of mechanised industries within the confines of the city itself become a viable option. In all such cases immediate access to the Welsh coal discharged at the city's quaysides (which reduced transportation costs) doubtless provided a further stimulus to (if not the rationale behind) establishing steam- powered industries within the city. The increased importation of American wheat in the nineteenth century also brought about the establishment of steam-powered flour mills on the city quaysides, where both grain for the mills and fuel for their engines could be easily unloaded.

Friday 26th August

Midleton Distillery

Midleton Distillery, county Cork, was established by James Murphy in 1825 in Marcus Lynch's former woollen mill of 1793. The surviving range of buildings dates from the 1830s onwards and includes three malting kilns, and is dominated by a six-storey grain store of c. 1830. In the latter each floor could hold up to 250 tons (total weight 1,500 tons), and a series of buttresses had to be used to shore one side of the building against an adjacent one. The original wooden floors have been preserved, which makes it the most complete surviving distillery grain store in Ireland. A late nineteenth-century brew house, complete with steel mash tuns and vats, has recently been opened to the public as part of the distillery tour. The late eighteenth century woollen mill was converted for use as a malt mill and mash house, powered by both water and steam. Its extant 22ft diameter waterwheel is by William Fairbairn of Manchester and was installed in 1852, where it was used in conjunction with two steam engines, one of which, a six column independent beam engine by Peele and Williams of Manchester, installed in 1835, has been retained *in situ*. The Midleton distillery also boasts the largest pot still in the world, a wash still with a capacity of 31,648 gallons, installed in 1826, which required 4.06 tonnes of coal every twenty-four hours. The two more recent feints and low wine stills associated with the latter, built by D. Miller of Dublin in 1949, are preserved in an adjacent still house.

Marcus Lynch's woollen mill, completed in 1793, and later adapted as a malt mill in Midleton Distillery



The Fairbairn suspension waterwheel of 1852 in Midleton Distillery

Wash still in Midleton Distillery of 1826, with a capacity of 31,648

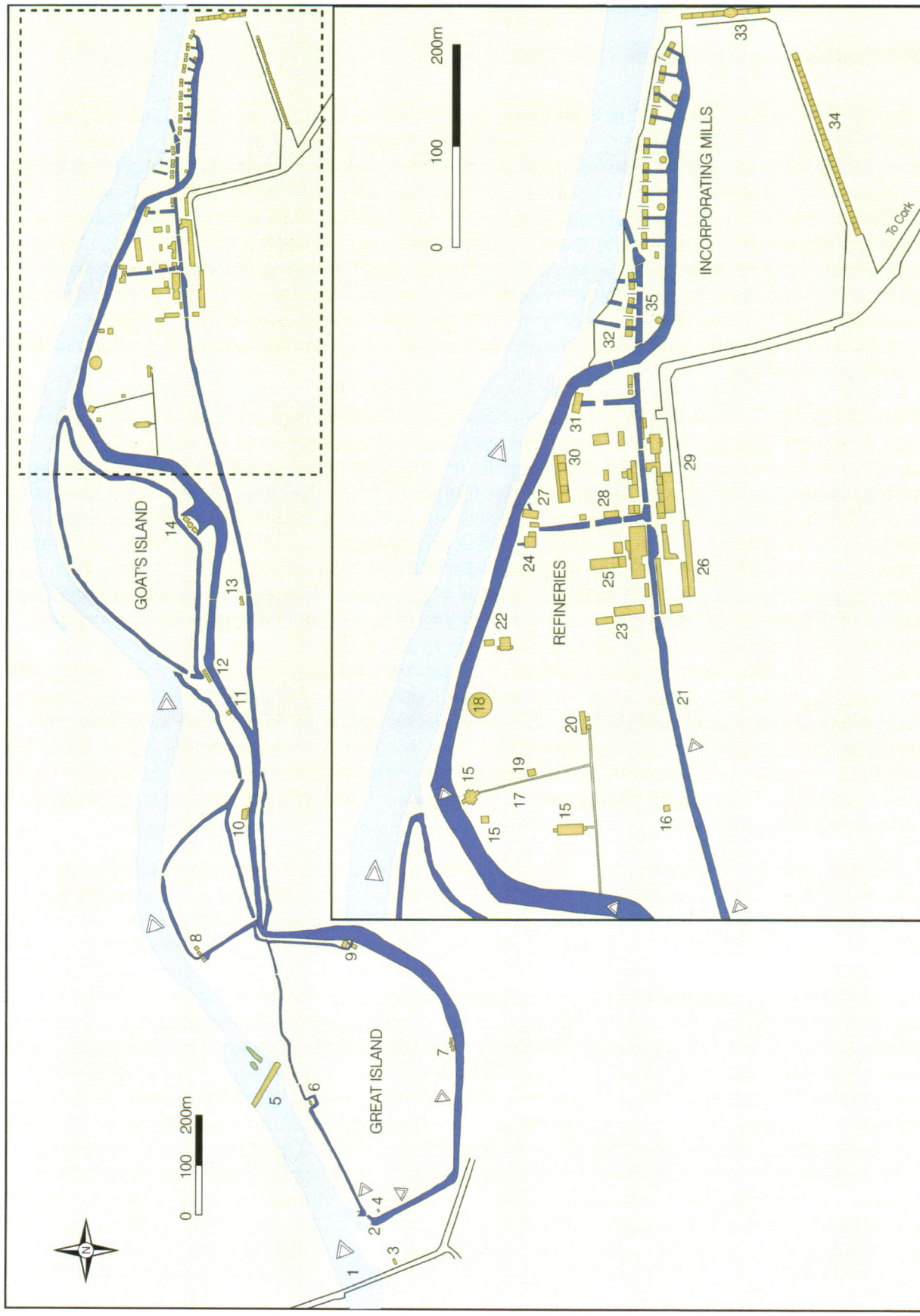
Sunday 28th August

Ballincollig Gunpowdermills 1794-1903

Up until the establishment of the Ballincollig Gunpowder Mills the Irish explosives industry had been centred around Dublin. Within a relatively short period of time, however, the Ballincollig mills had become became the centre of this industry. Between 1794 and 1815 the mills were the largest in Ireland and amongst the most extensive in the former United Kingdom. By 1822 gunpowder production within the environs of Dublin had effectively ceased. Moreover, in the second main period of their use, between 1833 and 1903, during which they were the only gunpowder mills in Ireland, the Ballincollig mills appears to have been second in size only to Waltham Abbey in England. During the early part of its history, the Ballincollig Gunpowder Mills, along with the adjacent cavalry and artillery barracks, formed part of an enormous military-industrial complex. It is the best-preserved industrial site of its type in Europe.

The Ballincollig Gunpowder Mills were established by Charles Henry Leslie, a Cork banker and later proprietor of the River Lee Porter Brewery (see below), and John Travers, in 1794. In that same year they acquired land near Ballincollig village, and constructed the original Inishcarra weir on the River Lee and laid out the gunpowder manufactory on the south bank. Good access to the port of Cork, some six miles to the east, was a critical factor in the choice of site, as production was clearly aimed at supplying the needs of the government. Nonetheless, further important criteria specific to the manufacture of gunpowder also had to be taken into consideration. In the first instance the site had to be sufficiently large and isolated to enable a notoriously hazardous series of processes to be carried out. Furthermore, as a number of these processes were mechanized, access to a water source which could be readily converted into energy was essential. In order to minimise the danger of chain-reaction type explosions, the buildings within the complex were well spaced out. This was particularly true of buildings in which gunpowder finishing processes were undertaken. In consequence, the main feeder channel within the complex (particularly in the period after 1804), had to cover a distance almost 2.5km long. The latter did, however, also facilitate the water-borne transportation of materials around the entire site. In the post-1804 period this system of hydro-power/transportation canals became one of the unique features of the site.

Leslie and Travers' manufactory occupied an area of just over 90 acres (compared to an area of over 431 acres when it came under Board of Ordnance control) situated in the eastern sector of the present complex.. The main feeder canal ran 2km from a point immediately above the weir at Inishcarra, to its outfall into the River Lee at a point immediately east of the incorporating mills.. At the eastern end of the complex four millraces were drawn off from the main canal: two for the incorporating mills with two pairs of edge-runner stones) and one each for the *composition mills* and mixing house and the original corning house. The westernmost incorporating mill, which appears to have been substantially modified in the 1830s, was excavated in 1985, during which part of the foundations of Leslie's original incorporating mill came to light. The other buildings in the original Ballincollig complex included a stove house, a charring (charcoal) house, a press house, a dusting house, a corning house, and sulphur and saltpetre refineries. Accommodation for the workforce, workshops and stabling were also provided. There was a lime kiln on the site, and it seems likely that the limestone quarries on the escarpment immediately south of the complex, which were later extensively used by the Board of Ordnance, were originally opened and utilised during the construction of the original complex. The only surviving features of Leslie and Travers' manufactory which can be identified with any certainty are the original hydro-



General plan of Ballincollig Gunpowder Mills, 1794-1903

power/navigation channel (running west-east through the complex), incorporating mill units 1 and 2 and the canal bridge immediately to the east of the incorporating mills.

In the first ten years of its operation the Ballincollig manufactory had, according to an English Board of Ordnance official, become a 'highly productive and prosperous concern'. Security at the mills became an ever-present concern to the British military, who were obliged to monitor their production, particularly in the aftermath of the rebellion of 1798. Indeed, government policy at the time was to seek a monopoly of gunpowder manufacture in these islands, and it was in pursuit of this goal that the Board of Ordnance bought Leslie out in 1805. As Sir Henry Hardinge explained in 1828, Ballincollig 'became one of the Ordnance Stations, both as being a convenient station for the embarkation of artillery from Cork for foreign service, as well as for the protection of the mills'. In March 1805 the Board appointed its chief clerk of works for powder mills, Charles Wilkes, as superintendent of the Ballincollig mills and by the following June the Office of Ordnance at Ballincollig placed an advertisement in the Cork press looking for local 'plumbers, glaziers, painters, coopers, masons, blacksmiths, copper-smiths, founders, ironmongers, stone cutters, millwrights and bricklayers'. Wilkes began by improving access to the complex from the old Killarney road to the north, by entirely rebuilding the Bridge at Inishcarra with 24 arches.

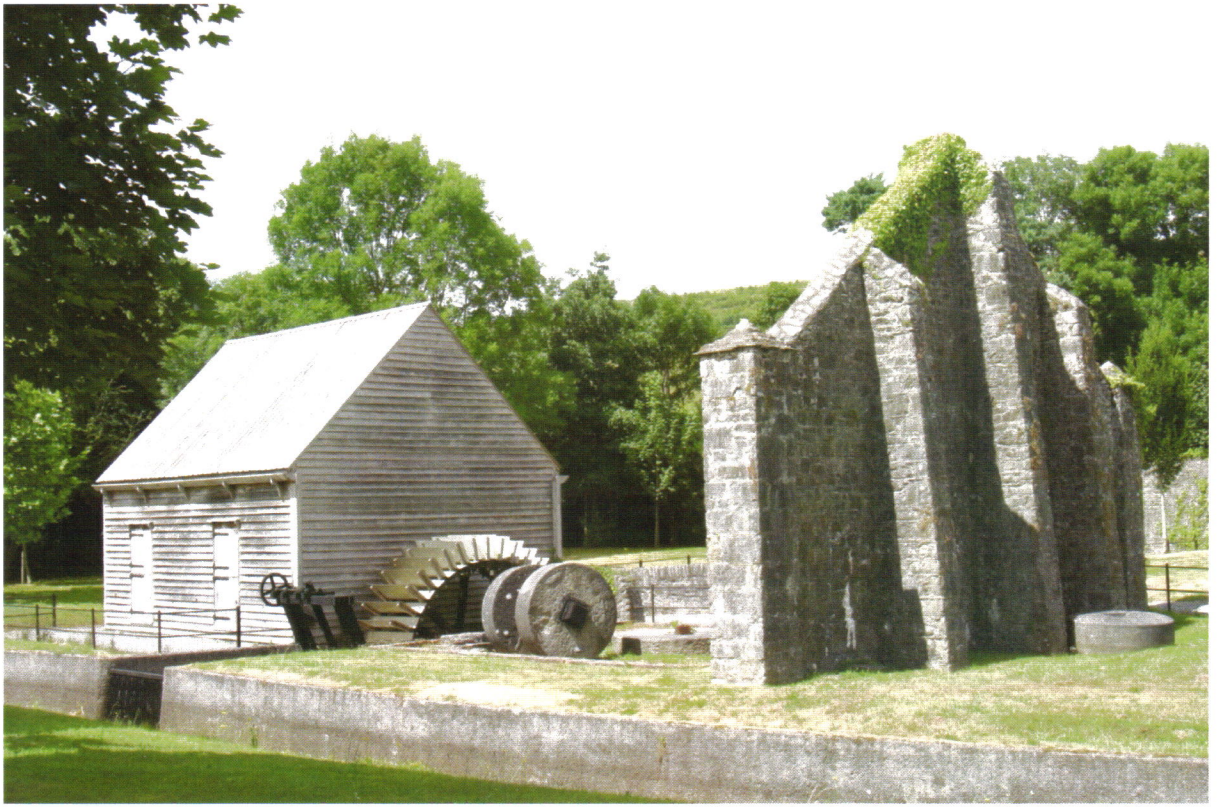
The effective area of the mills, including administration buildings, a network of canals and the new cavalry barracks, was greatly expanded in the period 1806-15, and the greater part of the 431 acres involved was enclosed behind a high stone wall. Limestone was quarried on the escarpment immediately north of Oriel Court, and was used extensively in the construction of the new mill buildings, the canal network and the enclosing wall. The bedstones and edge runner stones used in the various refining and composition processes, which were particularly fine-grained, are also likely to have been quarried here. Two lime kilns were also erected within the complex for the manufacture of lime mortar. Part of the fabric of one of these survives on the lands of Cork County Council's sewerage works at Ballincollig. All told, the Board of Ordnance invested almost £127,000 in the development of the complex and on harbour facilities for its storage and transportation in the period 1805-15.

A further twelve incorporating mill units were built between 1805 and 1809 along with a new steam stove house, a glazing house, a fire engine house, a saw mill, a cylinder house, an extensive range of craftmens' workshops, drying houses, new saltpetre and sulphur refineries and a new gunpowder magazine. A series of three *charge houses* were also built in the incorporating mills section of the complex. Nearly all of the water-powered installations were powered by breast-fed waterwheels with an undershot action, with diameters ranging from a maximum of 21ft, in the case of the Board of Ordnance incorporating mills, to 16ft, as in the new charcoal grinding mill. The vast majority of the buildings referred to above still survive in various states of dilapidation, and while these were added to and modified when the mills were returned to private ownership in the 1830s, the layout of the complex as it survives today is still essentially that designed and implemented by Charles Wilkes. Upon its closure in 1815 Ballincollig Gunpowder Mills was the largest installation of its type in Ireland, and one of the largest in these islands.

The Board of Ordnance's substantial investment in the Ballincollig manufactory was closely linked to the expanding military demand for gunpowder during the Napoleonic Wars. But in their aftermath the demand for gunpowder in the British industry as a whole slumped by almost 75%, and Ballincollig, along with a number of gunpowder mills in Britain, was closed down. Production at Ballincollig ceased sometime in 1815, and the entire complex was mothballed on the orders of the Duke of Wellington, but as the machinery within the complex could not be sold it was 'painted, oiled and taken care of'. Some of the machinery appears to have been dismantled, and while by 1828 the incorporating mills were described as 'much gone to decay' and the mixing house as 'in very bad order', the overall condition of the mills and plant was as good as might be expected after 15 years of disuse. In 1831 some items of plant were put up for auction, and by May 1832 the

machinery within the complex was said to be 'in a most dilapidated state'. In July of 1832 a decision was taken to remove some of the machinery to the Waltham Abbey mills in England. By this stage the weir and canal system had become so run down that it was impossible to work the water-powered pumps for the barracks' water supply. In 1832 it seemed that the mills would never operate again, but by the end of the following year they had been returned to private ownership under a new and more enterprising management.

In 1833 the Board of Ordnance sold the mills to the Liverpool firm of Tobin and Horsefall for £15,000, and within a short period of time work on the recommissioning of the mill canals was underway. Thomas (later Sir Thomas) Tobin (1807-81), the oldest son of Thomas Tobin of Liverpool, was dispatched to County Cork to become managing director of the rejuvenated mills. The buildings and plant inherited by Tobin had not been operated for some 18 years, but more importantly these were designed for gunpowder manufacture in the period before 1815. Under Tobin's management the mills were transformed into one of the most up-to-date manufactories in Europe. Tobin built an additional eight incorporating mill units, four in the 1840s and four in the 1850s, to supplement the operation of the pre-1815 mills. The company had been in production since the summer of 1835, with production gradually increasing from 7,517 casks in 1836 to 17,738 casks in 1842.

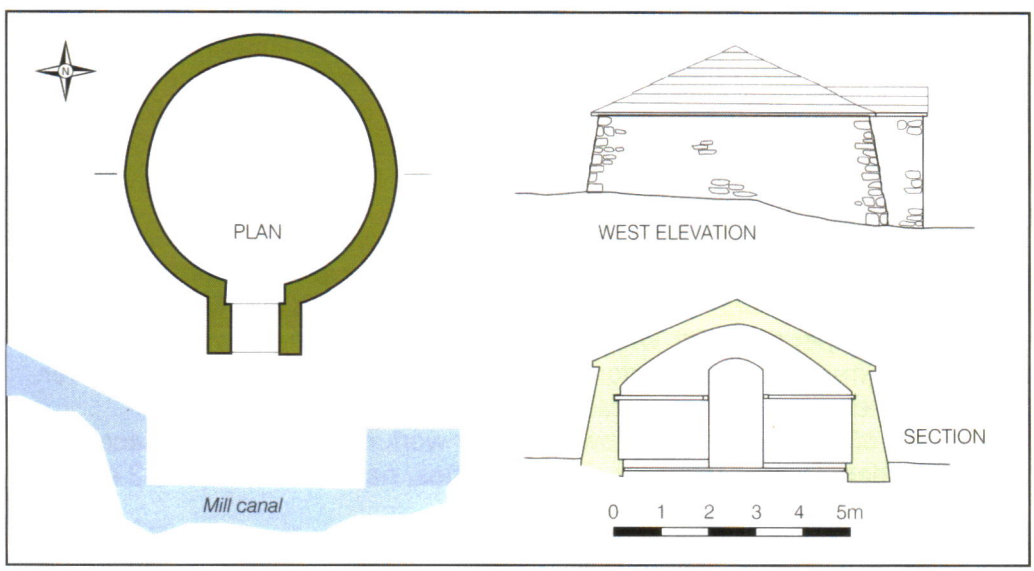


Restored mid-19th-century incorporating mill at Ballincollig

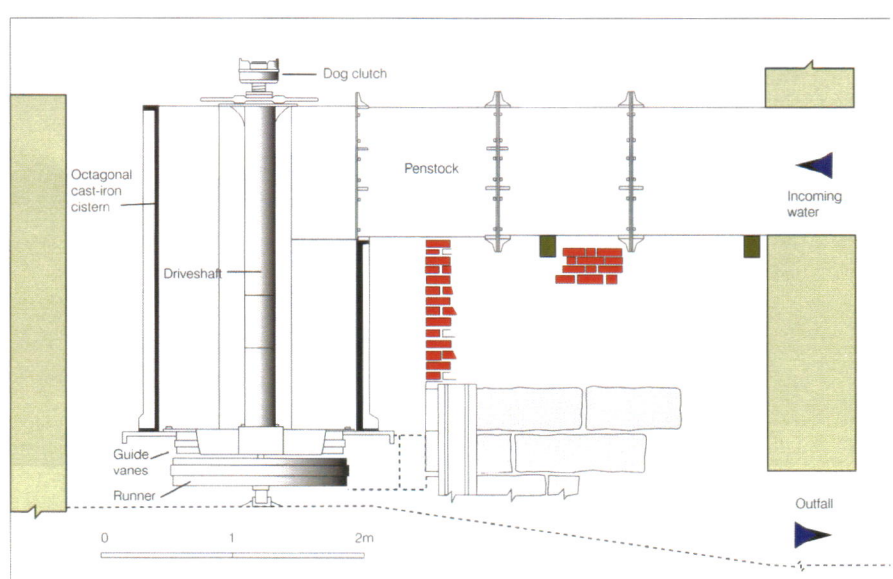
The decline of the gunpowder industry was brought about by the introduction of chemically manufactured explosives such as nitrocellulose (guncotton) and nitroglycerine, and ultimately by Alfred Nobel's dynamite. The so-called 'smokeless powders' which became increasingly used for small arms ammunition towards the end of the nineteenth century also eroded the traditionally strong market for 'black gunpowder'. From the second half of the nineteenth century onwards, gunpowder manufacturers found it increasingly difficult to compete with manufacturers of the 'new explosives', and were all but powerless to arrest the decline in demand for gunpowder. In its heyday the Ballincollig factory's markets included most of Ireland, the Lancashire, Yorkshire,

Staffordshire and South Wales coalfields, Africa, South America and the West Indies. But after 1880 exports from Ballincollig, which had previously averaged around 30,000 barrels per annum, fell steadily, and after 1890 sales rarely rose above 13,000 barrels. In the 1880s the Ballincollig Company attempted to arrest the decline by introducing new brands, the Royal Premier (RP) and Extra Treble Strong (ETS) varieties, but these developments could do little to prevent the substitution of black powder with smokeless powders such as cordite.

In 1889 the mills, which had for a long period manufactured powder for the African market, were refurbished for the manufacture of powder for government contracts. However, as the kegs for this powder were specially manufactured at the Royal Arsenal, the Ballincollig coopers who had formerly made kegs for the African powder were made redundant. In 1898 Ballincollig formed part of an amalgamation of eight gunpowder mills (mostly English) under the management of the English firm of Curtis and Harvey, and only the onset of the Boer War seems to have prevented its immediate closure. The mills were closed for the last time in July 1903.



Early 19th-century charge house at Ballincollig Gunpowder Mills



Jonval turbine of c. 1855 at Ballincollig Gunpowder Mills

Monday 29th August

The Cork, Bandon and South Coast Railway, 1849-1961

The idea of a west Cork railway was first proposed by Charles Vignoles in the Railway Commissioners' report of 1837-8, but it was not until 1843 when the County Surveyor for the West Riding, Edmund Leahy, and a local solicitor, J.C. Bernard, began to promote a railway link between Cork and Bandon, that any purposeful steps were made towards achieving this goal. A provisional 'Bandon and Cork Railway' Committee was set up in 1844, which appointed Vignoles as consulting engineer to survey and deliberate upon the route proposed by the acting engineers Edmund Leahy and his father Patrick. The enabling legislation was passed through parliament in July 1845 and by the winter of 1845 work had begun on the Bandon-Ballinhassig section of the line. Charles Nixon, who had worked under I.K. Brunel (1806-59), was appointed consulting Nixon decided that the timber members of the planned viaduct at Chetwynd be replaced with cast-iron, and that tunnels should be bored at Gogginshill and Kilpatrick instead of the deep cuttings proposed by his predecessor Leahy. The line's original twenty mile route had been divided into six lengths, each of which was let out to a number of different contractors. But in 1849 financial difficulties appear to have influenced the company's decision to open the Bandon-Ballinhassig section of the line as soon as it was completed: the first trains ran between Bandon and Ballinhassig in June 1849.

Chetwynd viaduct: In 1847 work began on the massive abutments and supporting pillars of the Chetwynd viaduct designed by Charles Nixon, on the Cork and Bandon Railway, some three miles from Cork. The superstructure, which consisted of 1,000 tons of wrought and cast iron, and spanned the main Cork to Bandon road and the valley of the Glasheen River, was completed in 1851. The bridge was manufactured by Sir Charles Fox and John Henderson and Company of London, better known for their work on the Crystal Palace, and was made up of lattice girders formed into four eliptical arches, each of 110 ft (33.52 m) span.

Chetwynd Viaduct of 1851

Bandon town: This was the centre of Cork's 18th- and early 19th-century cotton industry.

Overton Cotton Mill: Before his association with Hewes, George Allman (1750-1827) had already established a reputation as a cotton manufacturer at Bandon in county Cork. Allman's involvement in the local cotton industry was singled out for special praise by John Arbuthnot of the Irish Linen Board in 1783: 'This gentlemen is an acknowledged good Manufacturer but he has an additional merit in being an excellent mechanic, making, with his own hands, all the curious and difficult parts of the machines whether in wood, brass or iron'.

Allman's cotton mill was built was on some 46 acres of land approximately one mile south west of Bandon, at Overton, near the village of Oldchapel. Towards the end of the eighteenth century, Allman had told one of the Sadlier brothers, the principal cotton manufacturers in the Cork region and the second largest in Ireland by the turn of the eighteenth century, that the Cork industry would only survive if modern spinning mills were introduced. Indeed, Allman was acutely aware of the need to keep abreast of new technological developments in the cotton industry, and with this in mind he sent one of his sons (presumably the eldest, Francis) to Lancashire to learn about mule-spinning, sometime before 1804. It now seems likely that George Allman's association with Hewes may well have provided important contacts for the young Allman. From Hewes' account, it is clear that he completed the Overton mill in 1802, and added substantially to it in about 1810, by constructing the second five-storey wing which survives *in situ*. In 1810 the Overton cotton mills were described by Horatio Townsend as being 'hardly inferior to those of the best English construction, in the extent of the works and the elegance of the machinery'. But the true significance of the Overton mill was to be revealed by a brewer from Fermoy, county Cork.

In 1811 Henry Walker, a wealthy brewery-owner at Fermoy began what was to become a lengthy business correspondence with the Scottish engineer John Rennie. Walker was anxious to improve his brewery's motive power, and commissioned Rennie to design and execute the necessary millwork. This was a common practice in Ireland during the late eighteenth and early decades of the nineteenth century, until such time as English millwrights and machine makers had established foundries at Ireland's principal ports. Indeed, Walker explained why Irish industrialists preferred to use English technicians in a letter to Rennie in April 1814, '...having seen many mills in this neighbourhood [i.e. north county Cork] ineffective from any errors in the calculations, we do not like to depend on the engineers here. I will most cheerfully pay the [extra] expense'. Nonetheless, Walker was clearly prepared to investigate other water-powered industrial sites within county Cork. One innovation, in particular, in George Allman's cotton mill, prompted him to write to Rennie in May, 1811:

> At the cotton mills of Mr George Allman of Bandon we have seen a very fine wheel and wish for a similar one provided you think it is the best plan for our purpose. It is 40 feet in Diam and five feet wide - shaft & Rim Metal Arms 1¼ inch hammered iron braced by Inch iron - has no pit wheel but a set of cogs on the outer rim which work into a lying shaft - the soleing buckets are timber.

Walker also enclosed a sketch of a wheel of similar design, which he proposed for his own brewery which must surely be the earliest-known illustration of what has become known as the suspension waterwheel. From the foregoing a number of things are clear, the Overton mill was equipped with a 40ft diameter iron suspension wheel, installed in 1802, when Hewes built the original mill.

Overton Cotton Mill near Bandon, Co. Cork, 1810

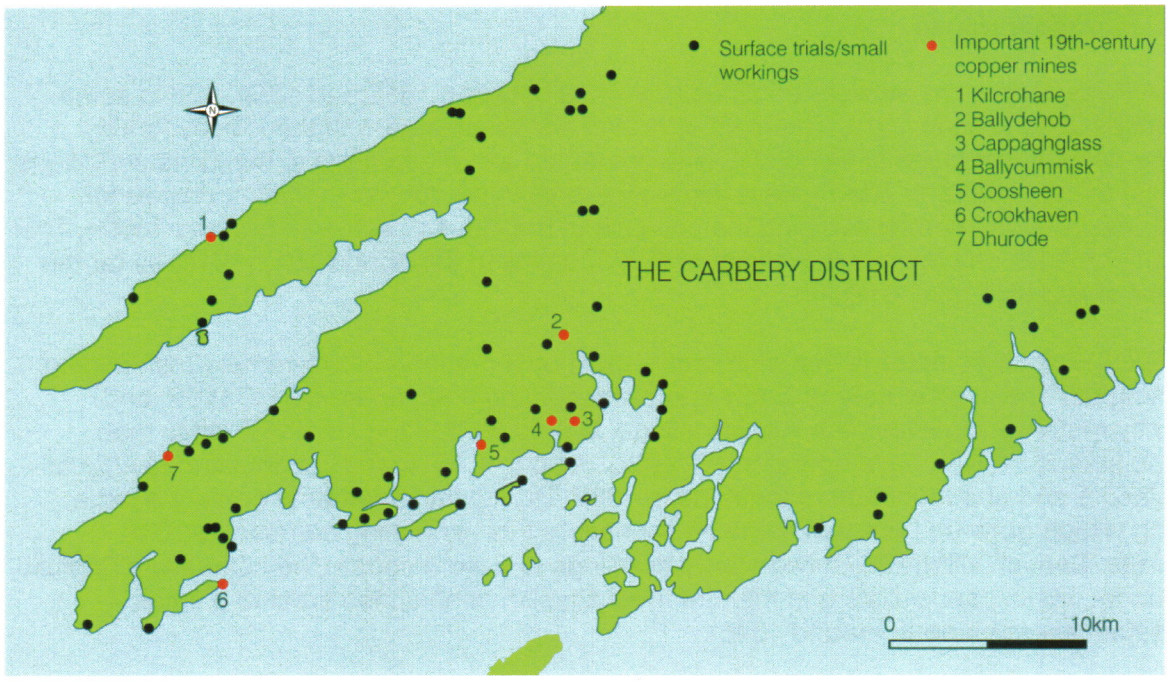
Axle of Hewes' suspension waterwheel at Overton Mills, Cotton Mill near Bandon, Co. Cork, 1802

Allihies copper mines

The Allihies copper mines were continually worked between 1812 and 1884, and in some instances up to around 1913. The main workings are associated with the Puxley family, whose palatial residence at Dunboy Castle presented a stark contrast to the living conditions of most of their workers. The Puxleys were able to sell their run down mining empire for £100,000 in 1869, thereby avoiding the collapse of the industry in the 1870s and 1880s. The output of the Berehaven mines was some 297,000 tons in the period 1812-1913, by far the largest of any Irish mining region

The Allihies mine complex is one of Ireland's most best preserved 19th-century Irish mining landscapes. The shell of Ireland's only known man-lifting engine, erected c. 1862, and recently restored, survives near Allihies village. During its working life, the Allihies man engine seems likely to have operated to depths of up to 1,494ft and continued in use up to the closure and abandonment of the mine in 1882. During the nineteenth century a large mining village grew up here, but immediately next to this the mining company built a separate 'Cornish village', with two-storey dwellings to accommodate the company's English engineers, mining specialists and their families. English miners also erected a small Protestant church here in around 1845.

General view of Allihies district in late 1840s



Main copper mining regions of County Cork

Restored man-engine house at Allihies

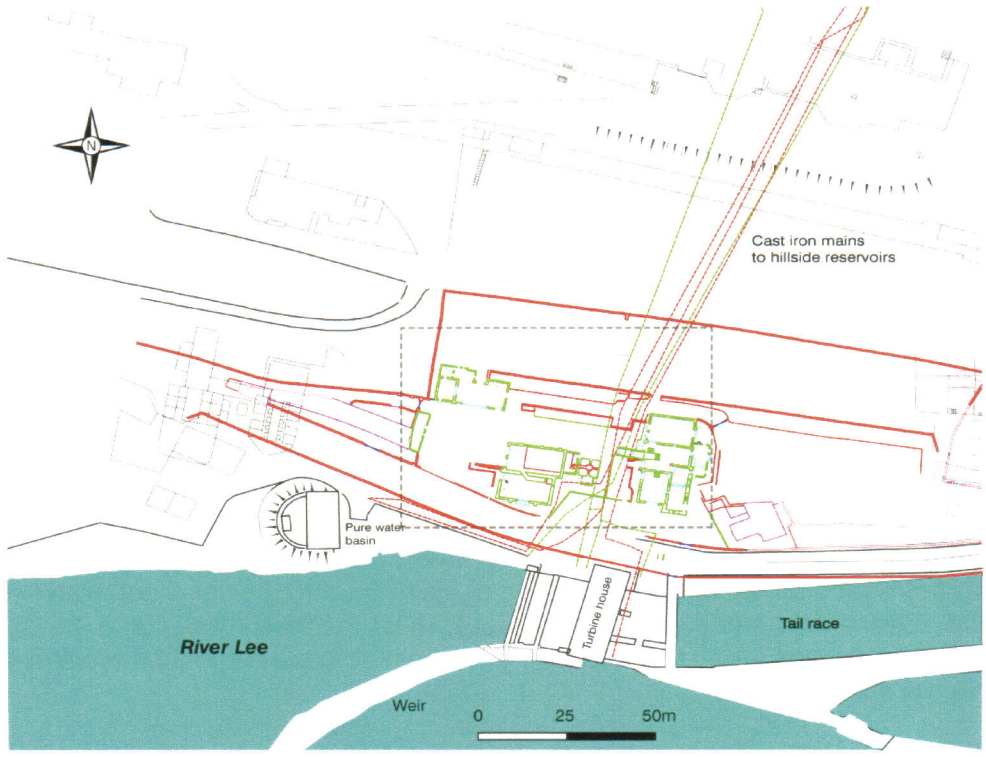
Tuesday 30th August

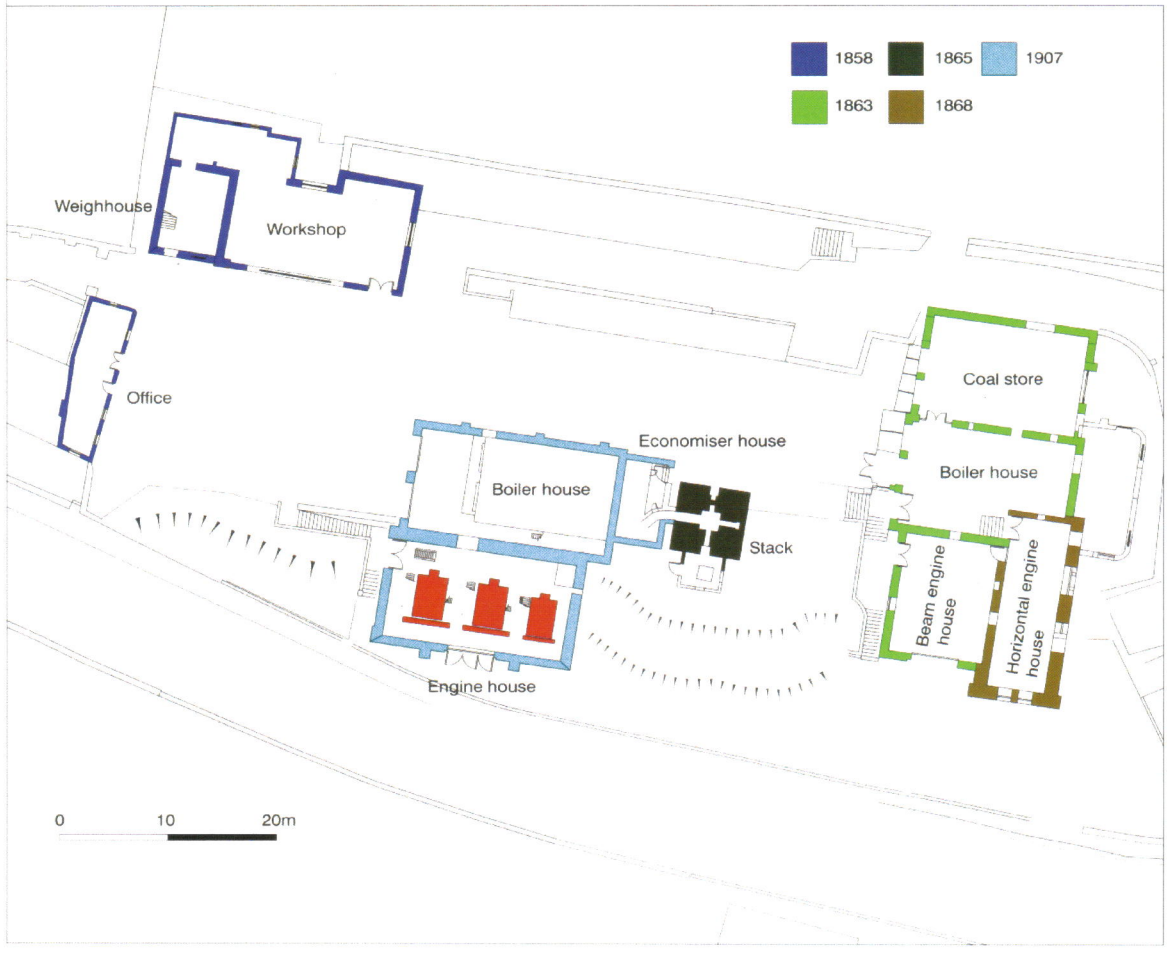
Cork Corporation Waterworks

The earliest attempts to regularise the city's water supply were made in the fourteenth century, when a charter of 1303 effectively renewed a murage grant of 1294, the purpose of which was to both maintain the city walls and provide the city with water. Little is known about subsequent efforts to establish a municipal water supply up until the second half of the eighteenth century, but it is likely that for most purposes the consistency of supply appears to have been a matter of individual initiative. Until the development of more sophisticated distribution networks water-supply networks operated with wooden water mains serving cisterns and public fountains. The eighteenth-century water supply of Cork was operated on similar lines, but artesian wells sunk within the precincts of the walled city required no great depth, owing to the low-lying situation of the city and the relatively high level of the water table. It seems likely, however, that owing to their relatively shallow depth many of these wells would have been prone to pollution. In certain quarters their utility was preferred to that of piped water, particularly for those whose water requirements were modest, or who were unable or disinclined to pay for piped water. Indeed, it is doubtful if the 18th-century piped water supply could meet the existing demand, particularly during the summer months when the level of the river would have disabled the water-powered pumps at the city's waterworks.

By the second half of the eighteenth century the demand for water for both domestic and industrial purposes appears to have increased to the extent that firm action was considered necessary by the civic authorities. In 1761 the common council of Cork was empowered by an Act to provide the means by which the city could be supplied with water. The provisions made in the Act may well have been a proposal, but if it was intended as a remedial measure its enactment was certainly unsuccessful. A further Act of 1762 amended its provisions and empowered the Mayor, Sheriffs and the Communalty of Cork to raise the necessary finance by issuing shares and establishing a Pipe Water Company. Water rates were set at a yearly rate of two guineas per household, while those for industrial enterprises were arranged by agreement. By 1762 the architect/engineer Davis Ducart (who is better known for his tub boat canal) had completed a set of plans for the proposed waterworks. In 1768, after a period of six years, during which time the Pipe Water Company had presumably raised the necessary cash, a Cork iron founder called Nicholas Fitton was appointed to carry out the installation of the pumping plant.

The location of the pumping works - well outside the city precincts on the north bank of the northern channel - was probably determined by four factors. The River Lee was the obvious source of supply, but in order to ensure that this was regular and uncontaminated, it was necessary to extract water at a point upstream from the city and beyond the tidal reaches of the river. A second important consideration is likely to have been the siting of storage reservoirs. The eventual choice of the site is likely to have been determined by proximity to an area where such a reservoir could be constructed at an elevation that would enable the water pumped into it to be distributed to all of the areas of the city served by the network. A further contributory factor appears to have been the location of an existing salmon weir owned by the Duke of Devonshire, which could have (and seems likely to have) been readily adapted to meet the water-power requirements of the pumping plant.





General plan of Cork Corporation Waterworks

The first open reservoir, called the 'city basin', was built on the adjacent hillside, at a height of *c.* 60ft OD, into which untreated river water was pumped. Its capacity is not known, but it appears that one of the expectations of its builders was that it could, to some extent, serve as a settling tank for turbid water. A second reservoir was built alongside this in 1774, but their lack of elevation restricted the number of areas within the city that they could supply, whilst the reservoir itself was only about 5ft deep. Indeed, as late as 1844 the Pipe Water Company was supplying only 800 of the city's 10,000 households. The present turbine house occupies the site of the original pumping works, the foundation stone of which (bearing the inscription 'Cork Pipe Water Company Established 1768', along with the municipal crest) has been incorporated into this structure. A French visitor to the city in 1790 observed that water was conveyed from the city basin in wooden conduits along the north bank of the river, a service which cost a guinea per year.

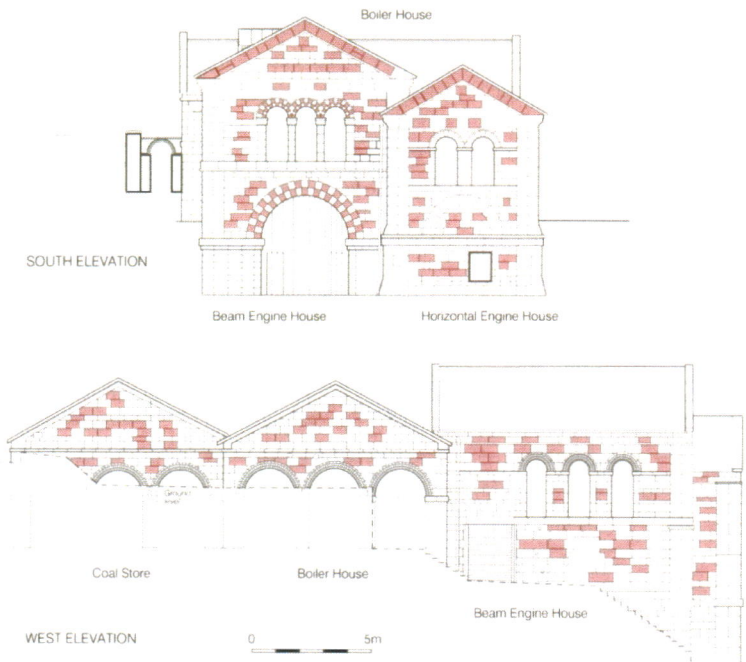
If the city of Cork was to have a municipal water supply which could adequately provide for the increasing demands of its households and industries, a series of wide-ranging improvements would have to be made. But it was not until 1852, with the Cork City Improvement Act, that the Corporation could attempt to do so. In 1854 Sir John Benson, the city engineer was instructed by the Pipe Water Company to make a survey of its works. By February of 1857 Benson's plan for the new waterworks had been submitted to 'several eminent engineers in London', whilst by May of the same year tenders had been issued for the construction of the new waterwork's reservoirs. The Corporation used imported cast-iron mains to replace the original wooden pipes, the first of which were shipped to Cork in 1857. The pipe-laying process was an ongoing one which continued apace throughout 1858 and 1859, with the pipes from the new Corporation Waterworks finally reaching the military barracks on the Old Youghal Road in February of 1859.

A 90hp Cornish beam engine, costing £2,875, was ordered from the MacAdam Brothers' Soho Foundry in Belfast, the installation of which began in April 1858, the engine itself entering commission in August of that year. The Cornish engine was designed to lift two million gallons per day to the lower reservoir, and had three boilers supplied by the Cork Steamship Company's Foundry. MacAdam Bros. also supplied two Fourneyron turbines, which were 7½ ft in diameter internally and 10½ ft externally for £2,100. The turbines powered two double-acting pumps with 11in plungers, and operated in conjunction with a 20ft diameter low breastshot waterwheel, which powered three, 12in diameter single acting horizontal pumps. This is the earliest recorded instance of the use of reaction turbines to pump a municipal water supply in either Britain or Ireland, whilst the Cornish engine is also the first example known to have been used in Ireland in association with a municipal water supply.

The Surviving Pumping Station Plant

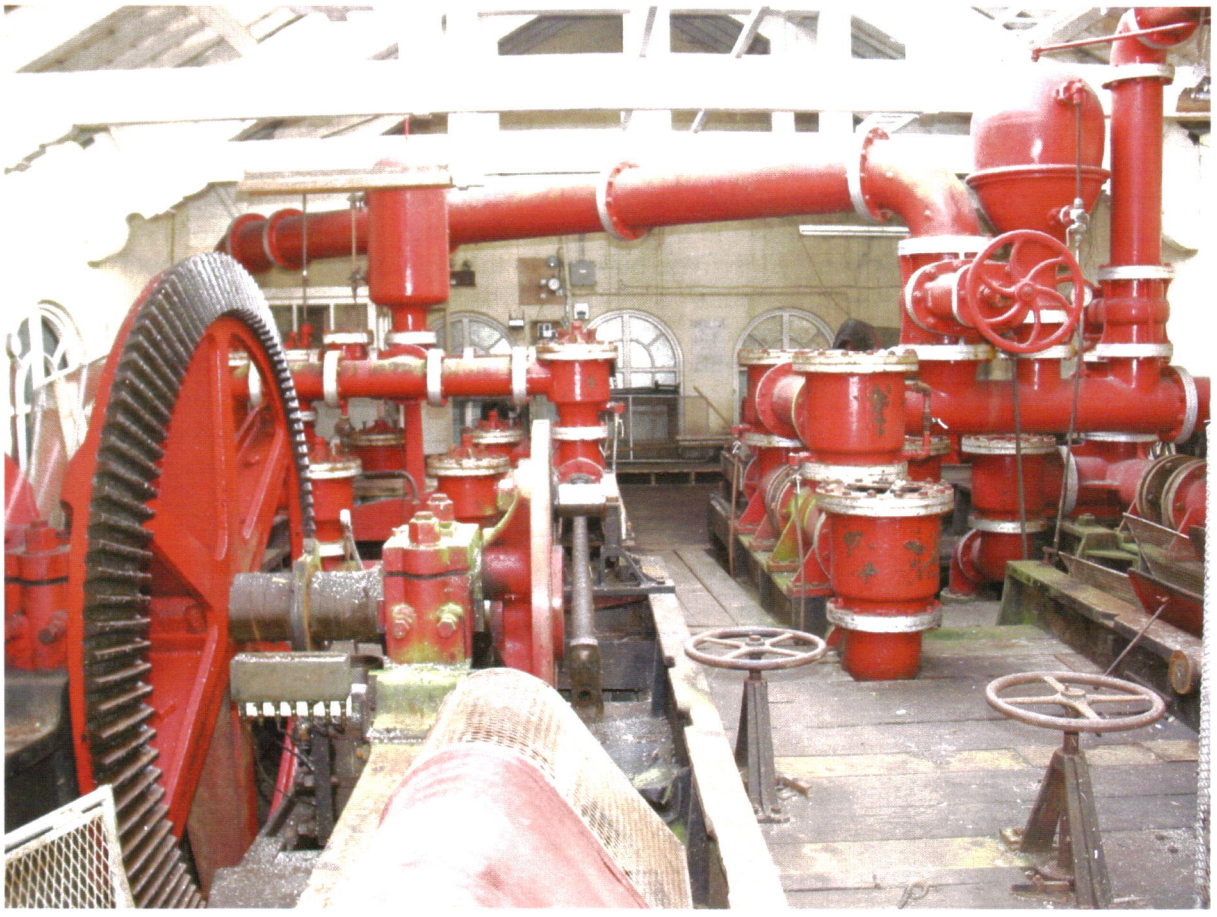
Cork Corporation Waterworks is the best-preserved Victorian water pumping station in Ireland. Most of the surviving buildings date to the second half of the nineteenth century and to the early years of the present century - these include the beam engine house of 1863, the main stack, 1858, and the turbine house of 1888. The turbine shafts drive a flywheel through a large bevel gear which in turn powers a reciprocating pump; four of those connected to individual turbine sets are twin double acting, the other is single double acting. There are three low lift pumps, each of which are twin double acting, which are able to pump *c.* 495,000 gals. per day against a static head of 239ft to the low-level reservoir, operating at 18rpm. The remaining two pumps lift *c.* 990,000 gals. per day against a static head of 383ft to the high-level reservoir. The five sets of turbine pumps all extract their supply from the original pure water basin, although the supply is no longer entirely dependent upon the filter tunnel. The high- and low-level reservoirs were phased out in the mid-1980s, but remarkably, the turbines continued to perform the function for which they were originally installed, and it was only in 1938 that the steam plant was initially decommissioned after the installation of electrically powered centrifugal pumps.

The three inverted triple expansion engines built by Combe and Barbour in 1905, and installed between 1905 and 1907, however, are the most striking features of the surviving plant. In the early 1980s the Institute of Mechanical Engineers of Ireland supervised a superb restoration of the surviving steam plant. In triple expansion engines the steam passes, successively, through a



Elevations of 1860s engine houses, Cork Corporation Waterworks

Lancashire boilers, Cork Corporation Waterworks



Interior of turbine house, Cork Corporation Waterworks

high- pressure cylinder, an intermediate-pressure cylinder and then into a low- pressure cylinder to act upon a low-pressure piston to initiate the cycle. The two large engines each have a Corliss valve gear, whilst the individual steam valves are also fitted with Combe and Barbour's own patent trip gear. The trip gear on the high-pressure cylinder was controlled by a fly-ball type governor, whilst those of the intermediate- and low-pressure cylinders are equipped with hand-operated cut-off gears. The individual flywheels are 12ft in diameter. In the basement of the engine house are positioned the ram pumps driven by the individual units of steam plant, and these are actuated through slide rods from the engine crossheads. Two surface condensers, which utilised the delivery mains as a cooling medium, are situated at the rear of the engine house. To the north of the engine house is a boiler house with two Lancashire boilers built by Victor Coates of Belfast in 1904 which are fitted with a 72-tube Green's Economiser with superheaters. During the Second World War the steam plant was recommissioned to obviate an over reliance on oil-powered generators of the electric pumping plant, and continued to be used for short periods afterwards.

The Lee Porter Brewery

The second surviving, though long defunct, eighteenth-century Cork porter brewery, is the River Lee Porter Brewery on Prospect Row, which was later incorporated into Beamish and Crawford's Nile Street ('Lee') Maltings Complex (see belwo). The River Lee Porter Brewery was built between 1796 and 1797, and by 1799 had passed into the ownership of the Cork banker and proprietor of Ballincollig Gunpowder Mills Charles Henry Leslie.

The brewery buildings are built around a quadrilateral courtyard, the eastern and southern sides of which originally faced out onto open channels, now culverted. A series of late eighteenth or early nineteenth-century drawings of the brewery, which provide valuable insights into the physical organisation of Beamish and Crawford's early rivals, have recently been discovered amongst the Beamish and Crawford collections held at the Cork Archives Institute. From the latter it is clear that the west wing of the brewery contained most of the plant. The northern end of this wing contained two coppers and two mashers, with an underback set between the mashers. Immediately south of these is a large tun and stilling room with seven double stillions and two 'working' tuns. The building to the right of the main Prospect Row entrance is called a 'vat storehouse', a term also used to describe the south wing of the brewery facing Dyke Parade. The River Lee Porter Brewery also appears to have operated water-powered machinery, which was possibly employed in the preparation of malt. The outfall sluice for the brewery's mill-stream was blocked up by 1833. In 1813 the brewery was sold by Leslie to Beamish and Crawford and was used as a storage area for its malting operation. The interiors of three of the wings have been entirely modernised by University College Cork.

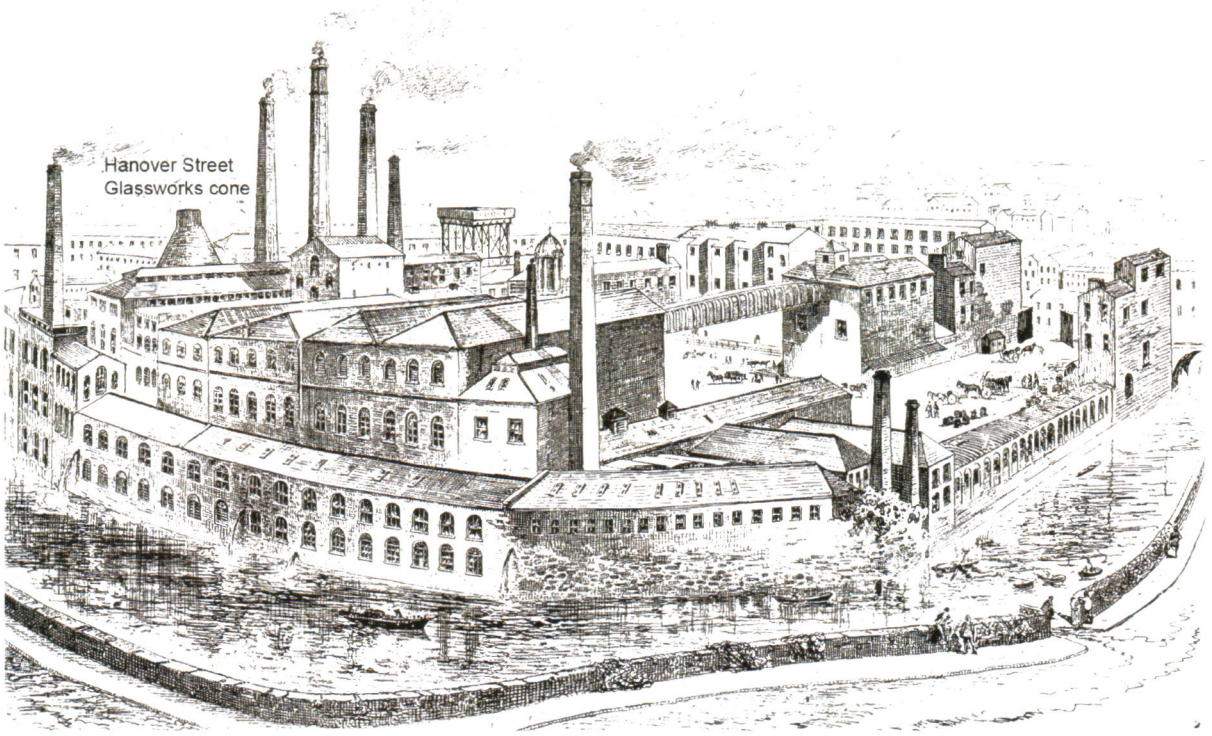
The Lee Porter Brewery

Beamish and Crawford's Cork Porter Brewery

This is perhaps the city's most enduring large-scale industrial concern. Its nucleus was a brewery and maltings in Cremer's Square converted by Aylmer Allen in 1782, the lease of which was purchased by William Beamish and William Crawford in 1791. They commenced porter production in 1792, in line with improvements made in the London industry.. Beamish and Crawford's output was of national importance, and it was the largest Irish brewery until 1833 when its output was exceeded by Guinness's of Dublin.

A large-scale survey by P. Aher dated January 1802 shows the brewery in embryonic form with its full extent lying between Lamley's Lane to the north and Morgan's Lane to the south. The old kiln shown on the south riverside of the complex was probably

part of Allen's maltings.



Beamish and Crawford's porter brewery in 1892

There were three vat rooms during this period, each containing four vats each, one large tun room (adjacent to the west riverside wall), a malt mill, and a cooperage and a cellar on Morgan's Lane. The earliest prime movers installed in the brewery were a series of horse whims. In 1818 these were supplemented by a steam engine, the housing for which still survives. From surviving plans of the complex dating to 1839, there can be little doubt that animal- powered engines were in use after 1818 and that these were used in conjunction with a steam engine. However, the installation of the second engine is likely to have allowed the horse whims to be dispensed with.

The physical development of the brewery before 1865 has largely been ignored in more recent accounts; where greater emphasis has been placed on the period subsequent to the refit of 1865-8. However, a large-scale survey of the brewery dated 1863 clearly indicates that further significant development occurred before 1865. There is, for example, substantial development in the southern half of the complex, where three cooperage stores have been built on the south quayside, whilst the malt loft is now connected by a tramway to a series of five new malt bins. The period 1865-8 witnessed a further period of refurbishment and redevelopment, during which it is claimed that some £100,000 was invested in modernisation. Doubtless important changes were made in the layout of the brewery during the 1860s, but its overall configuration at the turn of the twentieth century cannot be wholly ascribed to the developments undertaken in the 1860s. From the mid-1860s onwards the existing range of buildings was extended back onto the south-western riverside quay, with the construction of twin-storey cleansing and barrel-washing cellars, along with a bottle-washing facility.

By the early 1880s the brewery complex had reached its greatest extent. All of the intervening east-west laneways on the south side of South Main Street had now been

subsumed by its expanding mass, and the area to the riverside wall to the south of Morgan's Lane was occupied by its cooperage, the cooperage stores and yard. The Goad Insurance Plans of 1897 show two 40hp steam engines, one in the north-west corner of the site where the brewery's first engine was originally installed, the other in the engine house near the coppers loft. The Goad Fire Insurance Plans of 1897 show two boilers in this same position, but the mechanism involved is not expressly marked as an engine. Most of the impressive cast-iron superstructure of the main mashing loft dates to the period 1870-83. Details of the cross girders are shown on a drawing dated 14 March 1870, which provides a *terminus post quem* for the installation of the coolers in a special roof compartment above the main mash loft.

Most of the surviving buildings in the western half of the complex are eighteenth century, the principal exceptions being the malt-milling tower, the mash loft and the range of two-storey buildings abutting the western river wall. Where the main load-bearing walls of the late eighteenth-century range of buildings have not been rendered, it is clear that these are a mixture of sandstone and coursed limestone rubble.

The three-storey malt-milling loft, which has a relatively light framework sandwiched between wooden interior panelling and exterior corrugated ironwork, continues to dominate the skyline of the brewery. It is also probably unique in Ireland in that it still retains its entire range of late nineteenth early twentieth- century screening and milling plant. The upper floor of the tower contains the separator screens and a large wooden hopper, from which emanate wooden subsidiary chutes which feed the roller mills on the floor below.

The Lee Maltings

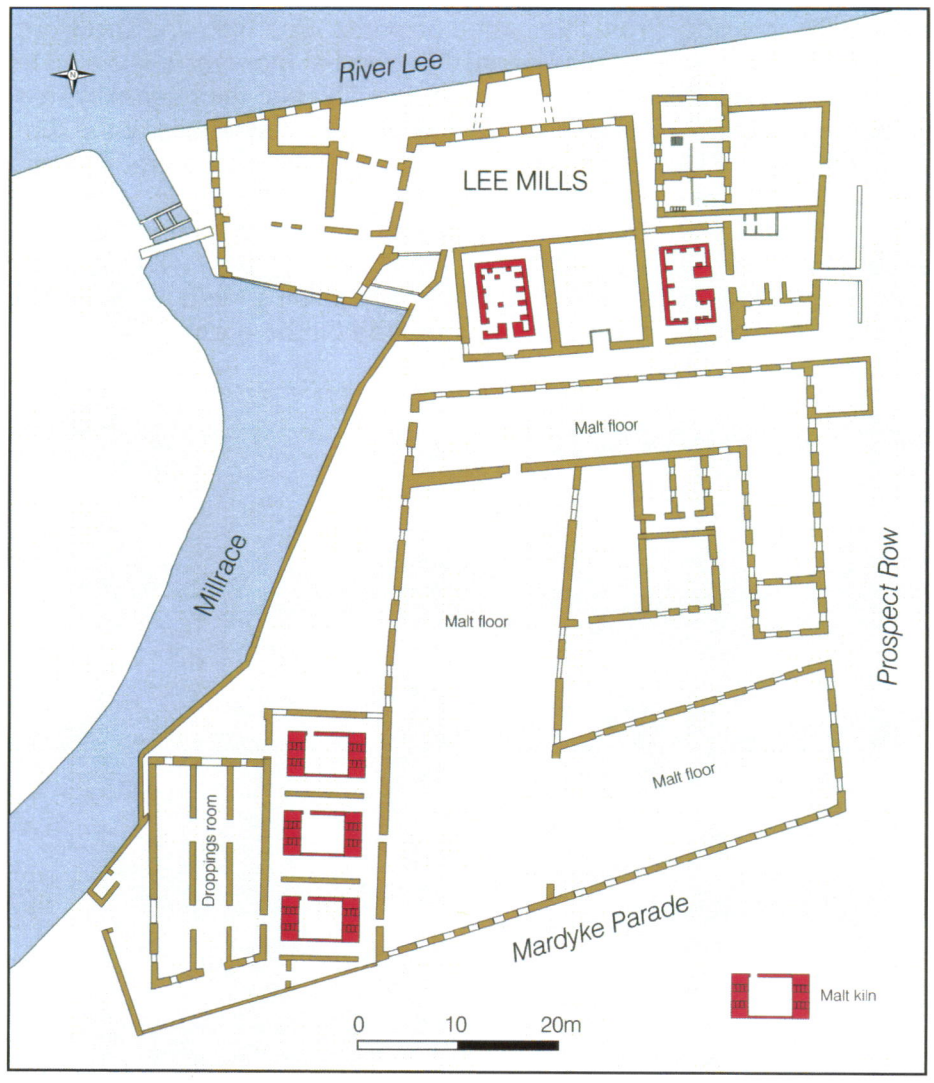
Up until the end of the nineteenth century the complex of buildings on Prospect Row-Mardyke Walk, known today as the 'Lee Maltings' consisted of a large, independently run flour mill, the former Lee Mills, and Beamish and Crawford's Nile Street ('Lee') Maltings. In 1813 Beamish and Crawford acquired the former River Lee Porter Brewery, which the company converted for use as a maltings and storehouses. For the greater part of the nineteenth century the maltings operation here was concentrated in the converted River Lee Porter Brewery complex, with the addition of two cellars adjacent to the headrace channel of the Lee Mills. These are clearly shown on a ground plan of the complex dating to the early 1840s and this is how they are depicted on the first edition of the OS of 1842.

The former River Lee Porter brewery complex operated three steeps by the mid-1860s. Each steep was positioned within a cast-iron framework made by Perrott's Hive Iron Foundry (see below), which survived *in situ* until its removal by University College Cork in June 1991. Two wooden-framed wagons on iron bogeys, running on wooden rails, were used to service the individual steeps, with a weighbridge positioned over the crossing point between the two main lofts. A trapdoor at the base of the wagon was positioned over the main feeder chute, from which were led three subsidiary chutes feeding (by gravity flow) the individual steeps. The steeps were positioned at the Prospect Row end of the malthouses, and the remainder of each storey served as growing floors.

By 1866 three substantial kilns and a droppings room (into which the kiln-dried malt was dropped from the kiln's drying floor) had been built onto the malthouses at their south-western extremity. Two further kilns, with an intermediate malt store and droppings room, had also been added. The construction of one of these kilns involved substantial modifications to the late eighteenth-century miller's house associated with Hayes' (i.e. the Lee) mills, which was effectively cut in half to form an

office and a smaller dwelling. From this period onwards, Beamish and Crawford began to concentrate their malting operations here and at Morrison's Island. The Lee Maltings at this period were clearly the largest in the city, and their capacity was further expanded with the conversions of the Lee Mills to malthouses at the turn of the century. Malthouses 1 and 2 each had two barley stores on the ground and first floors respectively, and four working floors. The largest surviving kiln, which post-dates the infilling of the headrace of the Lee Mills, was constructed in or around 1903. The other two surviving kilns appear to date to around 1867. Kiln no. 2 is a three-storey structure, the first and second storeys of which served as drying floors. The firing kiln, subsequently removed, was positioned on the ground floor.

The Lee Mills (latterly the Lee Maltings) in 1838



General plan of Lee Maltings

Early 20th-century malt kiln at the Lee Maltings

The Hive Iron Works

The Hive Iron Works was established on the western end of Hanover Street in 1800 by Thomas Addison Barnes, whose early output included web wire and bolting machines. Other specialist machinery manufactured by Barnes included brass wire web, and sieves for paper-making and frames for gunpowder manufacture. The frames for gunpowder manufacture were presumably manufactured for the Ballincollig Gunpowder Mills, with which the Hive Iron Works had a long association. Under Barnes' tutelage the Hive foundry built the iron gates which formally graced the entrance to Cork's Mardyke walk. Barnes and James Atkinson (who had worked as a machine-maker in Leeds) had manufactured flax and hemp-spinning machinery for the Besnard family's mills at Douglas and both men formally entered a partnership in 1811. In 1813 Barnes, Atkinson and two further partners Richard Perrott (1791-1870) and Paul McSwiney extended the original Hanover Street works.

The Hive Iron Works may well have been the first to manufacture steam engines within the city, and while there can be no certainty about this, the firm enjoyed the distinction of being the first in Ireland to manufacture marine steam engines. The first wholly Irish-built steamship, the Waterloo, built at Andrew and Michael Hennessy's yard at Passage West was fitted with engines built at the Hive Iron Works, under the supervision of James Atkinson. The engine appears to have been about 20hp and was in service up until 1870.In 1829 T.A. Barnes & Co. built a three-storey warehouse on Great Georges (Washington) Street, a formal structure with elaborate pilasters and moulded parapets, facing the street front..

By the late 1820s the Hive Iron Works, in addition to the manufacture of flour-bolting machines, wheat-scouring and patent separators, was also making steam boilers, both for engines and tannery-drying sheds. The amalgamated Hive Iron Works and Perrott's adjacent works occupied a long stretch of river frontage facing Wandesford's Quay, and became not only the largest engineering works in the city but one of the largest outside Belfast. In 1838 a total of twenty-eight steam engines, which collectively generated some 412hp, were at work in the city of Cork. The majority of these were manufactured by local foundries, namely Ring and Thompson's Union Iron Works on Lapp's Island, Paul McSwiney's King Street Iron Works, Edward King's Phoenix Iron Works on Smith Street and Richard Perrott's Hive Iron Works.

The Hive foundry was probably the first within the city to manufacture water turbines, a new technology which industrialists, engaged in the flax-related industries in the Cork area wholeheartedly embraced. In 1853 there were two water turbines (probably of the Fourneyron variety) at work in County Cork, at Ballineen near Bandon and at Riverstown near Cork. The first fully documented turbine manufactured by a Cork foundry, however, is the the 16hp Jonval-type turbine made by Richard Perrott for the Ballincollig Gunpowder Mills in 1855 (see above), which is the first of its type known to have been manufactured in Ireland. Perrott also appears to have manufactured metal waterwheels, from perhaps the first half of the nineteenth century onwards, one of the more noteworthy examples being a 20ft diameter wheel for Robert Webb's flourmill at Quarterstown near Mallow, County Cork in 1854.

By this period the foundry and engineering works on Hanover Street appears to have reached its greatest extents. The largest building within the Hive complex was the foundry which had three cupola furnaces with blowing engines powered by a 20hp beam engine. The main forge, which had a fitting loft above it and an adjoining machine maker's shop, was situated immediately to the west of this. The foundry's engine shop was equipped with lathes, planing, drilling and finishing machinery, all of which appears to have been powered by the work's steam engine via line shafting. Perrott was in the process of completing a pair of four-ton, cast-iron rollers for Ballincollig Gunpowder Mills in 1866 and was also manufacturing silk-dressing machines for export to Australia. Around the same time he was

fitting cast-iron stanchions for the line shafting of a flour mill at Bealick, near Macroom, County Cork.

Perrott's warehouse on latter-day Washington Street, built in 1829, is probably one of the first within the city to employ cast-iron supporting columns. The foundry supplied most of the cast-iron columns for St Patrick's Woollen Mills in Douglas village, built in 1882, and some impressive columns and beams for the main mashing loft of the Cork Porter Brewery in 1870 Perrott was also responsible for the cast-iron framework for the steeps installed in the Nile Street maltings in the 1860s for Beamish and Crawford. Ornamental ironwork such as railings can be seen all over the city (e.g. Sunday's Well Road, Sheares Street), and includes the entrance railings for Cork City Gaol and the bollards and quayside railings manufactured for Cork Harbour Commissioners.

Hive Iron Works warehouse of 1829

South Gate Bridge

South Gate Bridge and Quoile bridge in County Down have the oldest surviving three-centred arches in Ireland, a style which was widely adopted when bridge spans increased to reduce road gradients. The South Gate Bridge has two, 4ft 5in wide river piers with cutwaters, and three, three-centred arches, the northern and southern side arches of which have 21ft and 23ft spans respectively. The bridge's centre arch has a span of 26ft. The limestone used in the construction of the bridge was probably quarried locally. As far as can be seen, the west-facing or upriver section of the bridge is the original section of the bridge built by Coltsman in 1713, the downriver section (designed by Alexander Deane in 1824) being added later.

South Gate Bridge, 1722

The North Mall Distillery

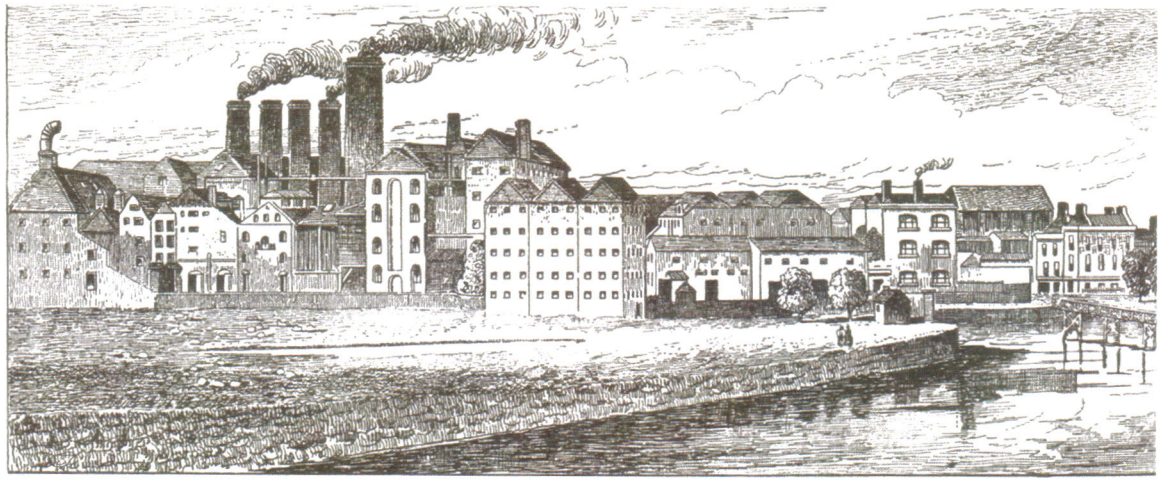
The traditional date for the founding of the North Mall Distillery is 1779, a date which has never been satisfactorily documented. In the nineteenth century the enterprise can be closely associated with the Wise family, but no-one of this name is known to have an association with distilling until 1782. Nonetheless, the Wise's were well- established at the North Mall by 1802 by which time they were working a new 1,112 gallon still, later replaced a 1,516 gallon still in 1807. Beaufort's map of 1801, appears to show the original grain stores for the distillery, facing Sunday's Well Road.

The North Mall site was the only distillery in the city to draw its water-power requirements from the North channel of the River Lee, via a diversion dam or weir which directed water into the distillery's millrace. In 1833 'Wise's Weir' was some 230ft long, and in 1863 its sill was 10ft 6in OD, which made it the second largest hydro-power dam on the North Channel of the Lee. The site of the weir and the mill channel are probably medieval, having a long association with the site of the Franciscan Abbey mill. The site of Wise's malt mill and its millrace is clearly shown on John Rocque's map of 1759 as the 'Abbey Mill". The distillery's title to the 'St Francis Abbey Mill' derived from a lease made to William and Thomas Wise by the Earl of Cork dated 26 March 1804. From 1809 onwards the distillery's cooling pipes were laid in the mill channel a practice recorded at most of the other distilleries within the city, but the primary uses of this channel are likely to have been for the operation of the malt mill and for the mashing machinery.

Relatively little is known about the early physical development of the North Mall distillery, despite the fact that it was the longest continually operated distillery in the city. A 20hp Boulton and Watt beam engine was installed in 1808 which made it the second distillery in the city to use steam power. In 1848 the malt mill was powered by an 11ft 6in diameter undershot waterwheel with 32 floats which were capable of powering four pairs of Irish stones, which were presumably all used for grinding malt. The entire site, which by the

1880s covered some 23 acres and had a frontage of 684ft, was described in detail by Alfred Barnard in 1887.

North Mall Distillery in 1842



Panorama of North Mall Distillery from Barnard, *Whiskey distilleries of the United Kingdom*, 1887

The granaries, which were built against a sandstone escarpment, enabled access from Sunday's Well Road, where doubtless some of the sandstone used in their construction was quarried. Barnard states that these had a capacity of 30,000 barrels. The barley was first passed through cleaning machinery before being conveyed to one of the four drying kilns, after which it was removed to the grain deposit rooms and thence via bucket elevators to the malt mill. The malt mill, which replaced the earlier structure described above, and which itself was demolished in 1985, was constructed in or around 1850. This

was a five-storey structure with hipped roofs on each main division, tied internally with cast-iron bars; the individual floors being supported on cast-iron columns (Ryan 1985). The mill straddled arches built immediately over the mill channel, one of which enclosed a 25ft diameter undershot waterwheel which drove six pairs of stones. The upper floors of the building functioned as storage lofts.

The power requirements of nearly all of the North Mall's machinery in the 1880s were met by two steam engines, of 60hp and 40hp respectively, by John Rowan & Sons of the York Street Foundry, Belfast, with six Galloway patent steam boilers. In the panorama of the North Mall distillery published in Barnard's account five chimney stacks are shown, but in 1877-8 the Cork Distilleries Co., who bought the distillery in 1867, demolished these and connected all of the main flues to a single stack 160ft high. The butt of this can still be seen on Sunday's Well Road complete with its foundation plaque.

The greater part of the North Mall premises was destroyed by fire in the 1920, when the main grain stores were destroyed. In the aftermath of this accident, the manufacture of pot still whiskey ceased. The malt mill was demolished in 1984 and up until 1988 the remains of the distillery's bonded stores survived at the foot of Wise's Hill. At the present showing the only surviving structures associated with the distillery are the corn stores fronting onto Wise's Hill and a twin-arched stone bridge allowing access to the adjacent island which currently houses some of Irish Distillers bonded stores and an early twentieth-century cooperage.

Cork Harbour Commissioner's bonded warehouses

The Cork bonded warehouses, at the rear of the Cork Custom House, designed by Abraham Hargreaves and opened in 1818, are a rare survival of an earlier form of fireproofing. The ground plan of the bonded warehouses was designed to match the footprint of the newly constructed quayside, being trapezoidal in outline and tapering inwards on a west-east long axis. It is a two storey and loft structure constructed with random rubble, local green sandstone, cut limestone being employed for both window and door dressings and, of course, for the distinctive fireproof stairwell towers, which have a circular ground plan and house stone spiral staircases. On the north-facing elevation the original hoist mechanisms survive *in situ*. In the interior, the first and second floors are constructed with a matrix of brick rib vaults, built with Youghal brick, similar to that used in Cork harbour Martello towers constructed in the period 1812-14. The vaults are laid on an east-west axis, and spring from a series of square brick columns. Stone flag floors are employed throughout and these, along with the brick vaulting, provided an elementary form of fireproofing. Given the high value nature of the goods store here (both spirits and tobacco), this was essential, and in the era before cast iron construction, vaulting provided both protection from fire and a means of ensuring constant temperatures. The wooden-framed and slate awning (which now survives mostly on the west-facing and south-facing elevations) is one of the most interesting extant features of the building. The main timber frame is suspended from the outer face of the building by wrought iron tensioning rods. These latter are affixed to wrought iron hoops, affixed to either the flat facing stones, decorating the outer ends of the window arches (at first floor level), or into limestone blocks set into the original masonry.

Cork Harbour Commissioners' bonded stores, 1818

Ford motor works

By 1912, Henry Ford had decided that Cork was to become the location for his first manufacturing presence outside the USA. There seems to be little doubt that Cork had no special economic attractions for any branch of American industry, and it appears that Ford's motives were wholly philanthropic. Cork, it is clear, was chosen largely for social and political reasons: Henry Ford's ancestral home was near Clonakilty in County Cork and Ford himself had visited there in 1912. The raw materials needed for the mass production of tractors were non-existent at any Irish location, while the demand for tractors in Ireland could only be optimistically described as negligible. The decision to locate a large tractor factory at Cork was given the full backing of the British government which passed an act of parliament to enable Ford to purchase the tractor works site at City Park.

Wharves were built to the east of Cork, on the City Park side of the River Lee to accommodate the new tractor factory, followed by an enormous machine shop and a mobile crane to facilitate the production of pig-iron from the factory's furnace. At its opening, in 1919, the Cork plant covered over 330,000 sq ft. In July 1919, the first Fordson tractor, a 22 hp, four-cylinder model which could work with either kerosene or paraffin, rolled off the Cork assembly line, and by the end of that year, some 300 tractors were completed. However, it soon became evident that the production of the Fordson tractor was not enough to keep the Cork plant going. Cork had been intended to function as an assembly and production plant for Britain and Europe, but when tractor production reached a peak of 3,626 in 1920, the demand for tractors in post-First World War I Europe slumped alarmingly. It became abundantly clear that the Cork plant could not produce tractors economically, and so Ford decided that the Cork works should begin to manufacture Model T components for the new Ford plant at Manchester. Nonetheless, in the

early months of 1920, the company invested a further £327,000 on the expansion of its foundry and a machine shop, which was fitted out with new equipment, whilst the existing wharfage was also expanded.

The foundation of the Irish Free State, however, brought further burdens for the Cork plant. New duties by the British government were now placed on the cost of Model T parts manufactured at Cork and exported to Manchester, the net result of which was that it was no longer viable to produce parts for the British market in Ireland. The future of the plant was assured, however, by its transformation into an assembly plant for Ford Model T cars for the Irish market, the production of which, at Cork, ended in 1927, by which time over 10,000 cars had been assembled.

In 1928, the parent company made the momentous decision to transfer the production of its tractors from its Dearborn, Michigan plant in the USA to Cork, and in the winter of 1928-9, all of the machinery of the Dearborn plant was shipped there. Cork was now the largest tractor factory in the world, a position it held up until 1932 when Henry Ford and Son decided to shift tractor production from Cork to its plant at Dagenham in England. The Ford Motor Works in Cork remained one of the largest employers in the Cork region up until its closure in the early 1980s. Extensive remains of the original tractor factory, which was clearly designed by Ford's architect Albert Kahn, (a brother of Julius Kahn, who had invented the reinforced concrete system that bears his name), along with warehouses and custom-built wharfage are in evidence, most of which are now used as storage facilities.

Ford Motor Works, Cork, 1919

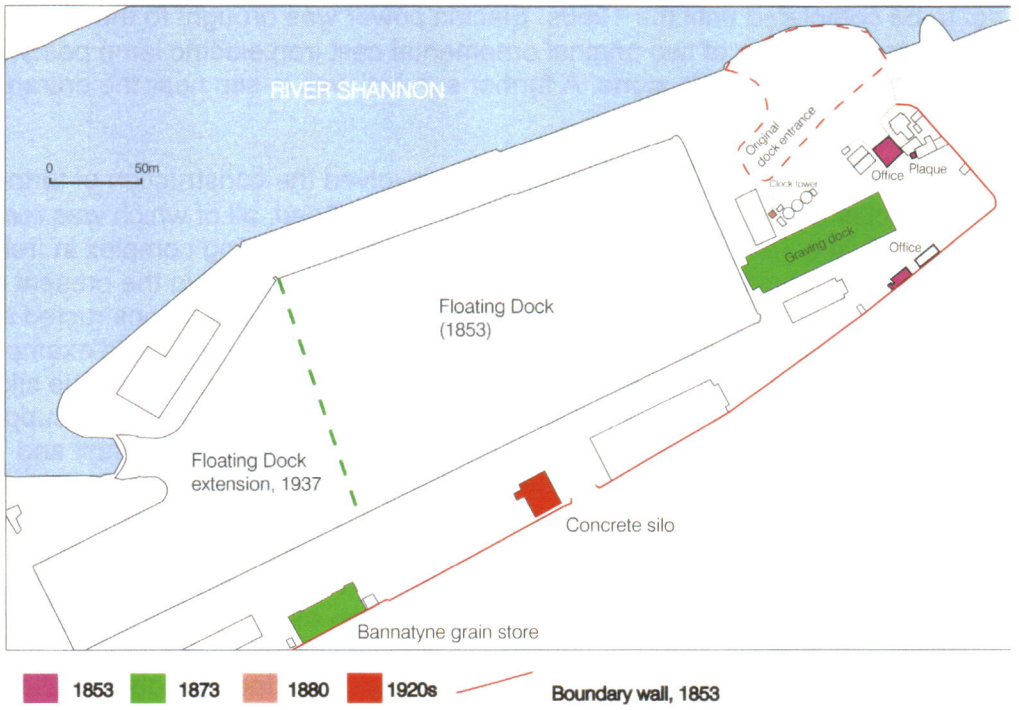
Wednesday 31st August

Great Southern and Western Railway, Mallow, County Cork

Construction work on the Great Southern and Western Railway (GS & WR) network, which was to effectively link the capital to the southern provinces, began in 1845. The network eventually covered some 1,500 miles, making the GS & WR, Ireland's largest railway company. In 1846 William Dargan was awarded the contract for the 78 mile Thurles-Cork section of the line, which within three years had reached the northern outskirts of Cork. The stretch from Mallow to Cork traversed some quite difficult country which required a series of high embankments, and three impressive stone viaducts over the Blackwater at Mallow, at Monard and at Kilnap near Cork. The Kilnap viaduct has eight masonry arches, each with a 42½ft span, and carries the line over the deep gorge formerly occupied by Shaw's flour mills. However, the railway's approach to the city quaysides required that a long tunnel be bored through a high sandstone ridge, a feat of engineering to which Dargan and Sir John MacNeill proved more than equal, but which was to take almost seven years to complete. Thus as an interim measure to accommodate Dublin-Cork services a temporary terminus was erected at Kilbarry which became known as Blackpool. The original railway station at Mallow, completed in 1847, is one of the best preserved main line stations on the GS & WR network.

Limerick docklands

The Limerick floating or wet docks were constructed between 1849 and 1853, under the overall supervision of the Limerick harbour Commissioner's engineer, John Long. As originally constructed they consisted of a basin some 7.66 acres in extent, internally faced with massive cut limestone blocks. The original 70ft-wide entrance was positioned on the upstream side of the dock and the lock gates were constructed by Robert Mallet's Dublin foundry using his patented 'buckled plates'. In Mallet's patent, a series of metal plates could be riveted together to form a rigid composite plate and he had begun experimenting with these in 1840, before finally patenting the idea in 1852. Thereafter his buckled plates (which enabled the required thickness of iron and steel plates employed in bridge construction to reduced) began to be used in the construction of metal bridges throughout the world. Buckled plates, on Mallet's patent, were used in the construction of the Westminster Bridge in London in 1859, in St Pancras Station, London (1867) and in a road bridge over the River Trent at Nottingham in 1870. Bindon Stoney also employed them in the rebuilding of Essex Bridge in Dublin in 1870. The use of buckled plates in the original Limerick dock gates is, therefore, the earliest recorded use of Mallet's patent in Ireland and is the only known use of this technique in wet dock construction.



General plan of Limerick docks

The expansion of the port of Limerick created a need for a graving dock on the site, work upon which began in 1870, but which was not completed until 1873. By the middle of the nineteenth century most Irish ports had a graving dock which were, in essence, dry docks, in which a ship's hull could be 'graved', i.e. cleaned of accretions and re-tarred. Other essential maintenance, such as the replacement of ship's timbers, could also be effected. At Limerick, as at the vast majority of other Irish examples, the sides of the dock were formed with cut stone steps, which could be used to wedge wooden props around the vessel once the dock had been drained. At its riverside end, the dock would be equipped with flood gates, which would enable a vessel to be floated in and, once closed, facilitate the pumping out of water in the dock.

The creation of the floating docks attracted other industries to its immediate environs. In 1873 what was then the largest grain warehouse in Ireland was erected by James Bannatyne and Sons within the dock complex. This latter is a seven storey grain store, flanked by two large service towers at each end. The internal pitch-pine floors are supported on cast iron columns with union castings on their upper extremities, but somewhat surprisingly there is no internal fire-proofing for a building of this period. This structure is one of the largest and best-preserved examples of its type and general date range in Ireland. In the main, Irish grain stores do not display this level of architectural ornamentation, the only examples within the north Munster region to display any architectural pretensions are Glynn's corn stores at Kilrush, county Clare, completed in 1837.

In 1880 a three stage clock tower was erected on the insula to the north of the graving dock. This is constructed with cut limestone with the stages defined by string courses: the uppermost stage has an attractive cast iron balcony. This is one of two surviving dock clock towers in Ireland. The other example, on the Waterford quaysides (erected in the 1870s) is, however, not as well-preserved as that at Limerick. A large section of the floating dock retaining wall (in all, some 470ft) collapsed in 1887 and, while repairs got underway in 1888, they were not finally completed until 1891. These latter appear to have been undertaken on the southern dock wall where different coping stones were employed. Continuing difficulties with the eastern dock entrance obliged the Harbour Commissioners, in the late 1880s, to apply for a loan for the construction of a new, western entrance to the floating dock, although

this was not to be completed until the 1950s. Electric power was brought to the site in 1904, by Limerick Corporation. One of two original ornamental cast iron electric lamp posts survives near the commemorative stone. A further survival was in situ near the entrance to steam boat quay up to the late 1990s.

The post-1900 expansion of the Bannatyne complex involved the construction of further grain stores and roller milling plant to the south of the Dock Road, all of which was removed in the late 1990s. By the 1907 this had become the largest flour-milling complex in Ireland, and remained so up to its closure in 1983. A multi storey grain silo, within the present docks complex, is the only important survival of this period of activity. This was constructed in the early 1920s, using Mouchel-Hennebique concrete, and is the earliest recorded example of a grain silo in Ireland to have been constructed using this type of ferro-concrete. The silo was connected by a conveyor belt which spanned the Dock Road, and by this means supplied the main milling complex. In Ireland, J and R Thompson of Roden Street, Belfast and Fairview, Dublin became Hennibique's licensee, and the Monarch Laundry in Belfast, completed in 1906 is, on present evidence, the earliest of the use of this system in Ireland. The Suir bridge at Waterford which opened in 1913, and later replaced by the present lifting bridge in the mid-1980s, was also designed by Mouchel and constructed using the Hennebique system. In 1933 work began upon the extension of the floating dock, but this was only partially completed in 1937. Not until 1953 did work begin on the western lock gates begin, which opened in 1956. The original dock gates, erected by Robert Mallet in 1853 were removed and the eastern entrance filled in.

Limerick docks, showing graving dock in centre, 1873

The Lansdowne Flax spinning and weaving mill, 1853- *c.* 1870.

The nucleus of the present site is a former flax spinning mill, constructed between 1851-3, for the flour milling magnates J. N. Russell & Sons. This follows a pattern, discernible in aspiring industrial towns such as Cork, Dundalk and Drogheda, to emulate the enormous international success of the Ulster linen industry which, by the early 1850s, had proved to be Ireland's main industrial concern. The cast-iron columns were supplied by Rowan and Sons York Street Foundry of Belfast, and are date-stamped 1851.The Lansdowne Spinning Factory, on Limerick's North Strand, began production in October 1853. To the west of the spinning mill, around 1855, a weaving complex was added to create a fully integrated spinning and weaving mill, then the largest of its type outside the Lagan Valley. By 1866, some 2,000 local people were employed in its operations. From the outset, however, a shortage of professional management skills was to impair the performance of the mill and, ultimately, to undermine its position relative to the Belfast industry. The latter, it is clear, gained significantly from the availability of a pool of highly skilled local labour. In all, some £40,000 was expended on plant and buildings. After the death of J. N. Russell, in 1859, one of his sons, J. A. Russell, undertook to run the mills and, in the light of their poor financial performance, commissioned James Campbell a former managing partner of the Belfast firm of James Boomer & Co. to report on the operation of the Lansdowne Mill. The mills were damaged by a fire in 1869 and by 1870 were no longer functioning as linen mills, but by 1877 had been converted for use as flour mills by Russell. Their use as flour mills was short-lived, for in 1884 the entire site became the location for the Cleeve brothers Condensed Milk Company of Ireland, upon which some £100,000 was expended on converting the premises to condensed milk manufacture. This was, for many years, the primary use of the site, although only small areas of the original flax mill were adapted for this use and, indeed, principally for storage. However, as its main plant was accommodated in other, purpose-built structures, its power requirements were quite different, and this necessitated the construction of a new engine house, boiler house and stack (see below). Water for processing was now acquired from a tidal pond immediately to the west of the site and a series of infiltration galleries were constructed to accommodate this. This latter, up to quite recently, was still being used.

Lansdowne flax mill, 1853

Bridges across the River Shannon: The Pain brothers were responsible for the design of two of the bridges on the River Shannon at Limerick, Athlunkard Bridge, which has five 67 ft (20.42 m) span segmental arches, and Thomond Bridge, built between 1838 and 1840 by the Board of Works. However, by far the most elaborate bridge spanning the Shannon at Limerick is Alexander Nimmo's Wellesley (Sarsfield) Bridge, which was completed in 1835. Nimmo, who had worked under Thomas Telford in Scotland, and who had first come to Ireland in 1825, based his design on that of Jean Adolphe Perronet's famous Pont Neuilly near Paris, of which it is a half-scale replica. In Nimmo's design, the arches are constructed using Perronet's 'bell-mouthing' technique, in which the external flat segmental arches on the front elevation change into an elliptical form on the arch interior.

Sarsfield's Bridge, 1835

Limerick Customs House: Davis Ducart's Limerick Customs House, begun in 1765 and completed in 1769, was, in its day, the most imposing building of its type ever to have been built in Ireland. Christopher Colles, who had developed stone cutting and boring machinery for his Kilkenny quarries, served as Ducart's assistant and was the site architect during construction.

Ducart's Limerick Customs House, 1769

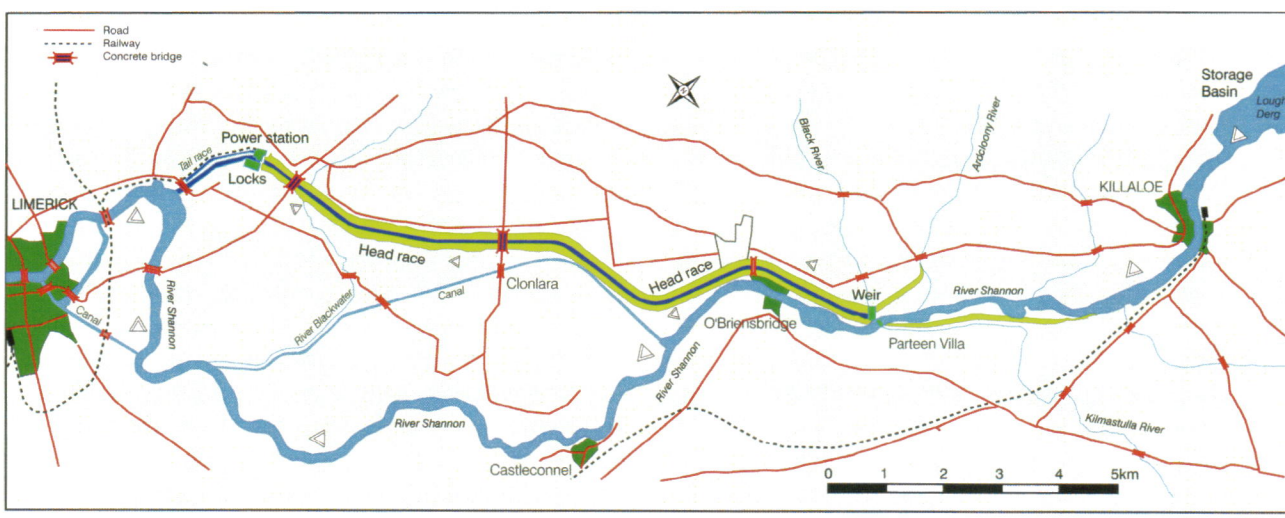
The Shannon Scheme hydro-electric scheme at Ardnacrusha

One year after independence, in 1923, there were around 300 electrical producers within the new Free State, creating current using coal, oil, gas and water-powered generators. Yet before the end of the 1920s Ireland, one least industrialized areas of Europe, and previously one of the lowest consumers of electricity, became the first country in the world to have a state-controlled national electricity grid. What became known as the Shannon Scheme was the brainchild of the Irish engineer, Thomas McLaughlin (1896-1957), who had joined the German electrical engineering giant Siemens-Schuckert in 1922. In 1844, Sir Robert Kane had estimated that upwards of 34,000 horsepower could be created using the waters of the Lower Shannon, utilizing the fall from Killaloe to Limerick. But unlike earlier proposals to put this to good use, McLaughlin had fully considered the technical difficulties and had devised practical solutions, with the help of his colleagues at Siemens. McLaughlin's technical vision for the Shannon Scheme also involved the creation of a state-run company to control the production and distribution of electricity generated by the project. This led to the establishment, by legislation, of the Electricity Supply Board (ESB) in 1927, Ireland's first semi-state body with, rather fittingly, McLaughlin as its first managing director.

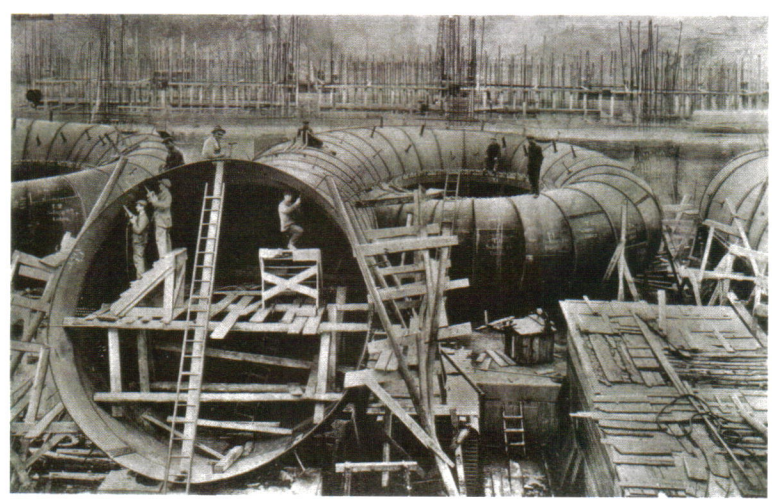
The contract for the Shannon Scheme was awarded to Siemens-Schuckert in 1925, the largest foreign engineering project to be won by a German firm since the construction of the Baghdad railway who, in addition to building the hydro-power station and its associated works at Ardnacrusha, County Clare, were also responsible for erecting some 3, 400 km of overhead cable in the period 1926-29. At its height in 1928, some 5,000 labourers were employed. The non-existent road network necessitated the construction of a purpose-built railway network some 100 km long, running on two narrow gauges, one of 900 mm (*c.* 2 ft 111/2 in) the other 600 mm. This was built by Siemens-Schuckert's sister company Siemens-Bauunion and accommodated up to 130 steam locomotives and as many as 3, 000 wagons and other rolling stock. This network was vital during the construction works and it has been estimated that it was used to carry 7.5 million cubic metres of earth and 1.25 million cubic metres of rock.

Ideally, the supply for the power station at Ardnacrusha, near Limerick, would have been created by the construction of a large dam across the River Shannon, which would have impounded a supply behind it. However, as local topography precluded this the waters of the Shannon were brought to the generating station site by what was, in effect, a giant millrace.

At Parteen Villa, near the village of O'Briensbridge, some 5 km to the south of the town of Killaloe, a weir was constructed on the Shannon, which was designed to raise the water level by 7.55 m: the same at that of Lough Derg. The weir intake has six sluice gates and a fish pass some 190 m long, this latter the largest of its type in the world to have been constructed up to that time. From Parteen Villa a head race channel 12.6 km long, led the water to the hydro-electricity generating station at Ardnacrusha. This latter comprises an intake sluice house, penstocks, a generating building, a waste channel and navigation locks. The headrace channel terminates in a 30 m high dam, which supplies three 41m long, 6m diameter penstocks, each inclined at a slope of 31° and delivering 100 tons of water per second. Ardnacrusha began operations using three Francis turbines in 1929, to which a Kaplan turbine was added in 1934, this latter being the first of its type to utilize a head in excess of 30 m. The tailrace is 2.4 km long and returns the waste water to the Shannon further upstream. Three concrete road bridges, all of which survive, were built over the headrace while a further example was built over the tail race at Parteen. The Pigeon House generating station was synchronized with Ardnacrusha in 1930 and was finally shut down in the same year; thereafter the city of Dublin and the greater part of its environs being supplied with current from the Ardnacrusha station. In that same year, the Ford factory at Cork was in receipt of a supply from the Shannon Scheme, which in 1931 generated some 96% of the current used in the 26 counties.



General location map of Shannon scheme



Volute casing for turbines under construction at Ardnacrusha

Thursday 1st September

Cobh and Environs

The town of Cobh commands the entrance to Cork harbour, where transatlantic convoys took on provisions throughout the 18th and early 19th centuries. However, owing to the shoals of the River Lee ships of larger burthen, into the 1870s, were obliged to tranship their cargoes to lighters. Owing to the strategic significance of the Cork harbour trade a number of important artillery forts, Forts Carlisle and Camden, were built on the cliffs overlooking the mouth of the harbour. During the 1790s a further fort was constructed on Spike Island (see map below). The harbour thus became the most heavily defended in Ireland.

Cobh also became important as a embarcation point for transatlantic liner, and was the last port of call for the *Titanic* in 1912. During Ireland's railway age, it also became the point at which the transatlantic mails were put ashore, where they were carried by rail from Cobh to Cork and to Kingstown (Dun Laoghaire), from which they were shipped to Holyhead. The victims of *Lusitania*, sunk by a German U-boat in 1915 off the Old Head of Kinsale are also buried near Cobh.

Admiralty map of Cork harbour, 1812

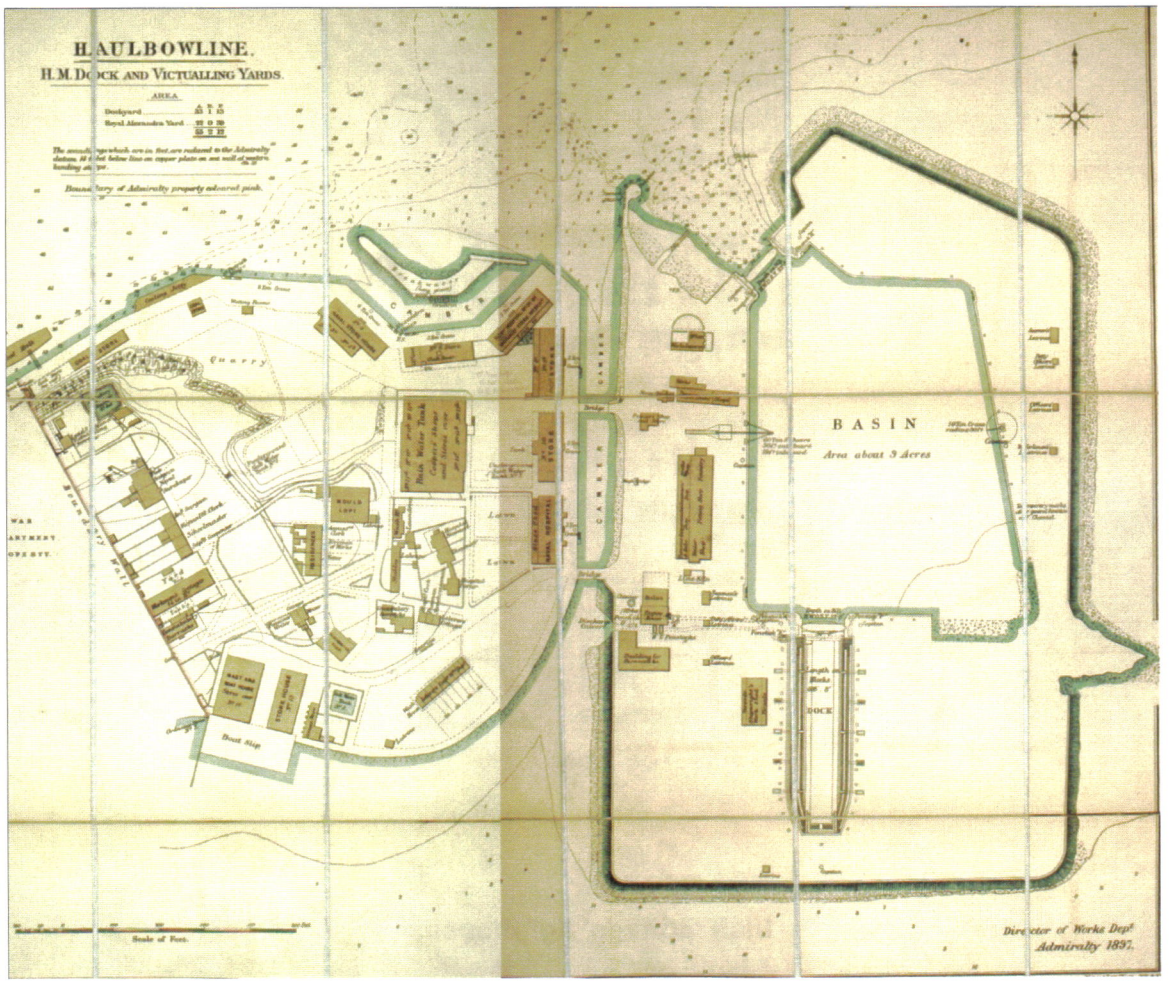
Supplying the South Atlantic Fleet: The Admiralty victualling yards on Haulbowline Island

The southern Irish ports of Cork and Waterford were to become important beneficiaries of Britain's transatlantic trade well before the Union was passed, a position they were to maintain up to the end of the Napoleonic wars. Of all the eighteenth-century Irish ports, however, Cork was clearly the most important single supplier of 'wet' provisions (i.e. butter, pork and beef) for both the British army and navy. Up to 1782, indeed, it enjoyed a virtual monopoly of the provisioning of British naval and army supply ships, and even after this date it still accounted for two thirds of wet provisions sourced in Ireland by the British military. A Cork harbour location became, therefore, the obvious choice when the Admiralty decided to revamp its victualling facilities in Ireland, early in the nineteenth century, in order that these could accommodate the entire needs of the British south Atlantic fleet . The harbour had long been an important assembly point for Atlantic convoys, and its increasing strategic importance to Admiralty had been underlined with the expansion of its defences. As early as 1795 it had been decided to construct new storehouses on Haulbowline Island to replace those already in existence in Kinsale harbour to the west. In 1806, orders were issued for what was to become an important British naval base on the island, protected by the artillery fort on nearby Spike Island and with unrivalled access to the rich agricultural hinterland of Cork harbour.

The Haulbowline victualling yards, built between 1816 and 1822, were to become the only home or overseas naval buildings whose construction was to be overseen by a female building contractor. Mrs Elizabeth Deane - mother of Sir Thomas Deane of the famous Victorian Deane and Woodward architectural practice – had taken over her husband's building firm after his premature death, undertaking important construction contracts up to her own death in 1828. Elizabeth was conveyed in a ten-oared galley from her home at Lapp's Quay, Cork to Haulbowline Island, on a regular basis to oversee the works.

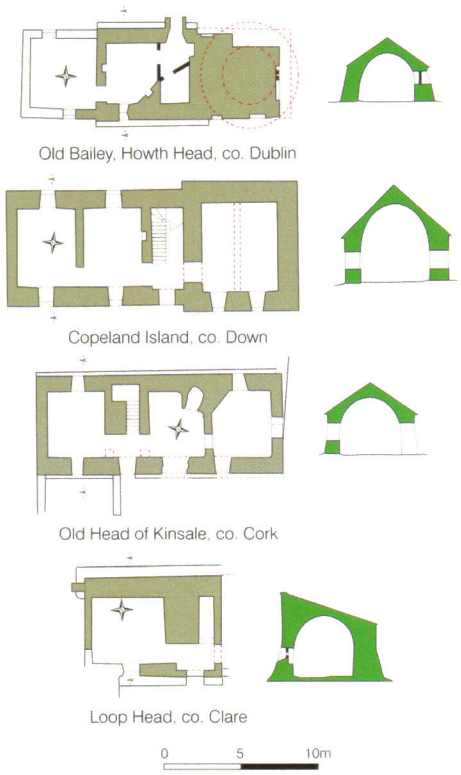
Enormous water tanks, to the west of the east-facing storehouses, were designed to hold up to one million gallons of water. The construction technique employed in the storehouses, which were provided with what appears to be an early form of transitional fireproofing, unique in Ireland, may well have influenced Edward Holl's use of cast-iron in later naval buildings, such as the Port Royal Jamaica (c. 1817) and Bermuda yards (1822-31). However, while the cast-iron columns and beams supporting the internal floors of the Haulbowline stores have a fish-backed profile similar to those of English fire-proofed buildings of the period, in contemporary British buildings, these beams are used to support a matrix of brick segmental jack arches. But at Haulbowline, the series of flanged sockets set into the upper edges of the girders were used to support wooden joists. Nevertheless, the Haulbowline internal iron framing (apart from being the earliest recorded example of its type in Ireland) appears to have no obvious Royal Naval exemplar elsewhere. The victualling yard at Haulbowline, in its heyday, was in full operation between 1816-1832, during which it was responsible for the provisioning of the entire British South Atlantic fleet. The Haulbowline dockyards also figure prominently in views of Cork Harbour, executed in various media throughout the nineteenth century. The southern storehouse buildings would have been a common site for mariners entering the harbour up to the late 1930s when the steelworks site was constructed.

Naval frigate off Haulbowline Island, c. 1844, by George Mounsey Wheatley Atkinson (1806-1884).



Admiralty plan of Haulbowline Island, 1897

Old Head of Kinsale lighthouses: Up to 1717, when the Trustees of the Barracks took over responsibility for the maintenance of both Irish barracks and lighthouses, the latter were commonly built under letters patent from the crown, by private individuals, who were empowered to collect tolls from shipping. Thus Sir Thomas Reading, in 1665, acquired patents to erect lighthouses in Ireland, which included two brazier lights on the Hill of Howth, and that on the Old Head of Kinsale. A number of early eighteenth-century Irish cottage lighthouses, principally at the Old Head of Kinsale, county Cork, and at Loop Head on the Shannon estuary, have survived, and it is clear from these that they differ in certain key respects from their contemporary British counterparts. In its essentials, the Irish cottage lighthouse comprises a stone or brick-vaulted cottage, which has an internal masonry staircase that facilitates access from the interior to a brazier platform on the roof. The internal vault, it is clear, was a fire-prevention measure. However, unlike British examples, where the living quarters were positioned in a tower, in Ireland, such accommodation was provided in what was essentially a modified form of vernacular cottage. Many of these early lighthouses, as in the case of that on the Old Head of Kinsale were erected on high headlands, but where this was not possible, as on Lighthouse Island in Belfast Lough (*c.* 1717), the brazier was elevated in 70 ft (21.33 m) high masonry tower. The Old Head of Kinsale cottage lighthouse was converted to candle light as early as 1703, and continued in this form until 1714, by which time it was found that the original fire provided a better light. A fire was reinstated from 1714 to 1803 and, indeed, brazier lights continued in use at Howth Head up to 1790 and in Belfast Lough until the beginning of the nineteenth century.



Irish 'cottage' lighthouses

Brazier lighthouse, Old Head of Kinsale, c. 1710