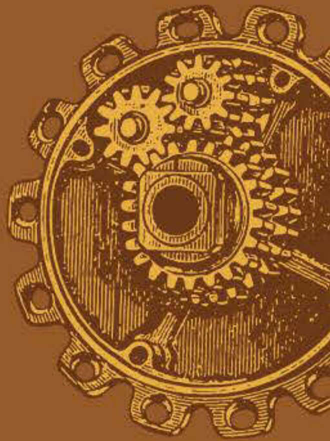
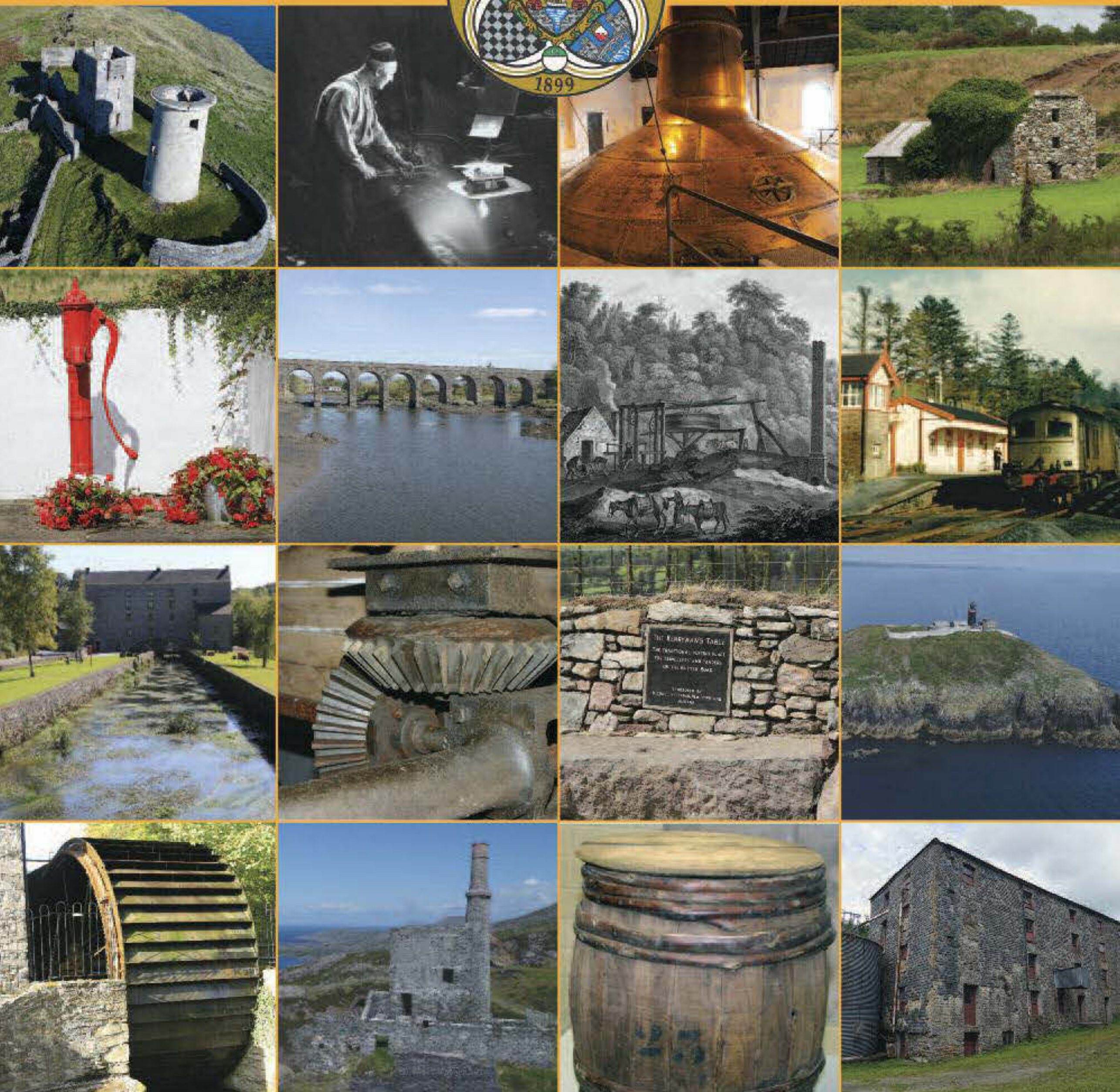
INDUSTRIAL HERITAGE
of County Cork





INDUSTRIAL HERITAGE
of County Cork

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Email: cork.heritage@corkcoco.ie

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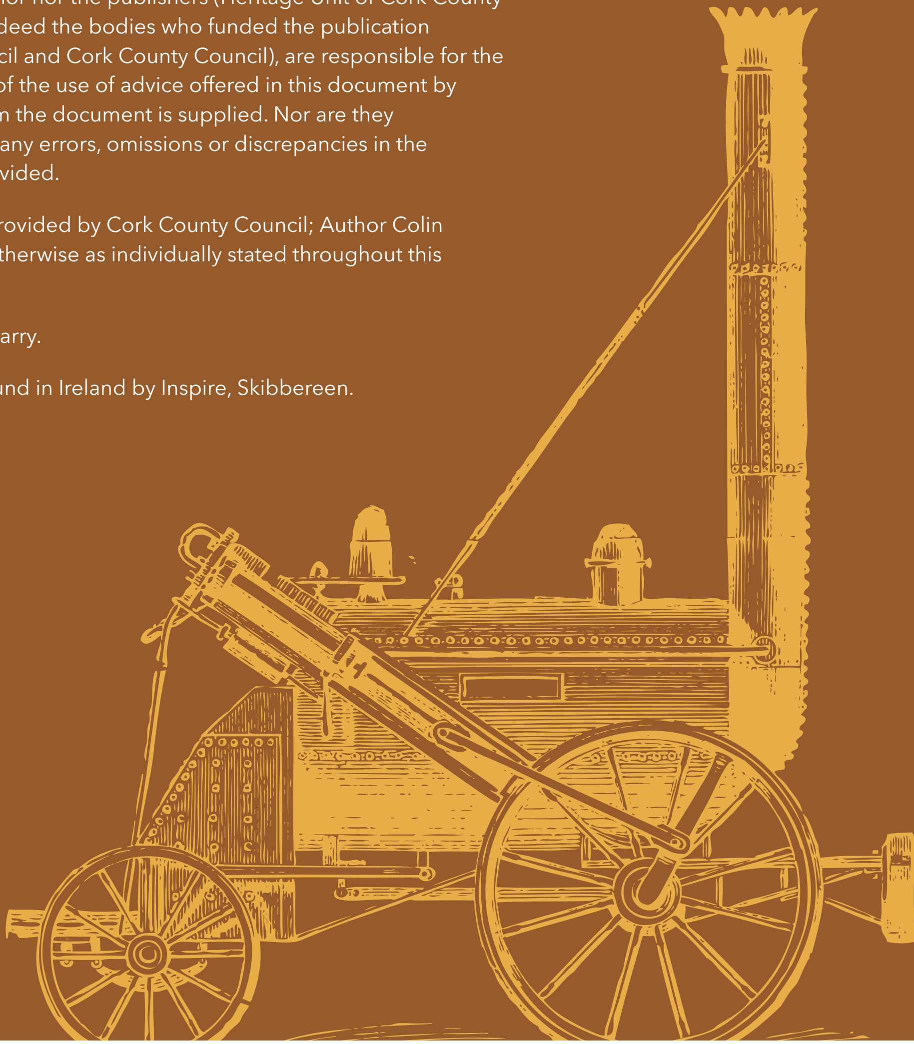

An Chomhairle Oidhreachta
The Heritage Council

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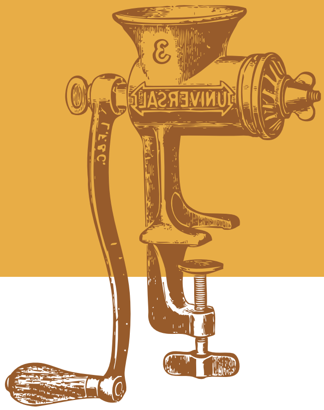
List of Contributors/Acknowledgements

Aidan Weir (Cork County Council), Áine Brosnan, Billy and Judy Wigham, Bridget Goulding, Carol Stack (Cork County Council), Castlelyons Tidy Towns, Claire O'Leary, Cllr. Anthony Barry, Cllr. Frank O'Flynn, Cllr. Marcia D'Alton, Colm Gimblette (Cork County Council), Dan Noonan, Denis Power, Derek Shears, Diarmuid Kingston, Donie O'Sullivan (Lombardstown Community Council), Donncha Collins, Derek Shears, Doug Lucey (ACR Heritage), Dr. Elena Turk, Éamon Lankford, Eamonn Leonard, Edmond J. Stack, Fergal Browne, Flor Hurley, Fr. Tom Ryan, Gerard Dineen, Gerry O'Leary, James Buckley, James Collins, Jim Murphy (Passage West Maritime Museum), Joe O'Leary, John O'Neill, John L. O'Sullivan, John Phair, Joy O'Callaghan, Lynne Curran-Nelligan, Máiréad McCarthy (Cork County Council), Máirín Lankford, Mark Boyden, Martina Williams, Mary Murphy (Knockraha Area Community Association), Maureen Cherry, Maureen and John O'Mahony, Michael Goulding, Michael McGrath (Charleville Heritage Society), Nick Hogan, Nicola Ahern, Noel Howard (Independence Museum Kilmurry), Patrick Twomey, Paul Cotter, Pauline O'Dwyer (Glanworth Community Council), Prof. William O'Brien, Rod MacConaill, Séamus Crowley, Seán Murphy, Stella Cherry, Tara O'Donoghue, Terri Kearney (Skibbereen Heritage Centre, Cork County Council), Theo Dalke (Allihies Copper Mine Museum), Thomas F. Ryan (Ballygarvan History Society), Tom McCarthy and Ursula Egan.



Message from **Cllr. Christopher O'Sullivan**, Mayor of the County of Cork and **Tim Lucey**, Chief Executive, Cork County Council

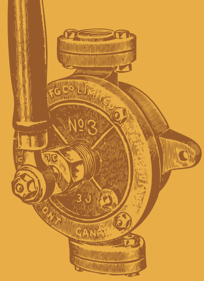
Cllr. Christopher O'Sullivan
Mayor of the County of Cork

Tim Lucey
Chief Executive, Cork County Council

One does not need to travel far to come across a feature of industrial heritage within the County of Cork; the County having many hundreds of mills alone in the archaeological record. This publication takes a look at the earliest origins of industry in County Cork, and focusses on the main industries over the many years, right up to and including the early 20th century. It looks not only at the physical remains of industrial activity but also highlights the important role that local Industry played in the lives of Cork's people.

This publication forms part of the Heritage of County Cork Publication Series, and is the 7th such release – a series that conveys with pride the wonderful heritage that is to be found throughout the County. In keeping with previous publications in the series, a number of sites that can be visited is also presented, reminding us that so much of our heritage is openly accessible and waiting to be explored and enjoyed by locals and visitors alike.

We feel confident that this latest publication by the Heritage Unit of Cork County Council will encourage a greater appreciation and sense of pride in the industrial past of our County and commend all involved – another wonderful addition to the Heritage of County Cork Publication Series.



Preamble and Acknowledgements

This publication is an action of the County Cork Heritage Plan which has gratefully received funding from the Heritage Council and through the heritage budget of Cork County Council. For more information on the effortless work and support of the Heritage Council, visit www.heritagecouncil.ie.

The Heritage Unit of Cork County Council (**www.corkcoco.ie/arts-heritage**) wishes to sincerely thank a number of people without whom this publication would not have been possible. First and foremost is Dr. Colin Rynne, primary author of this publication, who has a written a text that is both informative and enjoyable; a publication that conveys his vast expertise in the field of Industrial Heritage as it pertains to County Cork. Additional text, images and overall editing was carried out by Cork County Council's Heritage Unit (Mary Sleeman, Mona Hallinan and Conor Nelligan, with special thank you also to Emma Moir and Rachel O'Callaghan).

The project process from commencement to completion was managed by County Heritage Officer, Commemorations and Creative Ireland Coordinator, Conor Nelligan and County Archaeologist Mary Sleeman with the backing and support of Michael Lynch, Director of Service. A special thank you also to Beatrice Kelly, Head of Policy and Research, Heritage Council, for her advice and support.

As part of this project, numerous Heritage Groups and individuals throughout the County were asked to make submissions on the publication and a wonderful variety of information was submitted, from photographs to stories and local accounts. This wider engagement is a mainstay of the Heritage of County Cork Publication Series and a sincere thank you to everyone who engaged in the undertaking.

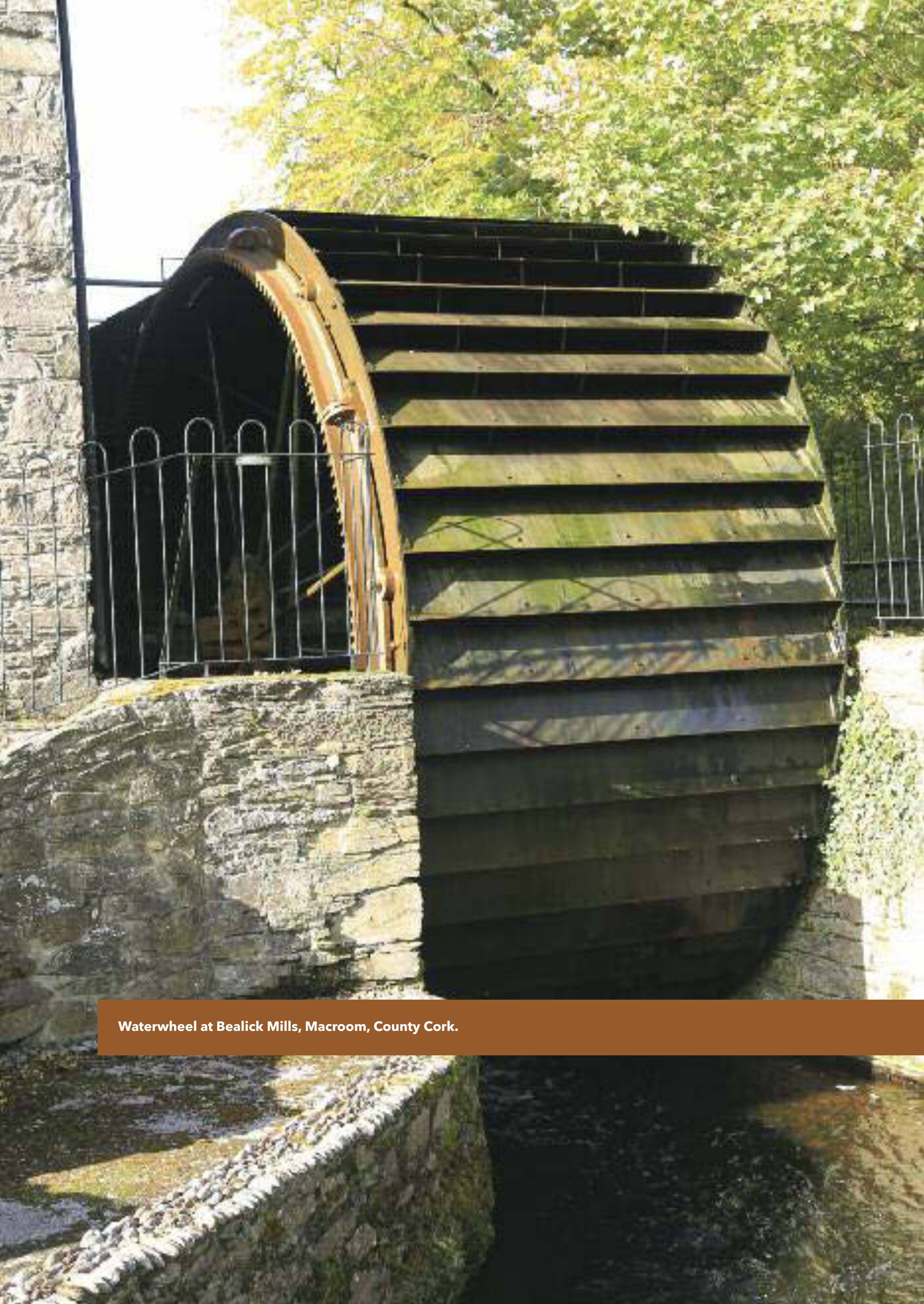
There are many aspects to the production of a book but two of the most critical ones relate to the design and printing of the publication itself. A very special thank you in this regard to Ian Barry for his creativity in design and a most sincere thank you as well to Fintan O'Connell and all at Inspire, who have produced a most delightful end product.

Lastly, thanks to you, the reader, for your interest in the shared Heritage of County Cork, and in particular the industrial past and heritage of this wonderful county.

Mona Hallinan
Architectural Conservation Officer
Cork County Council

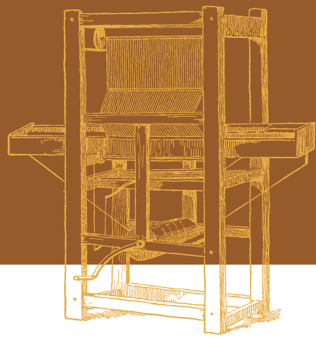
Conor Nelligan
Heritage Officer, Commemorations
and Creative Ireland Coordinator
Cork County Council

Mary Sleeman
County Archaeologist
Cork County Council



Waterwheel at Bealick Mills, Macroom, County Cork.

Chapter 1
Introduction



The archaeology of the recent past, despite its accessibility, both physically and intellectually, is the least studied of all periods of human history. It has recently been characterised as the 'familiar past', yet because of its closeness to us, in both physical and temporal terms, it is a period, the relevance of which, to the world today, has often been overlooked. And because of this seeming familiarity – every day we travel on road and railway networks created in the eighteenth and nineteenth centuries - we commonly assume that we are more familiar with our industrial past, and that our understanding of it will necessarily be easier than, say, that of more remote periods of human history. Nonetheless, when archaeologists have begun to engage with the post medieval period in general – it can be easily garnered that there is much to learn, particularly with regard to the heritage of industry.

Industry can be defined as an economic activity concerned with the processing of raw materials and the manufacturing of goods in specialised buildings or factories. Essentially it is the production; distribution and consumption of products and services. The manufacturing process usually entailed machinery, which in the eighteenth and nineteenth centuries, developed into a sophisticated and complex system. The focus of this publication is the Industrial heritage of this period and it seeks to highlight the nature and wealth of industrial heritage throughout the County of Cork from this time.

The archaeological study of the period of industrialization in Europe, during the eighteenth and nineteenth centuries, is the subject matter of the discipline known as *industrial archaeology*. Industrial archaeology has recently been defined as 'a period study embracing the tangible evidence of social, economic and technological development in the period since industrialisation'.[1] Industrialisation was also, of course, a cultural phenomenon. One of its most notable transformations involved the creation of a new industrial workforce, involving the movement of large numbers of people from the countryside to either urban centres, or their immediate environs, to take up paid employment in factories or other industrial enterprises. As a result, more people became involved in the industrial workforce than in agriculture. It also led to the creation of a new and largely impoverished, urban workforce that lived close to their place of work, often in appalling squalor. At the same time, a new industrial elite began to emerge to take advantage of changing consumer tastes, new technologies which enabled industrial production on an enormous scale and expanding international markets, to create vast fortunes with which they advanced their position in 'polite' society. The period of European industrialization was also characterized by mass production, rapid population growth, increased consumerism and the creation of new industrial urban centres. In the same period, the 'middling classes', who were beginning to become influential in the early eighteenth century, both as important consumers and arbiters of ‘good taste’, became important players in the administration and conduct of urban life.

However, Ireland’s relationship with the industrial revolution of the eighteenth and nineteenth century, while exhibiting certain aspects of English industrialization, diverged in many key respects. For most of the eighteenth century the sector of Ireland’s economy involved with supplying Britain’s overseas colonies was advancing towards industrialization. But the rapid contraction of this overseas trade, which followed in the wake of the Napoleonic wars, coupled with the general scarcity of important natural resources such as coal and iron, eventually relegated it to the role of an interested bystander in British industrialization. There were some successes, particularly in certain textile industries, shipbuilding, brewing and distilling. Yet for the most part this patchwork of industry can in no way be characterized as, or ever amounted to, large-scale industrialization. Thus, while Ireland did have industries of national and international significance, such as the Belfast shipyards and Guinness’ of Dublin (both the largest of their type in the world) it experienced little industrialization. In real terms, Belfast was the only Victorian industrial city in Ireland; the economic fabric of both Dublin and Cork was essentially commercial rather than industrial. The only region of Ireland to become industrialized in a European sense is the area of the Lagan Valley around Belfast. Small pockets of dispersed industrial activity became established near the ports and larger country towns, with varying degrees of success.

In County Cork during the eighteenth and nineteenth centuries, the main hub of industrial activity centred on the city and port of Cork and its immediate environs. Elsewhere, but with the odd exception, such as the large distilleries of towns such as Midleton and Bandon, industrial activities tended to operate on a much smaller scale, with production geared towards supplying the needs of local communities. These included small rural flour mills, the manufacture of textiles such as wool and linen, lime kilns and blacksmiths’ forges. Indeed, while some of these activities involved limited mechanization, such as milling or the fulling of woollen cloth, these were conducted in what were essentially vernacular structures little changed from earlier centuries. Ultimately, the finished products, with the exception of butter churned in rural homesteads which was commonly transported to Cork for export, were either consumed locally or sold in country markets. Thus, the essential nature of County Cork industry was either domestic or rural in nature and small in scale, and the overall distribution of its products remained limited up to the advent of railways in the 1840s.

The principal subject matter of this book concerns the industrial heritage of County Cork in the eighteenth and nineteenth centuries, which as noted was relatively small in scale relative to what was happening throughout most of Europe. Nonetheless, some essential physical characteristics of industrial buildings of the period of European industrialization are evident in the built environment of the county’s industries during this period. These include mechanization, the centralization of production in special buildings or factories, the adoption of advanced forms of vertical waterwheels, new prime movers such as steam engines and water turbines, the creation of workers’ settlements/villages and the construction of modern transport networks. But as we shall see in later chapters, not all industries were conducted in centralized locations, principally because rural industries existed to meet the needs of dispersed, agricultural communities and small urban centres. Their scale of production, therefore, was designed to cater for smaller communities on a regular basis, as in the case of rural corn mills, or seasonally, as was the case in the production of textiles such as linen or wool, or the burning of lime for fertiliser.

Domestic industries involved crafts which were invariably conducted in the home and which usually involved whole families. In terms of industry therefore, the family-based, domestic craft industry was the most basic unit of production. Domestic craft industries included the manufacture of butter, the preparation of linen and woollen yarn for weaving, all of which were undertaken in both rural and urban households. Many of these crafts as, for example, the churning of butter or the preparation of linen and woollen fibres for spinning, although vital to the rural economy, were not considered trades in themselves. However, all domestic craft industries, along with recognized trades such as carpentry, coopering and blacksmithing, all shared the same basic characteristics. The first of these involved the scale of production, which was almost invariably small-scale and geared towards the needs of the local population. The second concerns their distribution which was generally very limited in geographical terms, even if the finished products were sold in local country markets. It was the gradual mechanization of the processes involved in these domestic craft industries that led to the development of Cork County's rural industries in the eighteenth and nineteenth centuries.

Nevertheless, while the products of Cork's domestic industries most commonly provided basic human needs such as food and clothing for the household, some did make their way to international markets. At the same time the sale of these items enabled the purchase of certain luxury goods such as ceramics along with what were originally luxury goods such as tobacco and tea. The spread of railway networks in the 1840s allowed increased penetration into Irish rural markets for cheaper goods mass-produced in Britain, such as clothing and footwear, and even bulkier items such as Welsh slate. Railways also allowed farmers in west Cork to sell their milk directly to the larger county towns, and this, along with the development of co-operative creameries which began to produce butter using mechanical separators, removed the need to make marketable butter for sale in Cork City.

The types of industry commonly associated with the industrial revolution in both Ireland and Britain can be divided into four main categories, each of which, are applicable to County Cork, albeit on a smaller scale. The first two categories embrace a broad spectrum of industrial activities, while the other two are largely concerned with infrastructure for industry. These are:

(1) **EXTRACTIVE or primary** industries, such as mining and quarrying;

(2) **MANUFACTURING or secondary** industries, e.g. textiles and distilling;

(3) **TRANSPORT AND COMMUNICATIONS**, e.g. roads, canals, railways, ports and harbours; and

(4) **UTILITY INDUSTRIES**, e.g. water supply, gas, electricity and telecommunications.

Clearly, industrial activity occurred prior to the eighteenth century, even as far back as the Stone Ages - hunter gatherers were, for example, making and trading stone tools. Chapter 2 of this book examines the origins of industry in County Cork prior to the eighteenth century, by looking at key aspects of how they operated: their sources of raw materials, and how their basic processing was transformed with the introduction of new technologies. By this means the essential nature of the county's industrial past is comprehensively outlined, with the key focus being the industrial heritage of the eighteenth and nineteenth centuries.

Chapter 3 of this publication explores the nature and extent of the available forms of industrial energy – one of the primary essential ingredients in industrialisation – and secondly, the technologies employed for industry during this period. Chapter 4 examines the development of extractive and manufacturing industries - the two principal forms of industrial activity undertaken within the county. Chapter 5 concentrates on the infrastructure developed to support the growing industrial activities.

By their very nature industrial buildings have varied architectural styles and features – the buildings designed to accommodate the industrial activity within. Chapter 6, therefore, takes a look at the architecture of industry and details of associated machinery and plant, are also described and elucidated.

A quick glance at the industrial archaeological heritage in the Archaeological Inventories of County Cork demonstrates the extraordinary range and number of industries that survive. While all of these cannot be included in this publication, Chapter 7, provides a description and illustration of 30 specially chosen exemplars of the most common types of industrial heritage which survive in County Cork. The book then concludes and given the numerous different features associated with industrial heritage, a glossary of terms is also included, as well as a photospread, to highlight the vast range and variety of industrial heritage sites in County Cork.

So what, then, of the origins of industry in the county? The next chapter examines the precursors of Cork's eighteenth and nineteenth-century industries, in the medieval and post-medieval periods (c. 600-1700AD), where it will be seen that the use of water-powered grain mills extends as far back as the seventh century AD. Other industries such as ironworking and the finishing processes for woollen cloth also experienced limited mechanization in the same period. Yet it was the expansion of British Colonial Atlantic trade, with the fledgling America settlements and the Caribbean which was to provide the springboard for early attempts at industrialization within the city and county of Cork.

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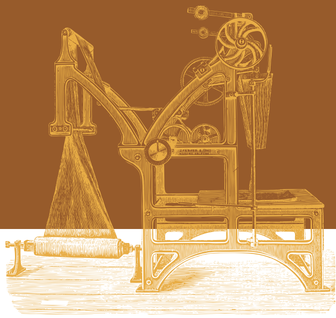
[1] M. Palmer, 1990, 'Industrial archaeology: a thematic or period discipline', Antiquity 64, no. 243, 275-85.

Chapter 2

The Origins and Development of Industry in County Cork



Industrial activity has been a feature of human society going back to prehistoric times and the development of industries in the eighteenth and nineteenth centuries was presaged by many smaller scale industrial activities, generally conducted either in or near the home, or in specialist workshops. These involved largely small-scale pursuits such as the processing of cereal grain into flour or meal; the manufacture of pottery and stone and metal tools. In this chapter we will examine some of the key industrial activities from important historical periods leading up to the 1700s, and in certain instances, how these continued to develop in the eighteenth and nineteenth centuries.

All industries have required four basic attributes: the acquisition of basic raw materials, a tool kit or technology (with which these materials could be fashioned into useful things), a place of work at which crafts and industry could be accommodated, and a means through which these items could be exchanged or distributed. The complexity of these basic requirements increased over time, as also did their relationship to their markets. Even the earliest prehistoric industries produced items that could become commodities, which could be traded and exchanged for other goods, sometimes over considerable distances. Industry, therefore, in all its forms, is about creating a product, which could be manufactured to meet a basic human need or passed on to others as part of an economic transaction. As we will see in this chapter, even the most mundane commodities manufactured in County Cork such as butter became increasingly geared towards global markets. This chapter will examine the origins of domestic and rural industrial activity in County Cork before the eighteenth and nineteenth centuries.

Sourcing raw materials

The first part of an industrial process is the sourcing of the raw material. The raw materials used by Cork industries, such as wood, stone, clay and the cereal grains required by millers, brewers and distillers were for the most part acquired locally, and the processes in which these were acquired are as important as those involved in their transformation into implements or commodities. As we will see in Chapter 4 later, the extraction of metals and building stones can be considered industries in themselves. Even in remote periods of Irish prehistory considerable effort went into the sourcing of flint and chert with which to manufacture stone tools. During the period 1700-1400 BC (in the Early to Middle Bronze Age) there was an intensive period of copper mining on Mount Gabriel, on the Mizen Peninsula, north of Schull and also at Goleen Co. Cork (c. 1900-1600 BC).[1] By the end of the Bronze Age, around 1200 BC, extensive, often overlapping, and complex trade and distribution networks had been created between Ireland and Atlantic Europe to supply raw materials. Even some of the earliest Irish metal-working crafts, therefore, were linked into national and international maritime trade networks.

Owing to their bulk and the difficulties of transporting them over large distances, building stones such as limestone and red and green sandstone, were generally sourced from local quarries. However, from the twelfth century onwards, Anglo-Norman communities in Ireland began to import a distinctive, light yellow limestone, quarried at Dundry near Bristol. *Dundry stone* was employed mostly for decorative purposes in ecclesiastical buildings (and occasionally castles), but it was also for burial monuments and baptismal fonts. In County Cork good examples of its use can be seen at St Colman's Cathedral, Cloyne; St Multose's, Kinsale, St Mary's Collegiate Church, Youghal and in the 'Chapter House' doorway at St Finbarr's Cathedral in Cork City.[2]

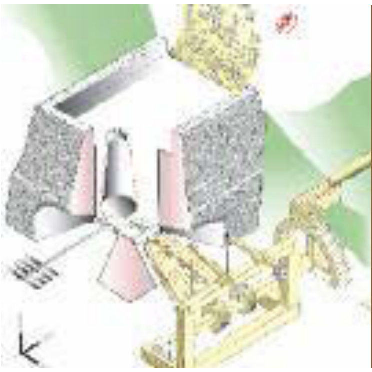
We currently know very little about vital industries such as mining and quarrying, for the medieval period as a whole. In many cases it appears that extraction sites for ferrous, non-ferrous metals and building stones will have been destroyed by eighteenth and nineteenth-century operations. Quarries may have been relatively large in medieval times but not plentiful as stone was only used in important buildings such as castles, mansions, churches and abbeys with the majority of the domestic and industrial buildings made of wood. In many instances it is clear the that proximity of good quality building stone proved to be an important factor of location for later medieval monasteries. At the first Irish Cistercian foundation at Mellifont, county Louth (est. 1142) and at the thirteenth-century Benedictine Abbey at Fore, county Westmeath, the stone quarries were immediately adjacent to the cloisters. While at Bridgetown Abbey, near Castletownroche, Co. Cork, a thirteenth-century Augustinian foundation, built near a bend of the River Blackwater, the original source of the building stone appears to have been a limestone cliff face accessible from the river, a few hundred meters downstream of the abbey.

Yellow Dundry stone used in window dressings at St Colman's Cathedral, Cloyne.

Yellow Dundry stone used in window dressings at St Mary's Collegiate Church, Youghal.

Remains of likely later medieval quarries at Bridgetown Abbey, near Castletownroche, Co. Cork.

A somewhat clearer picture of quarrying and mining activities in County Cork emerges during the early decades of the seventeenth century, when Richard Boyle (1566-1643), 1st earl of Cork, invested considerable sums in developing ironworks and in the creation of new towns, such as Castlemartyr, Clonakilty and Bandon, on his vast County Cork estates. The earliest recorded Irish blast furnace was built near Mallow Castle in 1593, by a tenant of Sir Walter Raleigh. Between 1610 and 1625, the English East India Company operated a blast furnace at Dundaniel, near Inishannon. Unlike earlier smelters, which produced wrought iron in relatively smaller amounts, the *blast furnace* could produce tons of cast iron within hours. These furnaces required large amounts of woodland whose trees were processed into charcoal, the fuel used in the smelting process. In addition to the mining operations required to source the iron ores, limestone also had to be quarried and burnt in a kiln to produce quicklime, which was used as a *flux*, an ingredient which helped to separate the slag, or waste material, from the molten metal formed inside the furnace.



The blast furnace uses large water-powered bellows to produce large quantities of cast iron, upwards of a ton at a time. Molten iron was run off via a tap at the front of the furnace into runnels made into a bed of sand. Cast iron contains 3-4% carbon which makes it brittle and so it cannot be reheated and worked by a blacksmith. However, it has the advantage of being able to be cast into complex forms, while it can also be refined into wrought iron, which was used for nearly every type of tool or weapon. The introduction of the blast furnace considerably reduced the cost of manufacturing iron.

Richard Boyle, 1st earl of Cork tomb at St Mary's Collegiate Church, Youghal, completed in 1620 with the wrought iron railing.

Cannon probably manufactured at Boyle's Cappoquin, Co. Waterford furnace, in the late 1630s.

Most of this was later refined into wrought iron, which could be forged (a more marketable commodity, which Boyle exported to England and Holland) but other items such as pots and pans, and even larger items such as canon, could also be manufactured at the furnace.[3] The elaborate wrought iron railings surrounding Boyle's elaborate tomb, completed in 1620, in St Mary's Collegiate Church at Youghal, are likely to have been produced in his own county Waterford ironworks. There is even a surviving 7ft long, 3.6in bore canon -which was almost certainly cast at his Cappoquin, county Waterford furnace, now on display in the St Mary's Collegiate Gardens at Youghal. This canon had originally been mounted on the town walls of Youghal by Boyle, sometime before the rebellion of 1641.

When Boyle bought out Raleigh in 1603, he transferred almost all of his iron mining and smelting operations to County Waterford, and there is only one recorded iron mine owned by him in County Cork. This was on the Knocknadoon peninsula, south west of Youghal and was at work around 1616.[4]

Boyle's extensive building works, from the walls of Bandon to his mansions, almshouses, market houses, mills, schools and military fortifications, required the quarrying of enormous amounts of building stone, which in this period was increasingly replacing timber as the main construction material for all building projects. Large quantities of limestone were also quarried and burnt in kilns to produce mortar for construction works, as a flux for his blast furnaces and for use as fertilizer. A deed recently discovered in the Boyle archives at Chatsworth, Derbyshire, dated 5th September 1610, records the transfer of ownership of the red marble quarries on Littleisland in Cork harbour to Richard Boyle's eldest son, Roger, who died in 1616. Such was the reputation of this Cork marble, that Richard Boyle was requested to supply 25 tons of it for Queen Anne of Denmark's house at Greenwich. Queen Anne was the wife of King Charles I, and this building, designed by Inigo Jones, is generally seen as the first truly palladian style building to be erected in England. Nevertheless, even though Boyle paid for this stone to be prepared for transport from Littleisland in 1617, there is no record of it ever having been used at Greenwich. Indeed, when Anne became ill in 1618, building work ceased, and upon her death in 1619 only the first floor had been completed. Work did not begin again until 1629 and was only finished in 1635.[5]

Deed transferring ownership of the Littleisland red marble quarries from John Matthews to Roger Boyle, dated 5th September 1610, courtesy Trustees of the Chatsworth Settlement.

During the later seventeenth and early eighteenth centuries, mining in Ireland was conducted on a relatively small scale and as late as 1780-4 only three Irish mines were exporting either copper or lead. This was because of the difficulty of pumping water out of deep mines which, in effect, limited the depths at which either ores or coal could be exploited. This was less of a problem in quarrying activities, where stone was generally cut from exposed rock faces. As we shall see in a later chapter, the large-scale mining of the ores of copper and other ores does not begin in the county of Cork until the early decades of the nineteenth century. The mining of coal in the county in the Dromagh area near Mallow, only began in the eighteenth century and then, even by Irish standards, was conducted on very small scale.

By way of contrast the demand for building stone increased substantially from the late seventeenth century onwards when stone becomes the main building material. In addition to more housing, the eighteenth-century expansion of Ireland's towns required new public buildings such as courthouses, market houses, gaols and new places of worship. Furthermore, the larger towns of the city and county of Cork were now provided with stone street paving. New roads and bridges were built and along the coast, new piers, quays and harbours were constructed. The north and south channels of the River Lee within the city of Cork began to be provided with quaysides made from Litteisland and Rostellan limestone from the early nineteenth century onwards.

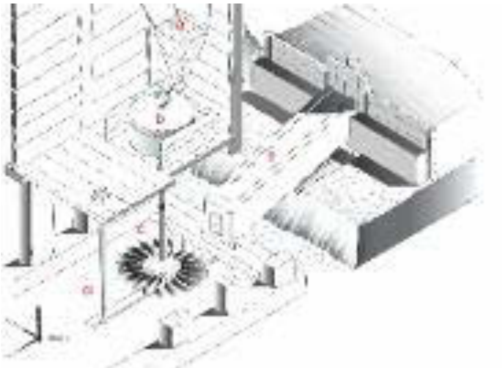
Ireland is perhaps unique in Europe in that brick was only manufactured here from the middle of the sixteenth century onwards. It was widely used in Ulster by English and Scottish colonists from the early seventeenth century onwards, as good quality building stone proved hard to come by. Brick only began to be used in County Cork buildings after the middle of the seventeenth century, a notable use occurring in Lord Broghill's (a son of Richard Boyle, 1st earl of Cork) mansion house near Charleville, begun in 1661, but destroyed in the 1690 rebellion. Elsewhere, the first widespread use of brick occurs in the port towns such as Cork, Youghal and Kinsale, where imported brick from Holland, was brought in as ship's ballast. Dutch influences are evident in the design of the Uniake family's 'Red House' at Youghal, built mostly with imported Dutch brick between 1705-1716 and also in the distinctive 'Dutch' gables depicted in early eighteenth-century paintings of Cork. There are also surviving mid eighteenth-century buildings with Dutch brick facades on Cork City's South Mall, and such was the demand for brickwork that brickfields were established on the north bank of the River Lee, roughly where the present Kent Station now stands.

The Red House at Youghal, built between 1705-1716.

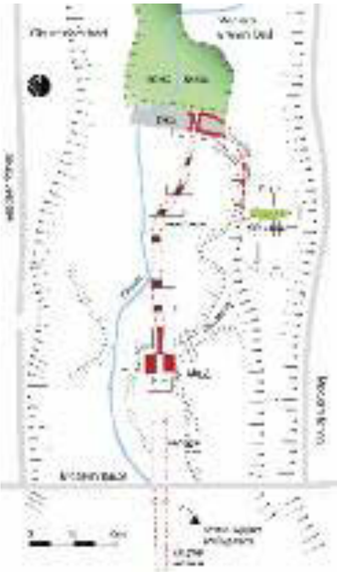
Buildings with imported Dutch brick façades on the South Mall, Cork City.

Technology

The improvement of technology is one of the main aspects of industrial development. One of the key changes in the history of technology is the gradual replacement of human and animal muscle power by inanimate sources of energy such as water- and wind-power. In Europe this was already beginning during the Roman period, in the 1st century BC and early centuries AD, when water-powered wheels were already being used to turn millstones, process iron and even power saws for cutting marble. By at least the sixth century AD water-powered grain mills had been introduced into many parts of Europe, including Ireland. County Cork has one of the largest concentrations of pre-tenth-century watermill sites not only in Ireland but in Europe, with excavated examples dated by dendrochronology (the science of tree-ring dating) from c. AD 630 to AD 1150.[6] The vast majority of these were *horizontal-wheeled* mills, where the water wheel is set in the horizontal plane and turned the upper rotating millstone, directly, without intermediate gearing via a vertical axle or driveshaft.



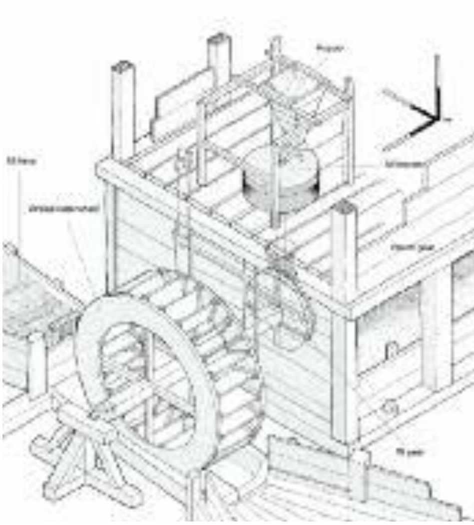
Reconstruction of horizontal-wheeled grain mill excavated at Cloontycarthy, near Ré na nDoirí in Cork's Gaeltacht Mhúscraí, dated by dendrochronology to AD 833. [a: hopper, for feeding grain into millstones, b: millstones, c: horizontal waterwheel, d: tentering device, used for adjusting distance between the millstones, e: wooden chute used to develop jet of water which set the waterwheel in motion.]



Early medieval millpond and millrace excavated at Mashanaglass, County Cork.

In most cases a small storage reservoir, or millpond, would be formed by impounding an adjacent natural watercourse, or springs, through the construction of a rudimentary dam. From the millpond the water was led in an open channel, or headrace, to the millworks. Before the water was allowed to strike the waterwheel it was directed into a large chute hollowed-out from a tree-trunk. This type of watermill continued in use in counties Galway, Sligo and Roscommon well into the nineteenth century, and in one instance into the twentieth century.[7]

In the second type of watermill, commonly known as the *vertical water-mill*, which was to become by far the most common variety by perhaps the later medieval period in Ireland, the axle is set horizontally. This arrangement required the use of intermediate gearing to transmit the motion of the axle, indirectly, to the millstones. It is a common misnomer that early vertical mills were more productive that horizontal-wheeled forms – it is, in fact, the diameter and weight of the millstones that



Reconstruction of vertical watermill at Littleisland, County Cork, dated by dendrochronology to AD 670.

determines output- yet the use of intermediate gear transmission provided them with the added advantage of being able to be either geared up or down to suit its water supply. It was, therefore, inherently more flexible than horizontal wheeled forms and could be used with a wider and more challenging range of water sources. One of the two earliest recorded watermills discovered at Littleisland, county Cork in 1979, is a vertical mill, the other was a horizontal-wheeled mill, which employed two chutes to power two, separate, horizontal waterwheels. Both mills are dated to AD 630 and are, in addition to being powered by impounded tidal waters, the earliest recorded close association of a vertical and horizontal mill recorded anywhere in Europe. The float or paddle of an undershot waterwheel, has also been recovered from the debris of a mill excavated at Ardcloyne, near Kinsale, dated to AD 787.[8]

With the advent of European monastic orders to Ireland in the 1140s, and the arrival of the Anglo-Normans in the 1170s, the use of vertical waterwheels began to outnumber that of horizontal forms. The vertical waterwheel also enabled other industrial processes, such as iron-working and the fulling of woollen cloth, to become mechanized. In 1994 the remains of a thirteenth-century water-powered smithy were excavated within the medieval town walls of Cork at the North Gate. Fulling, a process which involved the pounding (originally by human feet in troughs full of human urine) of woollen cloth to both degrease and felt it, became mechanized in the later medieval period. Water-powered fulling mills are recorded near Youghal, county Cork in the 1270s. The grain mills built to service later medieval monasteries and Anglo-Norman manors also differed from those built in earlier periods, in that they employed millstones of larger diameters. The Anglo-Normans also imported millstones from England and France, which were more suited to producing the varieties of flour and meal they had enjoyed in their homeland. Of course, many later medieval monasteries were also built close to large rivers, from which they extracted water both to power their watermills and to flush their sewers. The remains of substantial monastic mill races survive at the twelfth-century

Augustinian abbey at Athassel, county Tipperary, and at Augustinian foundation at Bridgetown, County Cork. The Knights Hospitaller preceptory at Mourneabbey, County Cork has the remains of a thirteenth-century, two-storey mill, on its precinct wall - a very rare survival in Ireland.

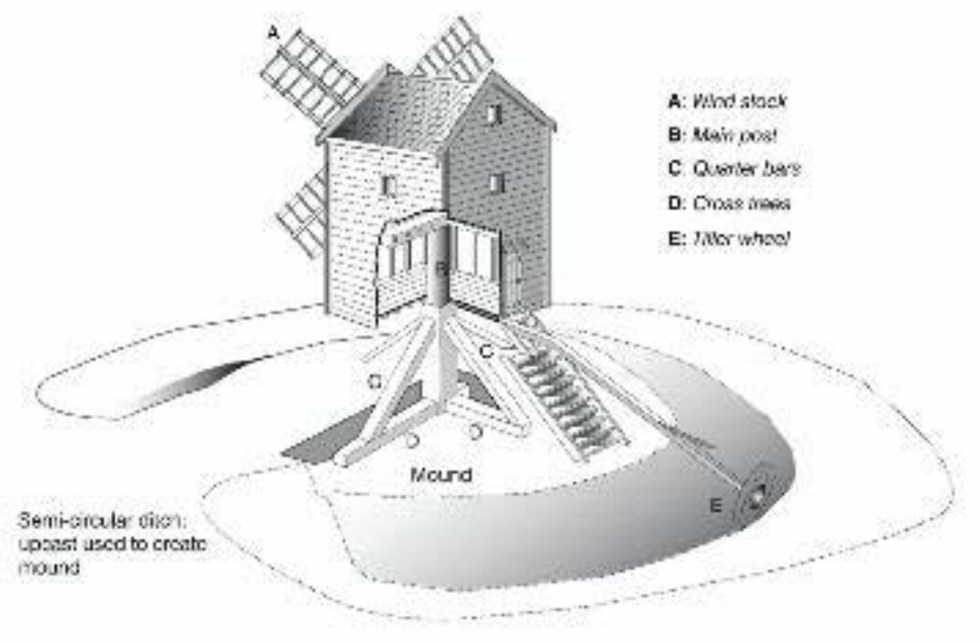
Notwithstanding the increasing importance of water-powered mills, from the medieval period onwards, they never entirely replaced hand-powered rotary querns. These latter appeared to have been still widely used both in the countryside and towns, despite being effectively outlawed under feudal law. The Anglo-Normans introduced the European feudal custom known as *suit to the mill*, into Ireland, whereby both manorial and ecclesiastical tenants were legally obliged not only to bring their grain to ground in the lord's mill, but also to pay a toll (*multura*). This toll was calculated, variously, as either one sixteenth or one twentieth of the flour ground in the mill. Technically at least, the use of ownership of private mills was illegal. As late as November 1740, the 4th earl of Cork, also Richard Boyle (1694-1753), still required his tenants to perform *suit* to one of his mills in county Waterford. The use of rotary querns was still common in western Irish counties well into the nineteenth century, and parts of county Kilkenny into the 1970s to make *praipíns* (made of oatmeal and sour milk).

Remains of two-storey watermill built onto precinct wall of the Knights Hospitaller preceptory at Mourneabbey, County Cork.

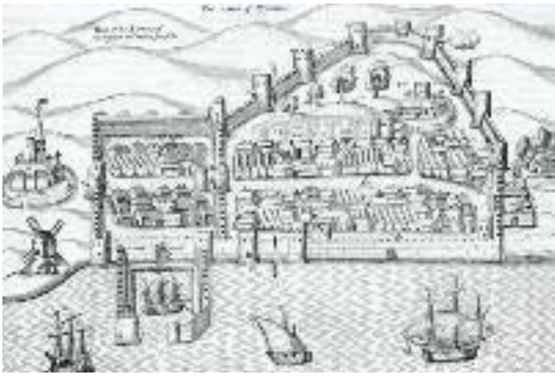
The first Irish windmills were clearly an Anglo-Norman introduction, the earliest recorded example was at work at Kilscanlan, near Old Ross, Co. Wexford, in AD 1281. However, while generally a useful supplement to watermills where sources of hydraulic energy were either unavailable or unsuitable, windmills suffered from the disadvantage of being unable to store their energy. As is evident from the documentary and archaeological record, the vast majority of the windmills at work in Britain and Ireland before the 1290s were *post-mills*. In the classic post-mill, the actual mill building is rotated about a central wooden pivot in order that the wind sails can face into the prevailing wind. By this means the entire structure could be rotated through 360 degrees by means of a *tail pole*, which enabled the miller to adjust the position of his sails to accommodate changes in wind direction, by the simple expedient of rotating the entire mill building. The mill machinery was contained within a wooden framework, and the entire structure was usually erected on high ground, often on a specially prepared mound.

One such windmill is shown on the *Pacata Hibernia* map of Youghal, of c. 1590, outside the town walls. But for the most part windmills were seldom used in County Cork, owing to the general availability of good water supplies, and the main period of their use is mostly restricted to the eighteenth century.[9] Before 1700, Irish windmills were used exclusively for manufacturing flour and meal.

In the post-medieval period water-powered mills were widely distributed throughout the county. A seventeenth-century grain mill has recently been excavated on the route of the Macroom bypass, at Killaclug, near Macroom. There is no apparent settlement nearby, but it



Reconstruction of post-windmill.

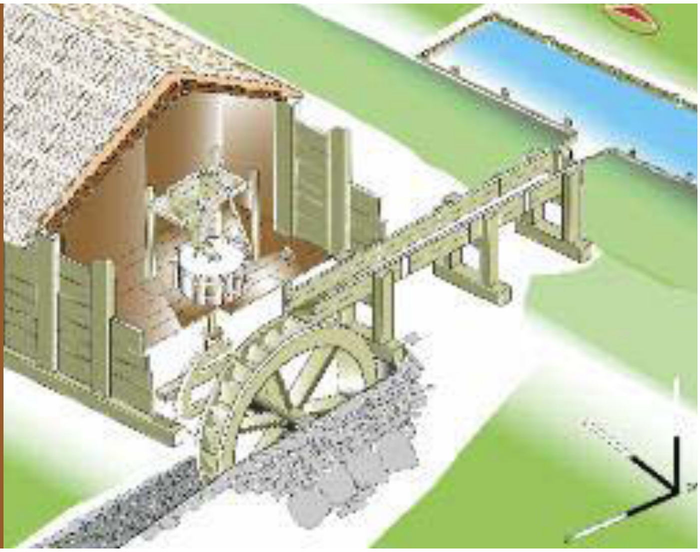


Post-windmill depicted on the *Pacata Hibernia* map of Youghal, of c. 1590. The existence of the site is indicated by a lane called Windmill Hill.

may possibly have been associated with the adjacent McCarthy tower house at Carrigaphooca. Several stones, in which the waterwheel's bearings would have rotated, were recovered from the site, which suggests the mill was in operation over a long period of time.

The 1st earl of Cork was to ensure that all of his new market towns were provided with up to date, English style watermills, from around 1603 up to his death in 1643. His Bandon mills were, by contemporary standards, state of the art, and his extensive personal archive of surviving papers demonstrates how important they were to him. But from this period onwards sites for water-powered mills, especially close to port towns, became harder to find. By the early decades of the eighteenth-century natural watercourses flowing into the River Lee in the Blackpool area were already experiencing severe congestion, in which too many water-powered industries were competing for the same water supply. For this reason, many of the city's larger breweries and distilleries were obliged to use horse wheels. In this arrangement a large diameter wooden gearwheel, which pivots on a vertical shaft, is turned by a horse, or

Reconstruction of seventeenth-century overshot watermill at Killaclug, near Macroom. This millrace which directed water from the Foherish River, extended over 1km in length. This mill operated with a single set of conglomerate sandstone millstones, several fragments of which were discovered during the excavation.



horses, harnessed to the spokes of the wheel. Up to the installation of a steam engine in Beamish and Crawford's porter brewery, in 1818, most of the main machinery used to pump water and grind malt was powered by horse wheels. However, as we shall see in later chapters, the expense of importing coal from England and Wales was to ensure that water power remained vital for industry in both County Cork and Irish industries well into the nineteenth century.

Technological change in the period 1600-1750 benefited from the discoveries of the Scientific Revolution, which began with Galileo in Italy in the late sixteenth and early seventeenth centuries. In this period it became increasingly common for new technical knowledge to be transmitted throughout Europe in the form of printed books and scientific treatises. This was also made possible through increased literacy, which allowed greater communication between those involved in the technical 'arts'. The impact of this era of scientific discovery on technological changes which presaged the Industrial Revolution, is best exemplified by the development of Thomas Newcomen's early steam engine, which was used in the mining industry in Ireland as early as 1740, at Doonane in county Laois. However, the technical development of new industrial technology, and the mechanization of existing ones before 1700, was still held back by the lack of development of power transmission systems, which would enable several machines to powered by the same waterwheel simultaneously. For example, the basic wooden gearing of a water-powered grain mill could only work one pair of millstones at a time, well into the 1600s. If a second set was required this required a separate waterwheel, an arrangement commonly referred to in written sources as a 'double mills'. Only with the development of *spur gearing* and *lay-or lineshafting* during the eighteenth century were these problems satisfactorily addressed.

Crafts and industry

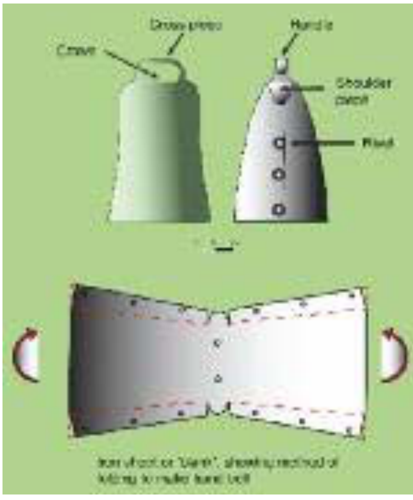
Though not technically considered an industrial activity, crafts and trades are considered here as they make a valuable contribution to the production and trading of goods. Many continued into the eighteenth and nineteenth centuries and become an integral part of the industrial activities of the county. Before industrialization a *craft* simply denoted any skilled activity in which commodities such as textiles (as in weaving and spinning) or pottery were made by human hands. However, a *trade* such as a blacksmith, silversmith or stonemason, required a long apprenticeship, during which specialist training was provided and the working conditions of the apprentice were carefully monitored. In urban centres, entry into many trades, along with the training required for them, was strictly regulated by guilds.

Although the main period of industrialization in Europe, during the eighteenth and nineteenth centuries, is more commonly associated with both mechanization and mass production, many of what were essentially handcrafts continued to thrive. Industries as varied as brewing, distilling, flour milling and gunpowder manufacture employed coopers to manufacture thousands of barrels, in which their products could be both stored and transported. In the greater Cork region the cooper's trade was particularly important given the prominence of the provisions trade, centred on the port of Cork. From the medieval period onwards, perhaps the most important craftsman in any community was the blacksmith who, in addition to manufacturing and maintaining a large range of iron tools, required by other craftspeople and farmers, also shoed horses, donkeys and mules. Even in Ireland's heavily mechanized linen industry, the manufacture of certain linen goods such as cambrics still required the skill of the handloom weaver well into the nineteenth century. Industrialization, therefore, did not entirely replace the dexterity of human hands, and even today Ireland's multi-million euro distilling and horse-racing industries continue to rely upon the astonishing skills of coopers to maintain the barrels used to mature whiskey and on farriers to shoe thoroughbred horses. Thus trades and crafts, which may have barely changed since the medieval period, could comfortably co-exist with complex industrial machinery.

Many crafts and trades of the prehistoric and medieval periods could be accommodated within the household (such as textile manufacture) or outdoors as in the case of smelting or pottery manufacture, without the need of specialized structures. Early medieval Irish monasteries are also known to have acted as patrons to a wide range of specialist metalworkers, as well as to blacksmiths and stonemasons. Recent excavations at the monastery of Clonfad, in county Westmeath, have produced evidence for the relatively large-scale manufacture of iron handbells, within the monastic enclosure between the sixth and ninth centuries.[10] Excavations at Gortnahown, near Mitchelstown on the route of the M8 motorway, have also revealed extensive evidence for the manufacture of iron handbells during the sixth to seventh centuries AD.[11]

Later medieval monasteries provided workshops for these trades either within the main monastic complex or on their granges (i.e. satellite farms on their estates, worked by their tenants).

The establishment of true towns in Ireland by Norse settlers, from the ninth century onwards, also attracted many crafts and trades people, who supplied both the needs of the urban



How early medieval handbells were manufactured.

populations and that of people living within their hinterlands. With the arrival of the Anglo-Normans in the late twelfth century, all of these urban centres were expanded and new towns, such as New Ross, county Wexford, and Buttevant in North Cork (dating to the early 13th century)[12], were also founded. Many crafts came under the control of medieval trade guilds, which regulated the input of newcomers into a particular trade, the conduct of their training and the standard of the goods they were expected to produce. Only guild members were allowed to work within a particular town, and many guilds, in effect, came to rigidly control the conduct of a particular trade within an urban area. During the seventeenth century, Richard Boyle the 1st earl of Cork, was to introduce large numbers of English craftsmen such as tallow makers, tanners, textile workers, along with semi-skilled trades such as millers, into his newly created County Cork market towns, such as Clonakilty, Inishannon and, Castlemartyr. The same practice was common in pre-existing towns such as Youghal and Bandon, which the earl did not create, but in which he was to invest large sums of money. The arrival of these newcomers, mostly from Boyle's home English county of Kent, is likely to have had wide ranging and lasting effects on pre-existing trade practices, on everything from the size of millstones employed in flour mills, to the types of leather and textiles produced within the greater Cork area.

Mechanization did, of course, eventually replace many processes formerly undertaken by skilled human hands. But from the late medieval period onwards crafts and industry could

The Dutch East India Company's warehouses and dockyard at Amsterdam in the seventeenth century.

overlap, in the manner in which certain processes could become mechanized, as in the case of the finishing processes of textiles such as woollen cloth. But as we shall now see, increased demand for consumer goods in the seventeenth century led to substantial increases in the output of what were still largely unmechanized, craft-based industries. This, in turn, also led to significant reductions in the cost of imported consumer goods. The entire European economy was transformed through the rapid development of global trade networks, beginning with the rise of Dutch colonial trade in Asia. In both England and the Netherlands, during the sixteenth to eighteenth centuries, this led to the creation of distinctive yet competing maritime empires, each characterized by the increased importation of new luxury goods from Asia and the Americas.

Dutch and English exposure to these, exotic, newly discovered, consumer goods had a profound and almost immediate effect on consumer demand, tastes and aspirations. Exposure to new luxuries also changed the way most consumers thought about their domestic possessions. 'Luxury' was no longer understood as a form of excess and became increasingly associated not only with convenience and enjoyment, but as a means of displaying fashionable taste. The new forms of luxury products, such as Delftware (a home-produced attempt to imitate fine Chinese ceramics), were certainly cheaper than the imported forms, but their increased consumption by the new 'middling' classes was because they were fashionable, not because they were inexpensive. This mass consumption of new consumer goods, particularly in the eighteenth century, has been characterized as a 'product revolution', in which items previously the reserve of the aristocracy now became available to the middling and commercial classes.

Increased consumption, and the types of luxury goods chosen to replace expensive foreign imports, combined to shorten the life cycle and general durability of domestic items. In the seventeenth century, for example, everyday items such as clothes were very likely to be inherited by one's heirs. The gradual replacement of what were essentially durable goods, as in the case of pewter for glass drinking vessels and wood for earthenware table ware, greatly affected the shelf life of many household items. But for contemporaries this was not really the point. The importance of these semi-durable goods was that their design and craftmanship proclaimed one's good taste. In consequence, by the eighteenth century many objects not only tended to wear out faster but went out of fashion sooner. Indeed, after 1650 a general trend emerges whereby consumers became more concerned with the standard of workmanship than with the actual material from which the object was made. The origins of the 'throw-away society', therefore, can be found as early as the seventeenth century. Perhaps the best example of this trend is the clay tobacco pipe, a common find on archeological excavations all over Ireland. The growing popularity of tobacco smoking in England and Ireland appears to have begun in 1570s, which led to a demand for clay tobacco pipes. After regular use, these were quickly discarded, becoming one of the world's first throw-away consumer items. In addition, the consumption of tea, which began as an aristocratic pastime, quickly filtered down to the lower orders of society during the eighteenth century.

Global Cork: Trade and Distribution

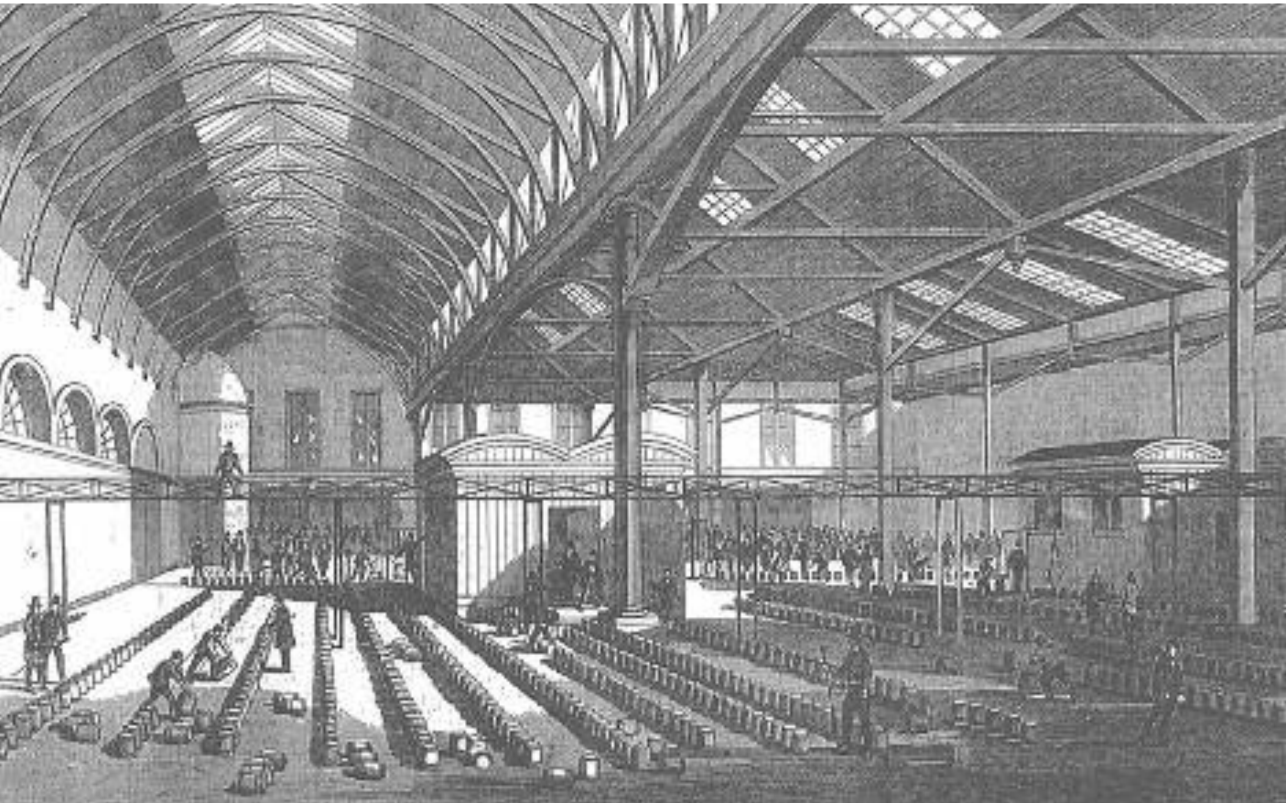
Since early prehistoric times boats from Britain and Europe traded with County Cork with, for example, tin, which was needed to manufacture bronze, being imported into the west of the county from Cornwall. Cork also formed part of important trading networks during the early Christian, Viking and Anglo-Norman periods. Excavations within the city of Cork have produced vast quantities of pottery manufactured and traded with Cork from the greater Bristol area, and with the wine producing regions of France, in the twelfth to fifteenth centuries. In the first three decades of the seventeenth century, Richard Boyle and other colonial entrepreneurs, created a series of market towns in western County Cork and eastern county Waterford. These were to provide an important conduit for the agricultural produce of the greater Munster region. By the end of the century, these goods were to become transformed into global commodities via local ports on the south coast such as Cork, Youghal and Kinsale. Although the City of Cork and its adjacent harbour were to become the veritable hub of the eighteenth - and early nineteenth - century Atlantic trade, based initially on the supply of provisions to the American colonies, and later with the British Caribbean, all told this trade amounted to only around 10% of Britain's total overseas trade. However, from a relatively early period, owing to the increasing reliance of the Royal Navy on the greater Munster region for on-board provisions for its growing complement of vessels, the Atlantic trade of the port of Cork assumed a key strategic significance for the British. Heavy investment in the port itself and on the fortification of Cork Harbour were to follow. Cork Harbour was then the largest known natural harbour known to European mariners, which gave the City of Cork an enormous advantage over its competitors in the region. This trade was almost invariably conducted in English registered ships, which sailed from southern English ports such as Plymouth to form convoys in Cork Harbour, where they took on their provisions, such as salted butter, pork, beef and porter. The British navy, indeed, sourced almost all of its butter in the Cork region.

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, whose expansion was a direct result of the preference of British shipowners for victualling their ships at Irish ports, and then transporting these provisions to the continent and the American colonies. *Victuals* included salted butter, pork and beef packed in barrels, along with other ship's provisions such as biscuits, which one enterprising Cork naval contractor, Daniel O'Callaghan, manufactured from flour milled in the Glanmire area.

The provision trade substantially enriched the city and county's merchant communities, and while finance was never really in short supply, local entrepreneurs were primarily merchants and not industrialists. In both Dublin and Cork were to be found the largest banking and discount facilities in the Kingdom. Merchants involved in the Cork butter trade were often required to make advance payments to farmers, and ready access to loan facilities was an important advantage unavailable in other south-western ports. In theory, at least, these same facilities were available to prospective industrialists. The complexion of Cork business activity, however, tended to favour the provision trade, the existence of which generated many spin-off industries, such as brewing, distilling, ropemaking and textiles.

The focus of the expanding trade in butter from the pastures of south Munster was the port of Cork. From Cork, Irish butter was exported to four continents as part of a burgeoning trade in provisions based on the development of English colonial concerns. In the eighteenth and nineteenth centuries, the export of butter made on south Munster farms was to dominate foreign markets, and the City of Cork was to become the focal point of the world butter trade. The export of butter was to become part of a wider scheme of things in which the port of Cork became a focus of Irish and English transatlantic trade in the eighteenth century.[13]

The importance of the provisions trade transformed the City of Cork, by the end of the eighteenth century, propelled the county of Cork, along with its principal port at Cork, towards industrialization, although ultimately the city and port were to adapt to a smaller scale of industrial development. But by then it had become the second city of Ireland, and its 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, whilst the largest porter brewery and the largest distillery in Ireland had also been established there. The quality of Cork butter was



The Cork Butter Market in 1855, from the *Illustrated London News*.

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. But as we shall see below, the city'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.[14]

However, in the immediate aftermath of the defeat of Napoleon in Europe, in 1815, the lucrative contracts for provisions and munitions ended. The over reliance on what was essentially wartime trade was cruelly exposed and the commercial and industrial development of Cork experienced a precipitous decline. For at least one industrial behemoth in the immediate environs of Cork City, the Ballincollig Gunpowder Mills, the end of hostilities in Europe brought about its almost immediate closure in 1815. In other industrial sectors the decline, though gradual, was irreversible. The provision trade was seriously undermined by the end of government contracts, which was followed by a general depression in British and Irish agriculture. The establishment of Royal navy victualling yards on the Haulbowline Island in Cork Harbour in the period 1808-16, provided some respite for local provision merchants.[15] Nevertheless, the more important food-processing industries within the greater Cork area, such as brewing and distilling, continued to develop apace. When the commercial clauses of the Act of Union began to be implemented after 1824, English textiles were dumped on the Irish market, with truly devastating consequences for the Cork-based textile industries. The failure of Cork's textile industries to adopt new technology also contributed significantly to their decline in the early nineteenth century. Indeed, the manufacture of linen yarn within the immediate environs of the city was not re-attempted until the 1860s, whilst the fortunes of the county’s woollen industry was not successfully revived until the closing decades of the nineteenth century.

The survival and continuity of industry in County Cork, in the nineteenth and early twentieth centuries, was contingent upon its overall ability -and willingness- to adapt to new economic realities. This transition proved difficult in the early decades of the nineteenth century, but successful industries such as brewing and distilling, along with the linen and woollen industries did so by adopting new technologies such as the steam engine and by finding and developing new international markets. Nonetheless, the overall complexion of county Cork industry remained essentially rural with small units of production such as corn mills serving mostly local markets.

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[2] D. O'Brien, 2017, 'The evidence for the importation and use of foreign limestone in Cork city and county during the later medieval period', *Jnl Cork Archaeological and Historical Society* 122, 123-137.

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[10] P. Stephens, 2012, 'Clonfad an industrious monastery', in P. Stevens and J. Channing (eds) *Settlement and community in the Fir Tulach kingdom: archaeological excavations on the M6 and N52 road schemes*. Dublin, 109-36.

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Chapter 3

Power for Industry: The Sources of Industrial Energy

The source of energy is one of the key aspects of industrial activity and one that developed significantly as a result of the Industrial Revolution. In trades such as blacksmithing, human muscle power was used to direct the blows of a hammer, or to operate the lever of a bellows. In other industrial processes a more powerful energy source was required, which often involved the muscle power of animals or water power. This chapter examines the development of energy sources for industry in the eighteenth and nineteenth centuries.

There were four main sources of industrial energy of the period: animal, wind, water and steam. The most common source of power in Cork was water followed by animal and steam with little use of wind energy. Often these energy sources were used in conjunction with each other, particularly in extractive industries. Animal and human power played an important role by many of the early eighteenth century industries and therefore did not unduly restrict where industries could be located. However, while increased scales of production eventually brought about a shift from animal- to steam-powered prime movers, in many cases water remained the main energy source, especially in the rural based industries, until it was replaced by electricity in the early 20th century. In many Irish industries, the steam engine was generally used only to supplement water-powered energy sources over the summer months, when water levels in natural watercourses were considerably reduced.

Animal power

Animals were extensively used for traction and for working machinery in eighteenth and nineteenth-century Ireland, while in certain industries the early use of machines relied heavily on the use of horses, donkeys and mules. For many industrial activities such as remote mining operations and even urban industries such as breweries and distilleries, animal-powered machinery offered the only practical means of powering machinery when water-power was unavailable. Even the early industrial development of Ireland's textile industries did, to a certain extent, involve the use of animal-powered machinery. Man-powered machinery - principally *windlasses* (a type of drum around which rope was coiled) used in early ships' patent slips (for hauling ships out of the water); early fire-fighting apparatus, cranes and prison treadmills - were also used in Ireland during the eighteenth and nineteenth centuries.

Two basic varieties of animal-powered wheels were used in County Cork industries. In the first of these, the motion of the wheel was directly transferred to the implement or device. These were commonly used in Cork mining operations as rope-winding machines (generally called *horse gins* or *whims*), where a circular, winding drum pivoting on a central, vertical shaft, was

Windlass used in mining, from *Georgius Agricola, De re Metallica* (1556).

set in motion by a horse or team of horses moving in a circle. In the second variety, the motion of the wheel was transferred, indirectly, to the machine by means of an intermediate gearwheel. Some three horse gins were erected at the Allihies copper mines in 1820.[1]

The two main forms of indirectly driven animal-powered wheels are called *horse wheels*, usually a large diameter wooden gearwheel which pivots on a vertical shaft, which was used in early textile mills, breweries and distilleries. In this arrangement, the wheel is set above the level of the horse's head and the horse or horses are harnessed to the spokes of the wheel. The second type of indirectly driven wheel, commonly called a *horse*

Horse whim in use at coal pit at Brosely, Shropshire , England in 1788.

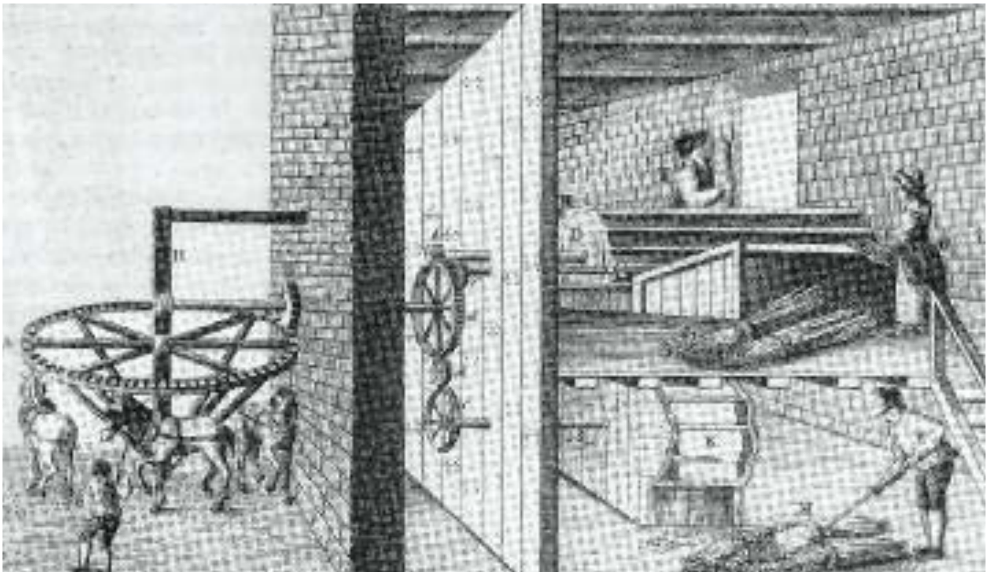
engine, is a nineteenth century development. This is usually a cast-iron, low level gear, to which the horse or horse team is harnessed above the gear ring. Such wheels were generally used for agricultural purposes such as threshing or churning butter and so forth. However, as the gear was set at a low level the horses often had to step over the driveshaft emanating from the gear ring as they made their rotation.

Throughout the nineteenth century and in the early decades of the twentieth century, horse-powered machinery was used on nearly all of Ireland's numerous brickfields, in the preparation of potters' clay, as at Youghal, and in the grinding of alabaster in nineteenth-century Cork City.[2] Animal-powered machinery also featured in the early mechanisation of Ireland's textile, brewing and distilling industries. Horse-powered cotton machinery had been installed in George Allman's mill at Bandon by the early 1780s, whilst a woollen manufacturer in Cork City had set up horse-powered machinery in 1795.[3] The use of horse-powered plant in Cork's premier food-processing industries, brewing and distilling, particularly in those established in urban centres towards the end of the eighteenth century, was critical to their development in the period before the advent of steam power. In Cork City, the main centre of the Irish brewing and distilling industries at the end of the eighteenth century, horse wheels were used to power nearly all of the machinery in the city's main breweries, and in some of its distilleries. Up until 1818 all of the machinery in Beamish and Crawford's brewery, established in 1792, was worked by horses, and even after steam power had been installed, horse wheels were still used to work water pumps until the early 1830s.[4] The horse wheels in the Watercourse Distillery in Cork city and at Walker's Brewery in Fermoy were both replaced by beam steam engines, respectively in 1811 and 1814.[5]

Horse engine, early twentieth century at Skerries Mills, Dublin.

As early as 1832 Perrott's Hive Iron Foundry at Cork was manufacturing threshing machines for the Munster market. These were usually of compact, cast iron horse engines, where the drive was taken from the top of the wheel rather than at the bottom of the driveshaft, as in the traditional wooden horse wheel. The use of cast metal added to the durability of the mechanism and it became no longer necessary to construct an elaborate engine shed to protect it from the weather. By 1875 it was estimated that some 10,000 horse engines for threshing machinery were at work in Ireland. The site of horse-powered threshing machines at Young Grove House, near Lisgoold in county Cork (c.1842), survives as a raised, circular earthen platform.[6] Horse and donkey engines were also used for churning milk and sawing wood, and the remains of these and of threshing engines and their emplacements, can still be seen in some places.

In the provision of utilities in the nineteenth century, water supply was provided by manually-operated cast iron pumps, and were commonly used throughout rural Ireland up to very recent times. In many small country towns, up until the widespread construction of public water supply networks towards the end of the nineteenth century, these pumps would often be the only means of water supply, apart from the local well or stream. Wooden, hand-operated pumps were also the mainstay of many Irish tanneries throughout the nineteenth century, and it is often forgotten that early firefighting equipment relied heavily on manually-operated machinery.[7]



Horse wheel powering threshing machine, at the Latouche estate, county Laois in 1794.

Wind Power

Relative to the rest of the island of Ireland, the use of wind power in County Cork industry was very limited. At least two windmills were at work within the city of Cork in the second half of the eighteenth century and the first half of the nineteenth century, at Lady's Well on the north side of the city and on Windmill Road on the south side. Very little is known about their physical development, but it seems likely that they were all *tower mills*. The earliest evidence for their use within the city is J. O'Connor's *Map of the City and Suburbs of Cork* (1774), which shows a windmill on the high ground in the Patrick's Hill area of the city. Charles de Montbret noted in 1790 that the best available view of the city of Cork was from the 'old windmill' on the north

Reconstructed early nineteenth-century multi-storey tower mill at Blennerville, county Kerry.

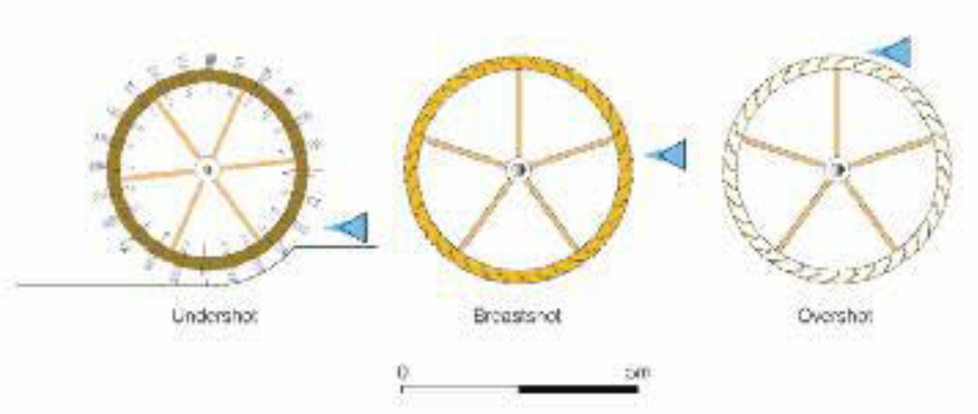
Windmill stump at Rath, near Churchtown.

side of the city. The windmill at Windmill Road, illustrated in F. Calvert's *The First Series of Select Views of Cork and its Environs*, published in 1807, had ceased to exist by the late 1840s. The Windmill Road tower mill was owned by Isaac Morgan in 1824 and had a bakehouse attached to it.[8] The Cork City windmills seem likely to be an attempt to capitalise on the increased demand for cereals in the period 1770-1815, and were probably used as a supplement to existing watermills. For the most part, the county did not lack the kind of natural watercourses suited to the establishment of water-powered installations, which explains the general lack of windmills. In County Cork the only surviving tower mill is a small, two-storey example at Rath, near Churchtown.

Water Power

Cork is well endowed with a good water supply with its many rivers and streams. It is therefore, no surprise that the main source of energy as a prime mover was water power. The rotation of the *vertical waterwheel* transmitting power via the axle and through a system of gearing, transferred power to the machine. As we shall see, both the waterwheel and the gearing system became more sophisticated over time making it more efficient and powerful. The nineteenth century also witnessed the return of the horizontal wheel, now called turbines, which proved to be more efficient. The general paucity of exploitable coal measures in Ireland meant that in many industries steam engines were often employed as supplements to water-powered wheels, during the summer months, when water levels were low and the length of time waterwheels could turn machinery might be severely restricted.

There were three basic varieties of vertical waterwheel employed in Cork industries up to the twentieth century. These were based on the where the water was delivered: undershot; breast shot and overshot.



Waterwheel types.

Undershot: This is the least mechanically efficient means of directing water on to a waterwheel and is generally thought to be only around 35% efficient. In this arrangement the waterwheel is suspended over an artificial channel and the incoming water is carefully guided, by means of a wooden or stone lined trough, onto wooden paddles or floats, at a point slightly above the lower part of the waterwheel's circumference. These wheels were generally employed in low-lying areas, where the fall of water was negligible, such as large rivers or tidal estuaries. However, in 1823 the French engineer Jean Victor Poncelet (1788-1867), substantially modified the traditional undershot waterwheel by replacing its flat paddles with curved vanes and providing an angled sluice or inlet control gate, which allowed the incoming water as close to the vanes as possible. Poncelet's improved design successfully married the principal advantages of the traditional undershot waterwheel (low construction and maintenance costs) to the demands of increased mechanical efficiency. The use of curved vanes and the improved sluice arrangement enabled incoming water to enter the vanes without impact and to exit with little or no velocity. The Poncelet-type waterwheel was introduced into Ireland in the early 1830s and came to be widely adopted at mill sites at which traditional undershot waterwheels had formerly utilised low falls. Glanworth Woollen Mills and Fermoy Flour Mills in county Cork retain fine examples of such waterwheels with cast iron frames and curved wooden vanes, all of which were in use up until quite recently.

Breastshot: The more efficient varieties of vertical waterwheel used the *potential energy* of falling water, where the weight of the water, directed into enclosed buckets on the periphery of the waterwheel, set it in motion. There were three basic types of breastshot waterwheel: *low breastshot*, which received water from a point below the level of the axle; *breastshot*, where the water was received about mid-way up the circumference of the waterwheel and *high breastshot*, where the water entered the buckets at a point above the axle. These varieties became commonly used in Ireland towards the end of the eighteenth century, and by the early decades of the nineteenth century, breast-wheels were beginning to outnumber other types of waterwheel in many parts of the county. Good examples of high breastshot wheels in county Cork can be seen at Midleton Distillery and at Bealick Mills near Macroom. A number of all-wooden examples, survive within the Monard and Coolowen ironworks complex, near Blarney.

Overshot: In the overshot waterwheel the water is delivered into buckets at the top of the wheel. Of all the traditional varieties of waterwheel this was the most effective, being capable of providing from the same volume and fall of water, almost twice as much power as an undershot wheel. These also came to be replaced by different varieties of breastshot waterwheels during the nineteenth century in Ireland, particularly when the power requirements of most industries began to expand. The substitution of overshot wheels for high breastshot models was probably more widespread than has previously been imagined, while it is possible, also, that with the advent of water turbines, the installation of larger and more powerful overshot types was dispensed with. However, in county Cork the standard breastshot form is the most common. At the Monard and Coolowen Ironworks three overshot waterwheels of early twentieth century date, each with a diameter of 3.19m, complete with cast-iron frames (but with wooden buckets), survive *in situ*. In 2018, the remains of a seventeenth-century overshot grain mill were excavated at Killaclug near Macroom.

In the early 1800s Thomas C. Hewes (1768-1832) of Manchester was developing what was to become known as the *suspension waterwheel*. Before the introduction of this type of waterwheel, the motion of the wheel was transmitted to the gear wheels via its wooden axle. The stresses involved required that the axle be of stout construction. The *compass arms* or struts supporting the external rim of the waterwheel, or the framework of *clasp arms* (as at Monard spade

ABOVE: Poncelet type undershot waterwheel at Glanworth Woollen Mills.

BELOW: High breastshot all-iron waterwheel at Bealick Mills, near Macroom.

Compass arm waterwheel, near Schull.

Suspension waterwheel with the segment wheel attached to the outer rim of waterwheel and smaller pinion wheel or bull nut transmitting power into the building, c. 1829, at Dyan Mills, county Tyrone.

mills) introduced in the eighteenth century for the same purpose, also added to the weight of the waterwheel and thus increased the pressure on the axle.

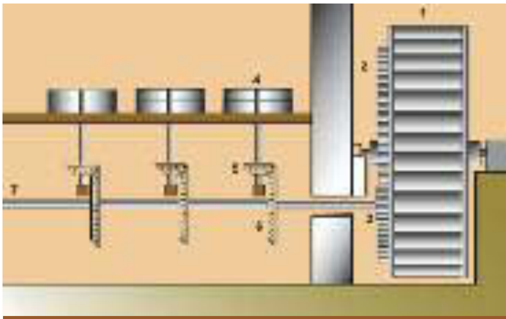
However, in the suspension waterwheel, power transmission from the wheel was transmitted from its rim. As the principal driving wheel or *segment* was now affixed, in sections, to the outer rim of the waterwheel, it was no longer necessary for either a large axle or a heavy frame. The rotating segment portion of the waterwheel engaged a smaller gear wheel called a *pinion* or *bull nut*, which drove a horizontal driveshaft called a lineshaft or layshaft, and thence to any series of devices such as millstones.

It now became possible for the diameter of the axle and the cross-sectional area of the arms to be greatly reduced. Heavy wooden axles could now be replaced with slender cast iron ones, with internal wrought iron suspension rods providing support for the framework of the wheel. In c. 1802 Thomas Hewes erected the earliest-known Irish example of a suspension waterwheel at Overton Cotton Mills, near Bandon.

This was 40ft (12.19m) and 5ft (1.52m) wide and, while most of it was made of metal, the buckets were of wood.[9] On present evidence, this would appear to be the first example of such a waterwheel ever built, and fortunately its original axle survives *in situ*.

In the late 1820s William Fairbairn (a former employee of Thomas Hewes) developed *ventilated buckets*, a further refinement to the new, all-iron waterwheel, which greatly improved the way in which individual buckets handled the entrance and exit of water. Fairbairn played an important role in the dissemination of the suspension waterwheel in Britain and Ireland. During the 1840s and 1850s an increasing number of these waterwheels were installed in Ireland, but the only surviving example of a Fairbairn-built, high breastshot waterwheel is that installed at Midleton Distillery in 1852, which is only one of two surviving in either Britain or Ireland today. There is also a further fine example of a high breastshot suspension wheel of c. 1860, manufactured by McSwiney's foundry of Cork at Bealick Mills.

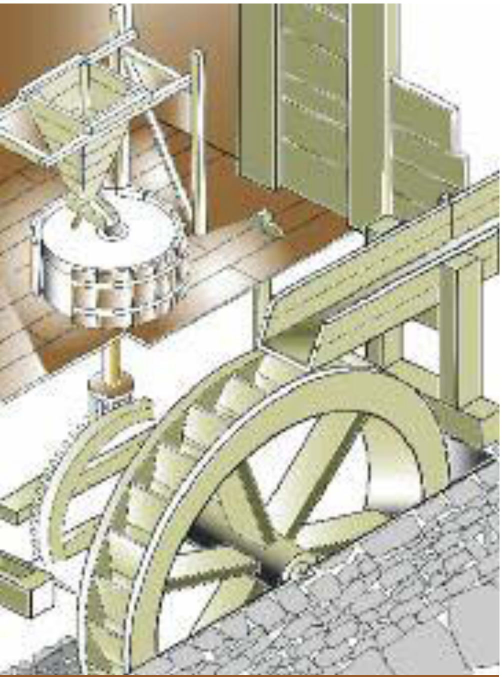
The basic types of gears employed to transmit the motion of the waterwheel before gear segments and pinion wheels were employed, required that the axle of the wheel extend into the mill building through a



ABOVE: How the combination of segment and bull nut gears turns a layshaft and thence pairs of millstones: 1. Suspension waterwheel, 2 Segment wheel, 3. Bull nut or pinion. 4 Millstones, 5 Wallower, 6 Bevelled face gear wheel, 7 Layshaft or lineshaft.

BELOW: Axle of the suspension waterwheel (c. 1802) at Overton Cotton Mills, near Bandon. It is the earliest known example of Suspension waterwheel in Ireland.

Fairbairn suspension waterwheel of 1852, at Midleton Distillery. Note the slender cast iron arms and the segment gear attached on the far side.



ABOVE: **Cog and rung gearing.**
BELOW: **Pit wheel and wallower gearing.**

specially built opening. A rectangular, stone-lined pit known as the gear pit, constructed inside the building and parallel to this opening, allowed a large gear wheel, called the *wallower*, attached to the axle, to rotate freely. This gear then engaged a further gear wheel, set at a right angle to it called a *lantern pinion*, to which was attached an iron axle, which extended upwards to turn the upper millstone. This arrangement was commonly referred to as *cog and rung* gearing. Close-grained woods like elm and crab apple were often used by the traditional mill carpenter or millwright for the gear teeth. This type of gearing was used throughout Ireland well into the nineteenth century, usually in small country oat and meal mills. In Ireland, probably from the late 1780s (and certainly from the early 1790s onwards) the wooden gear wheels were being replaced by a cast iron bevel gear or pit wheel, which meshed with a further beveled gear or *wallower* set at right angles to it. The use of a spur gear set on top of the wallower's upright shaft enabled a series of devices to be powered via auxiliary shafting, an advance that would appear to be closely associated with the development of multi-storey flour mills in later eighteenth-century Ireland.

Where the individual storeys of a large mill or factory complex were involved, a long horizontal shaft (*line shaft*) enabled machines to be powered from a large waterwheel set some distance away. The use of line shafting, however, only really became technically possible with the introduction of the suspension waterwheel, and would not have been common in Ireland until at least the 1830s onwards.

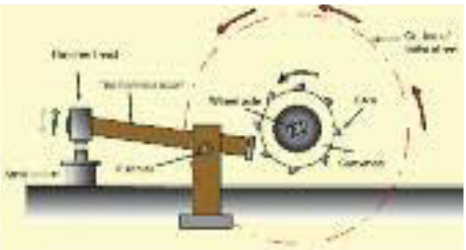
Geared transmission was extensively used for everything from simple grain mills to large textile mills. But for a number of mechanised industrial processes, such as those involved in the finishing of textiles, such as linen and wool; the dressing of ores, metal-working bellows and spade and shovel manufacture, the *cam* was the principal means of power transmission. A series of radial cams set in a wheel affixed to the waterwheel's axle was generally

End of cast-iron line shafting in late 19th-century sawmill at Glenville. Note how the bevelled gear engages with the wallower on the line shaft transferring power upwards.

used to set a vertical stamp hammer; a trip hammer, a forge bellows, fulling stocks and beetling engines in motion.

Once layshafting/lineshafting was introduced, transmitting the waterwheel's motion via belt pulleys and fan belts became commonly used in the mid/late nineteenth century to drive many forms of industrial machinery. In this system the pulley wheels were attached to the layshaft, and fanbelts connected to these drove smaller pulley wheels attached to the driveshaft of, for example, the upright shaft powering a set of millstones. Fan belts and belt pulleys were cheaper to make and more flexible. The pulley wheels could be easily moved up and down the layshaft to accommodate a new device, or a new wheel added to the layshaft for the same purpose. Bevelled gears on the other hand were cast in one piece, whereas belt pulleys could come in two pieces and be bolted together on any section of the layshaft. Also the vertical driveshaft of the pinion wheel required a thrust bearing fixed in a baulk of timber, which made it inherently less flexible - as in difficult to move.

Great care and skill were generally exercised in providing a regular supply of water for a mill. The construction of dams, artificial channels (*millraces* or *leats*), and storage reservoirs



A camwheel used to operate a trip hammer. This arrangement was commonly used in spade mills.

Layshaft and pulley wheels at Castleview Mills. These were used to power flour and meal sifting machines.

Layshaft and pulley wheels at the Logwood Mill in the Monard and Coolowen spade mill complex. These were used to power sanding machinery, which were used to polish the handles of shovels and spade.

(*millponds*) not only required sound planning but often involved considerable expense. In most instances an artificial channel (the *headrace*) was used to direct water from a natural watercourse such as a river or stream, either on to the floats of an undershot waterwheel or into the buckets of breastshot or overshot waterwheels. The water leaving the waterwheel was then directed back into the natural watercourse downstream of the mill, by means of a further artificial channel called the *tail race*. The sides of mill races were often revetted with masonry to counteract erosion, whilst the base of the channel was commonly sealed with puddled clay (i.e. clay which had been washed and worked into a plastic consistency) to prevent leakage. Both the headrace and tailrace channels were normally excavated, often deeply into bedrock,

Head and tail race channels of gunpowder incorporating mill, Ballincollig Gunpowder Mills.

to maintain the fall of water required to lead the water from its source to the mill works. Not infrequently, the millrace could also follow the contours of a hillside to ensure that the fall was adequately maintained. However, in certain instances one or both sides of the millrace had to be formed with embankments to carry it over a low-lying and/or marshy area. An early example of such a millrace, which was in existence in the 1780s, survives at Riverstown Distillery, near Glanmire. The main section of this channel is a cut feature, which follows the contours of adjacent hillsides for almost a mile from it source, before taking an almost ninety degree turn to pass under a roadway. The remaining section, approximately 180m in length, is an elaborately constructed embanked millrace, the inner side of which is formed, on its southern edge, by the outer face of a hillside, the outer edge of the millrace being formed by two stepped earth and clay embankments, one built on top of the other. The embanked section ends in a millpond, formed by high embankments on each side, that on the northern side being up to 8m in height. The most elaborate system of millraces to survive in Ireland is at the Ballincollig Gunpowdermills. This is one of the largest hydro-power sites of any type in Europe where, in its initial phase of construction (c. 1794-1809). It had over 9km of millraces (which also served as transportation canals). The long winding mill races, weirs across rivers and mill ponds are depicted on the Ordnance Survey maps.

The flow of water in the channel at the entry to it or immediately before its discharge on to the water wheel was controlled by sliding vertical control gates called sluices. On the main head race channel, the sluice gates were normally placed at a point near or on the juncture of the main inlet with a weir. By this means the entry of water into the headrace could be carefully controlled, particularly during the winter months when floods were a common hazard, not only to the lands traversed by the millrace, but to the integrity of the millrace itself. The sluice gates could also, if required, be used to drain the millrace for maintenance and repairs. At smaller mill sites a bypass or overflow sluice, set in the wall of the headrace channel close to the mill building, was commonly provided as a ready means of shutting off excess flow to the waterwheel and directing water back into the river. Wooden, and later cast-iron, troughs or

Stone aqueduct carrying the mill race to the high breastshot suspension waterwheel of 1852, at Midleton Distillery.

launders were commonly employed to deliver water into the buckets of breatshot and overshot waterwheels, and in some instances stone aqueducts, carried on arches, were constructed to direct water onto to these types of waterwheel, as at Overton cotton mills and Midleton Distillery.

Weirs were also commonly used both to divert water from rivers into mill races and to increase the fall of water available for a mill site. The height of the weir caused the river level to rise immediately behind it, enabling mill races set a higher level than the river bed to be supplied with river water. In this way, greater control could be exercised over the level at which the incoming water could be directed onto the waterwheel, enabling (at the very least) certain varieties of breastshot wheel to be employed. In the eighteenth and nineteenth centuries weirs constructed across wide rivers were now built with substantial rubble cores, held within a timber framework externally faced with either pitched rubble or cut-stone blocks.

At industrial sites where the water tended to be scarce, or the available flow of water was limited, artificial reservoirs or millponds were formed to store the water. A supply of water was usually built up in the pond overnight for use during the day. The bed of the pond was normally sealed with puddled clay to prevent leakage, while the sides of the pond were often faced with stone walling to counteract erosion. The inlets and outlets to millponds were generally controlled by sluices, primarily as a means of controlling the level of water in the

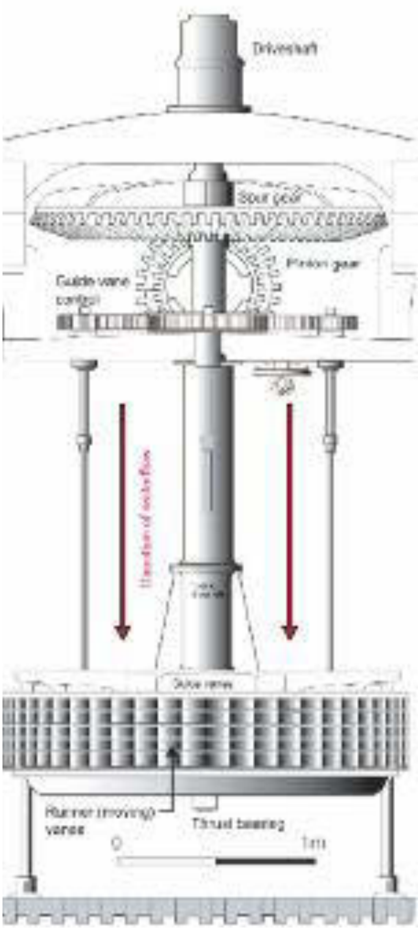
The waterworks weir, Cork. The weir diverts water towards the waterworks and its origins go back to at least the early seventeenth century.

pond but also as a defence against flooding. Millponds were also prone to silting and the growth of vegetation (which could damage the lining of the pond), and therefore required regular maintenance. They were frequently drained and cleaned out, and in the Ballincurrig Woollen Mills, this became an annual social event, notwithstanding the work. Where the outlet from the pond was via a weir, silting was a common problem, and it was often necessary to have a means of draining the pond to effect repairs, usually by means of a drainage channel controlled by a sluice. Ponds varied in size from about one to several acres, depending on local conditions. When steam engines were introduced as supplementary power sources, the pond or ponds often doubled up as a supply for the boilers.

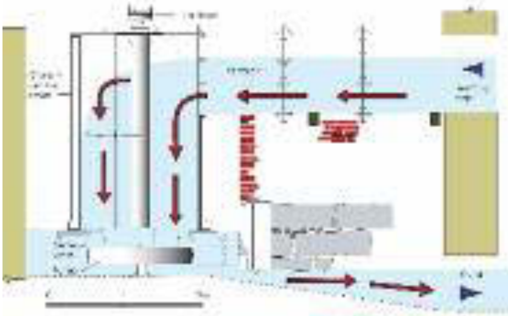
At the Monard and Coolowen Ironworks, near Cork City, a series of millponds was ingeniously constructed in a glacial valley on the headwaters of the Blarney River in the 1780s. The mill ponds were constructed at three different levels, the water in the upper pond being used by a succession of mills each served by separate millponds. Water exiting from the upper mill passed into a pond immediately below it, and in this way four separate mills could be worked during various parts of the day: the upper mill in the early morning and the lowest mill in the afternoon.[10]

As we have seen, many improvements were made to the design of vertical waterwheels from the late eighteenth century onwards. However, the mechanical energy generated by them (regardless of the available water supply), could only be increased by constructing wheels of larger diameters. Large waterwheels of between c. 50-70ft in diameter were built in Ireland, but the locations at which they could be used were extremely limited; owing to difficulties in constructing emplacements for them, and of delivering water into their buckets at such increased heights. In many cases, particularly in urban areas where existing watercourses were already seriously congested at the end of the eighteenth century, the only alternative was to acquire steam-driven prime movers to facilitate further expansion or, indeed, to establish new industrial sites further away from the urban core. The development of the water turbine presented enormous opportunities for many Irish industrialists, particularly those involved in branches of linen manufacture. Here was an excellent opportunity to both capitalise on existing water resources and to reduce an increasing reliance on steam-powered plant. Irish industrialists and millwrights were, for the most part, quick to grasp the significance of this new technology.

In the early period of their development the term 'horizontal waterwheel' was applied to all turbines to distinguish them from the vertical waterwheels then in common use, but as designs improved and methods of water delivery were modified, the terms *impulse* and *reaction* were introduced to differentiate between turbines utilising one or other of the two basic types of fluid energy. Impulse turbines use fluid energy in its kinetic form, where the potential energy of the water in the reservoir is converted into kinetic energy as it falls towards the turbine. A conduit or pipe called a *penstock* developed a jet of water, which was discharged against the vanes of the turbine. In reaction turbines, on the other hand, the vanes of the turbine are completely submerged when it is in operation, and no water jet is formed. Only part of the potential (pressure) energy of the water is converted into kinetic energy as the water passes *through* the turbine.[11]



Fourneyron turbine.



Jonval turbine, built by the Hive Iron Foundry, Cork c. 1855, at Ballincollig Gunpowdermills.

On an island with limited coal resources, the continued development of existing sources of water power became a technological imperative for Irish industrialists. Imported coal added to the cost base of Irish industry, and so all means were explored to make the most of existing hydro-power sites. In this regard the water turbine offered considerable advantages over the various types of vertical waterwheel. By the late 1840s water turbines could produce efficiencies equal to and often higher than the most developed vertical waterwheels, utilising falls of less than one foot (0.3m) up to hundreds of feet. The equivalent range for vertical waterwheels was about 2-50ft (0.6-15.2m) and, whereas the vertical waterwheel could not operate efficiently when flooded, the water turbine could continue to work effectively when entirely submerged.

The first reaction turbines to be used in County Cork industries were based on the designs of the French engineer Benöit Fourneyron (1802-67). In Fourneyron's turbine, incoming water was admitted into the centre of the turbine. A series of centrally positioned, fixed guide vanes then directed the water, simultaneously, onto the curved blades of a rotating outer wheel (the *runner*). The outward movement of the water leaving the turbine exerted pressure on these curved blades, the motion of which was transferred to the turbine's driveshaft.[12]

Between 1850 and 1896 MacAdam's foundry in Belfast built Fourneyron-type turbines. Many of these were used in the Ulster linen industry, and the latter's influence in the south of Ireland led to their adoption in processes associated with flax-related industries in county Cork, as at Ballineen, near Bandon and Riverstown near Cork City, by the early 1850s - one of the first counties outside of Ulster were such trends can be discerned.[13] In 1858 Cork Corporation Water works became the first in either Britain or Ireland to use water turbines, built by

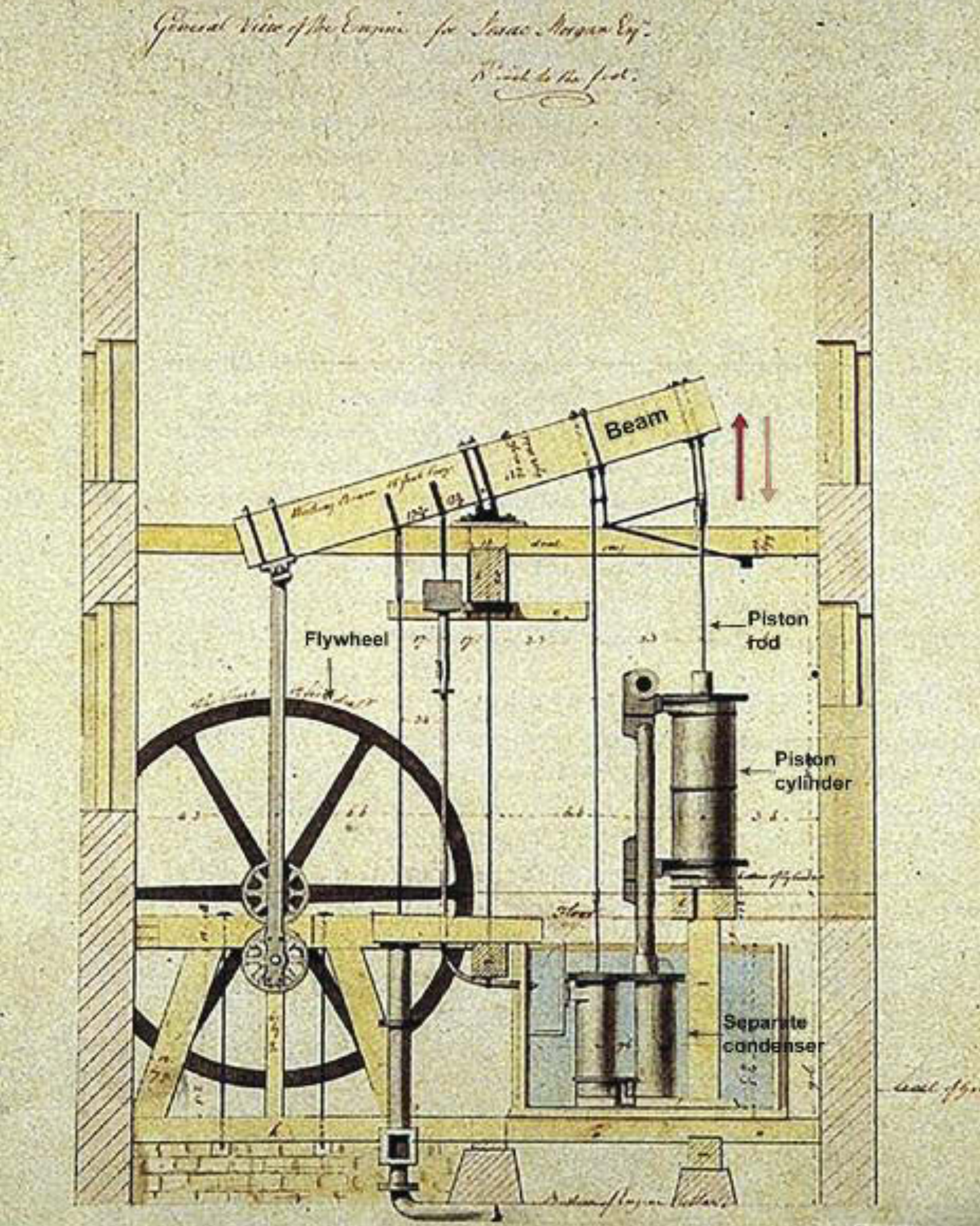
Turbine house of 1888, Cork Corporation Waterworks.

MacAdam of Belfast on the Fourneyron model, to power pumping machinery.[14] Perrott's Hive Iron Foundry in Cork City, also built and installed a Jonval-type turbine for a sawmill at Ballincollig Gunpowdermills around 1855.

The Ballincollig turbine could generate 16hp from a fall of 8ft (2.43m): over twice that of any of the breastshot waterwheels used elsewhere in the same complex.[15] An entire battery of turbines installed at Cork Corporation Waterworks between 1888 and 1916, were still in commission up until 1993. The two Fourneyron-type turbines installed in 1858 were replaced by two imported 'New American' turbines which were brought into commission in 1890 (370hp in total), to which a further two examples were added in 1901. All four of these turbines were reconditioned in the period 1912-1916, and a fifth was added in 1916. Up until 1993, when this facility was decommissioned, these turbines continued to pump about 10% of the city's daily needs to storage reservoirs on an adjacent hillside. Since 2002, two of these turbines are being used to generate electricity for the present Cork City Council.

Steam Power

In Irish industry the industrial use of water-power was extended, insofar as was possible, through the rapid adoption of improved waterwheel designs and ultimately water turbines. But by the closing decades of the eighteenth century it had become apparent that Ireland's larger units of industrial production could only expand with the adoption of steam-powered prime movers. Some moderately sized mills and factories, with excellent water-power resources, were obliged to acquire what effectively became 'back-up' engines to carry them



Rotative beam engine, by Boulton and Watt, installed at Isaac Morgan's flour mill at Cork.

over the summer months, when river levels ran low. But all such advances came at a relatively high cost. Ireland's native coal resources were pitifully small and poorly served by transit facilities.

Industrial steam engines are generally referred to as *stationary* steam engines to distinguish them from locomotive engines, i.e. those used for tractive purpose. The first working steam engines used in Ireland were employed in pumping out deep mines. In *beam engines*, which were the earliest form of stationary types, a large pivoting beam was connected by chains, at one end, to a piston set vertically in cylinder, and at the other to pump rods which extended down a mineshaft. When low *pressure steam* (generally just above atmospheric pressure) was admitted into the cylinder, the weight of the pump rods on the opposite side of the working beam raised the piston upwards. This pushed one end of the beam upwards and the other end, with the pump rods attached, downwards. By injecting cold water into the piston cylinder the steam was rapidly condensed, and the sudden change in atmospheric pressure drove the piston downwards, pulling with it the chains attached to the beam, and in the same process raising the pump rods at its opposite end, creating the energy required for pumping out the water. The completion of this cycle is called the *working stroke*. The first steam-using engine was Thomas Newcomen's single-acting atmospheric beam engine of 1712.

In the second half of the eighteenth century a number of important improvements in steam engine design, principally by James Watt (1736-1819), greatly expanded the range of early steam engines. In 1769 Watt patented his *separate condenser*, which he developed from his discovery that by keeping the engine cylinder continually hot (instead of cooling it at every stroke), the engine could be run much more efficiently. The steam was now condensed in a cast iron box (the *condenser*) beneath the cylinder, which obviated the need for reheating the cylinder. Watt's second major contribution was the application of the double acting principle to the engine's cylinder. In early Newcomen and Watt engines the steam acted on only one side of the piston. But by allowing the steam to act on both sides of the piston, alternately, it was now possible to derive twice the power from the same size of cylinder.

Up to the 1780s the use of beam engines was restricted to pumping water out of deep mines. However, the development of *rotative* steam engines, in which the motion of the beam could be adapted for rotary motion using a crank, enabled engines to drive almost any type of machinery. Rotative engines enabled Cork breweries and distilleries to both expand and maintain their operations over the summer months when water levels in natural watercourses inevitably ran low.

Early beam engines were heavily reliant on the structures housing them for both support and shelter; the working beam often resting on one of the end walls or on an intermediate supporting wall. These were generally called *house-built* engines, after the early practice (continued with Cornish pumping engines) of building beam engines as an integral feature of the engine house. Boulton and Watt went on to develop *independent* beam engines, which enabled beam engines to operate in conditions that did not require a large masonry engine house. An engine bed consisting of large masonry blocks was now built to support a framework of anything from one to six cast-iron columns, which was used to support the beam.

Six-column independent beam engine, in situ, at Midleton distillery: a, piston cylinder; b, piston rod; c, flywheel; d, governor; e, supporting column.

The best-preserved Irish example of a six-column independent beam engine in Ireland is on display, *in situ*, at Midleton distillery. This was built by Peele and Williams of Manchester and was installed in 1835.[16]

A second engine of similar construction, from the same site, and dating from around the same period, has been dismantled and removed to the Steam Museum at Straffan, county Kildare, where it has been installed as a working exhibit. It now seems likely that this engine, which seems likely to have been manufactured locally, was acquired second hand and installed in the distillery in the period c.1866-77.[17]

A variant form of independent engine, the *A-framed* engine, employed a working principle in which the engine acted directly upon the crankshaft. In this and in later *direct acting* engines, the motion of the piston could be transferred directly to the crankshaft without employing the up and down action of the beam. In A-frame engines, the flywheel and the crankshaft were mounted on two A-shaped trestles or frames, the cylinder being set directly upon a baseplate. An A-framed engine from Allman and Dowden's Brewery at Bandon, which dates to the late 1830s, is on display as a working exhibit at the Steam Museum, Straffan.

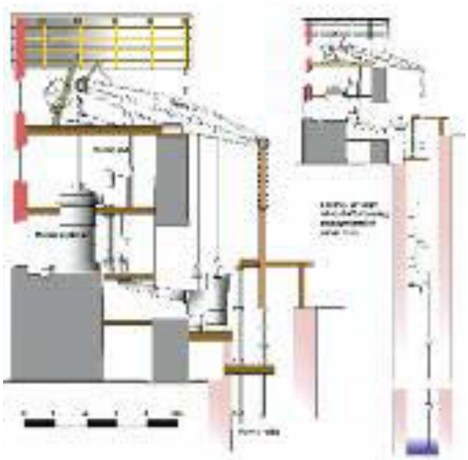
Independent beam engine, installed at Midleton Distillery c. 1866-7, now on display at the Steam Museum Straffan, county Kildare.

The next important development in steam engine design was the introduction of high- pressure steam. Early boiler designs were unable to withstand high pressures, and in early Watt engines the risk of boiler explosions generally prevented steam pressures greater than a few pounds above the atmosphere from being employed. Yet high pressure steam did have significant advantages. By using steam pressure alone, the engine stroke of a typical beam engine could be dispensed with, as it would be no longer necessary to condense the steam in the cylinder to achieve the desired effect. The development of improved boilers by engineers such as the Cornishman Richard Trevithick (1771-1833), in the early years of the nineteenth century, facilitated the advent of *non-condensing* locomotive engines. Trevithick's *Cornish boiler* enabled two major developments. The first was to make steam engines more compact and portable, and ultimately to power wheeled vehicles. The second was the development of the Cornish beam engine, which was to become the pumping engine of choice for dewatering deep mines. In the *Cornish engine* high pressure steam was admitted into the engine's cylinder to initiate the first part of the stroke. By using the steam expansively, significant fuel savings were possible, whilst sufficient levels of steam were maintained within the cylinder to permit a smoother action of the piston. This arrangement was ideally suited for beam pumping engines. The Cornish engine was the ultimate house-built engine, its enormous beam extending out from the reinforced end (or *bob*) wall of the engine house, which gave protection from the elements for the engine's mechanism. The outer end of the working beam and the upper sections of the pump rods were outside the bob wall. In deep mines the pump rods often extended hundreds of feet downwards into the mineshaft. Most of the timber used for pump rods in Irish mines was either Oregon or Danzig pine, made up in 18in (0.457m) square sections; the entire pump rod linkage often weighing up to one hundred tons. The Cornish engine was in use in Ireland from at least the early 1820s onwards.

A-framed engine originally installed at Allman and Dowden's Brewery at Bandon, dating to the 1830, now on display at the Steam Museum Straffan, county Kildare. Note also the use of lineshafting and belt drives.

The largely English complement of mine captains and skilled personnel, brought over to Ireland by contemporary mining companies, preferred to have their engines made in Britain by reputable firms such as Harvey's of Hayle in Cornwall or the Neath Abbey Iron Co. in Wales. In 1815 the Neath Abbey Iron Company in Wales supplied a beam pumping engine to a mining company at Allihies. It is by no means clear precisely what kind of engine was involved here, but the engine with the 36in diameter cylinder supplied by Harvey and Company of Hayle, Cornwall to the Dooneen Copper Mine in the Allihies area in 1824 would, on present evidence, appear to be the first Cornish engine used in Ireland.[18]

Cornish beam engine pumping house at Kealogue mine, Allihies.



Reconstruction of Kealogue pumping engine.

Early independent beam engines had certainly freed mill and factory owners from the expense of large engine houses. However, in the *horizontal engine* the beam could be dispensed with entirely. The cylinder was laid horizontally (as opposed to vertically as in traditional beam engines), but there was initially a reluctance to use horizontal cylinders as it was believed that non-vertical cylinders would wear unevenly. Trevithick was the first to challenge this orthodoxy, producing the first stationary steam engine with a horizontal cylinder in 1802. By the late 1850s horizontal engines were beginning to be introduced into Ireland. The beam engine in a flour mill at Millfield, just to the north of Cork City, was being worked in conjunction with a 25hp horizontal engine in 1857, whilst at least two further flour mills in Cork were operating horizontal engines in 1861.[19] For mill owners, horizontal engines had many advantages, the most important of which was the saving of space.

Horizontal textile mill engine at Orr's Mill, Benburb, County Tyrone.

By the mid-1860s there is evidence that *Corliss engines* were being used in Irish textile mills. The American engineer George Henry Corliss (1817-1888) developed a quick-acting valve gear which enabled greater fuel savings in the operation of steam engines in which they were employed. The Corliss valve was introduced into Britain in 1863, and in that same year a variant on the Corliss valve was patented by William Inglis (1835-1890). In 1866 an Inglis-Corliss engine with 40 hp and a Spencer-Corliss valve gear, made by Hick and Hargreaves of Bolton, was supplied to Wallis and Pollock's spinning mill at Donnybrook near Douglas at the edge of Cork City.[20] This is the earliest recorded use of such an engine in Ireland. In the late 1880s Murphy's Lady's Well Brewery in Cork City had installed a Parsons *steam turbine* for electricity generation which is, on present evidence, one of the earliest recorded uses of a Parsons steam turbine in Ireland. The Parsons steam turbine was developed by Sir Charles Parsons (1854-1931), the sixth son of William the third Earl of Rosse, of Birr Castle county Offaly.[21] In Parson's design, steam was used to set a turbine in motion rather than exert pressure on a piston as in a conventional steam engine.

Looking at these many examples it is clear that power was a key factor in the development of industry in the county. Of perhaps even more interest, is the purpose for which the power was used.

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[1] R.A Williams, 1991 *The Berehaven copper mines Allihies, Co. Cork, S.W. Ireland*. (Worsop), 62.

[2] T. Breslin 2002, *The Claymen of Youghal*. (Youghal), 45; C. Rynne 1999 *The industrial archaeology of Cork city and its environs*. (Dublin) 34-5.

[3] A. Bielenberg 1991 *Cork's Industrial Revolution 1780-1880: Development or decline?* (Cork), 32.

[4] Rynne 1999, p. 49

[5] Rynne 1999, p. 68.

[6] D. Power et al., 1994 *Archaeological inventory of County Cork. Vol. 11, East and south Cork*. (Dublin), 131.

[7] For the use and manufacture of traditional wooden pumps in Ireland see O'Sullivan, J.C. 1969 'Wooden pumps', *Folk Life* 7, 101-16.

[8] *Southern Reporter*, 23 October 1824.

[9] C. Rynne 2002, 'The industrial archaeology of the textile mill in county Cork, Ireland c. 1780-1930' *III Jornadas de Arqueologia Industrial*, pp. 409-22.

[10] R. Wigham and C. Rynne, 2001 *A life of usefulness: Abraham Beale and the Monard Ironworks*. (Blarney), 40-5..

[11] Rynne, 2006, *Industrial Ireland*, 47.

[12] C. Rynne, 1989 'Early water turbines- An Irish history', *Technology Ireland*, 21, no. 3, 19.

[13] Rynne 'The influence of the linen industry in the south of Ireland' p.

[14] Rynne 1999, p. 157-8.

[15] Rynne, ibid. 2006, 50.

[16] G. Bowie 1980. 'Surviving stationary steam engines in the Republic of Ireland', *Industrial Archaeology Review* 4, no. 1, (1979-80), pp. 81-90. See Bielenberg (1991), however, for the correct dating and provenance of this engine.

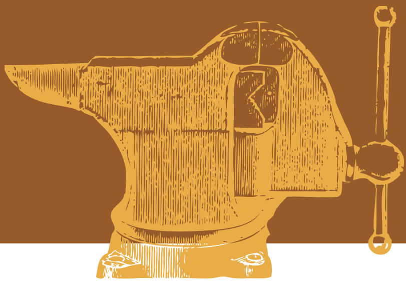
[17] Rynne 2006, 59.

[18] R. A. Williams, 1991 *The Berehaven copper mines Allihies, Co. Cork*, S.W. Ireland. (Worsop).

[19] Rynne 1999, 91.

[20] Ibid. 103

[21] J. F. Clarke 1985 'Charles Parsons – the man' *Trans. Newcomen Soc*. 58 (1984-85) pp. 48-51.



Chapter 4

Extractive and Manufacturing Industries

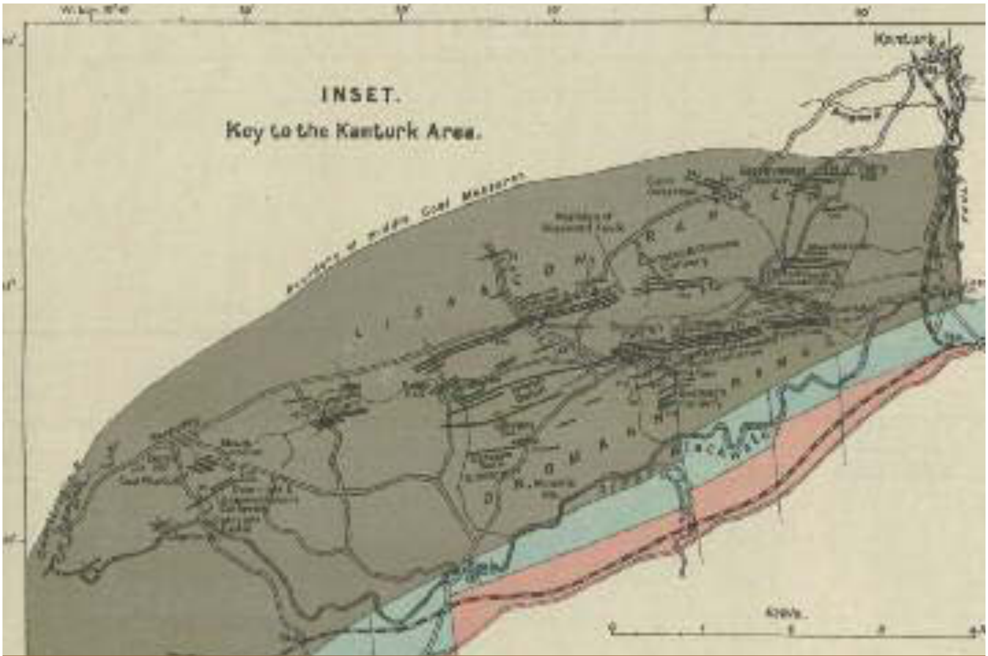
The two principal forms of industrial activity – extractive and manufacturing, were vitally important to the development of County Cork in the eighteenth and nineteenth centuries. The Extractive industries of mining and quarrying were essential in supplying the much needed raw materials for a wide range of activities, from road construction to rebuilding our towns and villages. Manufacturing entailed a series of processes in which the raw materials were converted into a usable commodity. County Cork has an extraordinary range of industries from this period, from rural flour mills to Ireland's largest gunpowder mills complex, and in the twentieth century, the manufacturing the first Irish automobile.

The focus of this chapter is on the surviving physical remains for these principal industrial activities within the county in the eighteenth, nineteenth and early twentieth centuries. Owing to the relative dearth of physical evidence, several industries, such as papermaking, glassmaking, tanning, shipbuilding, have only passing reference.

Extractive industries

Mining or quarrying essentially involves the sourcing and extraction of raw materials for other industries, whether they are manufacturing or utility industries. Limestone, for example, could be quarried for building purposes or burnt for mortar, fertiliser or as a purifying agent in the production of coal gas. It was mainly stone that was quarried and minerals embedded in the rock that were mined. The principal geology of County Cork consists of limestone valleys and sandstone hills, both of which are highly suitable building stones. In West Cork the underlying rock is sandstone with some mudstones that are relatively rich in certain minerals, mainly copper, barytes and manganese.

Around 345-400 million years ago in the geological period known as the *Devonian*, the bedrock geology of County Cork was radically altered. During this era rivers flowing from enormous mountain ranges to the north were to deposit sand, silt and mud, which were to compact, under their own weight, to create the purple and green sedimentary rocks associated with Old Red Sandstone geology. In the succeeding *Carboniferous* geological period (299-359 million years ago) the seas began to encroach inland, depositing mud and sand, which were to form, in the east of the county, extensive deposits of white, carboniferous limestone which extend across the valley of the River Lee, across Cork Harbour and as far east as Youghal. In addition to this fine-grained limestone (much prized as a building stone) *copper-bed mineralization*, in which the ores of copper are formed, is common in the West Carberry region of the county.[1]

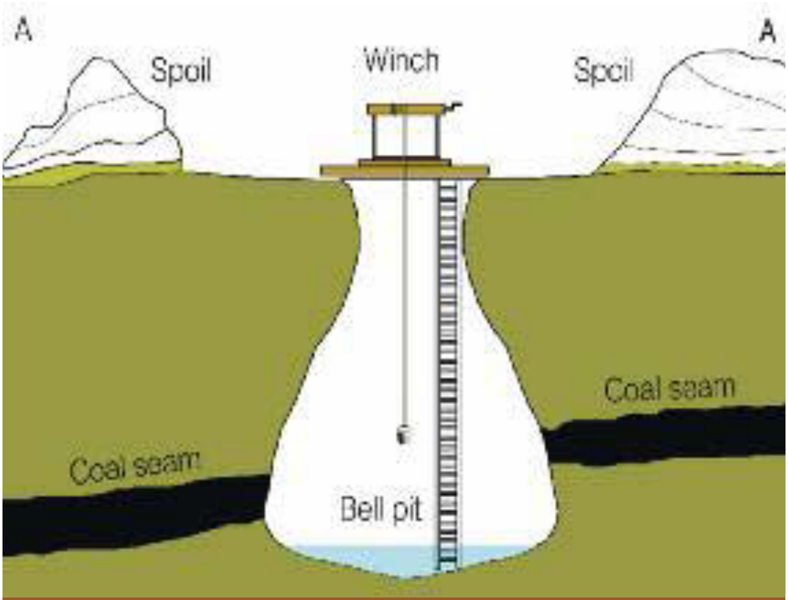


The Kanturk coalfield in 1920.

Coal mining

In the early eighteenth-century what appeared to be substantial deposits of anthracite coal were discovered at Dromagh, near Kanturk, which even lead to an ambitious scheme to transport coal, via a canal and the River Blackwater, to the port of Youghal. A number of other collieries were opened to the south-west of Kanturk during the nineteenth century, but for the most part this coal was both sold and consumed locally.

Early coal mining in Ireland took form of opencast or surface working, where coal could be dug from outcrops on or near the surface. *Bell pits*, so-called because the shallow undercutting at their bases gave them a distinctive bell-shaped cross section, were then resorted to so as to exploit deeper seams, but when these pierced the water table they often had to be abandoned because of flooding. When one of these shallow workings was abandoned another would be opened a short distance from it in order not to miss the seam, and in this way the landscape became pock-marked with abandoned workings as mining activity was transferred from one localised area to another. This mining technique was, however, uneconomic and ultimately wasteful of coal. The working life of pits was very short, as water seeped in and quickly flooded the workings. Deeper mines could only be worked with the aid of water-powered pumping machinery.



Section through a bell pit.

The increased depth of coal shafts, however, brought with it new challenges. Proper drainage was a perennial problem for all Irish coal mines during the eighteenth and early nineteenth centuries. Water-powered pumps were also used on the Munster field, as recorded at Castlecor near Kanturk, where Edward Deane used a large waterwheel to power water pumps for coal workings in 1810.[2] However, little is known about how these pumps operated or how their waterwheels were supplied with water. Some four years later, Richard Griffith reported that the deepest mine on the Dromagh field was 80 yards (c. 73m) deep, where presumably coal could not be extracted from deeper seams unless steam-powered pumping engines were employed.

Remains of bell pit (or *basset* working), on the Slieve Ardagh coalfield near The Commons, County Tipperary.

As with all Irish coal mines poor transportation networks limited the distribution of coal won on the north Cork coal fields. A canal from Mallow to Lombardstown was constructed in the eighteenth century, with which it was hoped to link the Dromagh coal field with the River Blackwater. Yet even the development of Ireland's rail network did little to rectify matters. Even the opening of the Killarney Junction Railway linking Killarney with Mallow in 1853 and, ultimately, with the Dublin-Cork section of the Great-Southern and Western Railway, brought a national rail link within two miles of the Dromagh collieries, appears to have had little effect. The Mining Company of Ireland's Duhallow Colliery was adjacent to the Rathcoole siding of the Killarney line in 1882, but despite the accessibility of such an important national rail link, the development of the Kanturk coalfield never expanded to serve a truly national market. In the 1840s the most extensive collieries on the Munster field were situated in the Duhallow area of County Cork. The most important colliery at Dromagh was initially closed as early as 1861, re-opening some years later before closing for the last time in 1882.[3] In the period c. 1820-1882 Dromagh collieries produced upwards of 950,000 tons of coal, most of which was consumed locally.[4] The first edition OS 6in survey for County Cork (1842) shows several of what are clearly bellpits to the south of Coolclogh. All of the latter have been filled in, but the remains of a post 1840 coal pit, now overgrown, survives to the north of Coolcogh in the townland of Snacon. Over 40 colliers and 300 labourers were employed daily in the collieries, most of whom lived in Dromagh mining village. This village is shown on the 1842 OS map with two long ranges of houses set around a Fair Green and it is known that four fairs were held annually but had been discontinued by 1883. Indeed, like its counterpart New Birmingham on the Slieve Ardagh coalfield in south Tipperary, the settlement proved to be a failure.

Non-ferrous metal mining

The county of Cork possesses the richest non-ferrous metal (i.e. does not contain iron) mining heritage in Ireland. These include some of Ireland's most important copper mines, in addition to mines working significant deposits of manganese and barytes. These may be divided into six main groups:

(a) The Crookhaven and Goleen mines (copper)

(b) The Schull mines (copper and barytes)

(c) The Ballydehob mines (copper and barytes)

(d) The Sheep's Head peninsula mines (copper and lead)

(e) The Skibbereen and Glandore mines (copper and manganese)

(f) The Beara peninsula mines (copper)

Throughout the nineteenth century in Ireland skilled labour was imported from the Cornish mines, where mine 'captains', generally experienced mining engineers, acted as general overseers and mine managers for Irish mine owners. This technological hegemony brought

ABOVE: **The Cornish Engine house at Glandore manganese mines.**

BELOW: **Powder house magazine Crookhaven.**

specialists from all of Britain's main mining regions, and both Cornish and Welsh miners were employed in Irish copper mines. The mine galleries were blasted with black gunpowder, most of which was produced at the Ballincollig Gunpowdermills. The black powder was normally stored in isolated magazines called powder houses, the best examples of which have survived at the west Cork mines. These include a double shell structure at Allihies Mountain Mine, which is rectangular in plan and has a vaulted roof. Circular powder magazines survive at the Dhurode and Crookhaven mines, the former having decorative, mock battlements.[5]

By the early years of the nineteenth century Irish metal mines were becoming progressively deeper, which increased drainage problems and made life more arduous for miners. The water flooding issue was overcome with the Cornish Beam Engine which pumped out the water. In deep mines the descent was made by wooden ladders up to 24ft long, and at the copper mines at Allihies, where miners went down 300 fathoms (c. 548 metres) or more - this involved a double journey which could take up to two

BELOW: **The Mountain Mine, Allihies.**

The Dooneen mine at Allihies.

hours. At the Mountain mine in the west Cork Allihies complex a man lifting engine or 'man engine' (the first and only example of its kind ever to be built in Ireland) was erected c. 1862 - a working model is on display in the Allihies Copper Mine Museum. By the late 1870s work in Ireland's deep copper mines was becoming uneconomic, and in 1875 work at the Dooneen and Kealogue mines at Allihies was abandoned.[6]

With the exception of one abortive attempt to smelt copper ores in Ireland, in the late eighteenth century, thereafter all copper ores mined in Ireland were shipped by schooner to Wales for smelting. Ores raised at the Allihies mines were loaded on to ships in Ballydonegan Bay to be shipped either directly to Swansea or to be temporarily stored in company facilities at Dunboy. The remains of the latter, which include copper and timber stores, have survived, while many of the West Carbery mines such as Ballycummisk, Cappagh and Coosheen also had associated wharfage to provide accommodation for the loading and unloading of ores.[7]

By the 1840s, the expansion of mining operations in west Cork required a sizeable work force, which by the 1850s had risen to c. 1200-1500 mineworkers.[8] Mining companies, became obliged to provide what were often basic living quarters for their workforce. Two factors were at play here: the need to attract the right type of mining operative and the fact that the isolation of many mining sites simply compelled them to provide accommodation, along with other basic facilities, such as churches, for incipient mining communities. The best surviving example of this phenomenon is Allihies village in the Berehaven mining complex. 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. The English miners also erected a small Protestant church in around 1845 which is now a remarkable Mining Museum and cafe.[9]

Barytes or barium sulphate (Ba SO4), which is often found in association with lead and copper sulphide deposits in Ireland, began to be used as a filler in the second half of the nineteenth century in many materials such as linoleum, rubber and paper. But the undisputed centre of Irish barytes mining and, indeed, of the United Kingdom, were the mines of the Bantry district of County Cork. Mining for barytes appears to have begun at Derreenalamone, near Durrus, County Cork in the 1840s, where some 2,500 tons were being raised in 1851, compared to a combined output of just over 800 tons for the other three localities in the United Kingdom producing barytes in the same period. At Derreenalamone the barytes was washed and then dried in revolving furnaces after which it was crushed in steel rollers and then milled to produce barytes flour. The flour was bagged and transported by an aerial ropeway 1.25 miles long to Dunmanus Bay for shipment to London, Liverpool and Glasgow. However, by the end of the 1850s the output of the Bantry mines was eventually superceded by the barytes mines of Derbyshire. Nonetheless the decline of copper mining in west Cork in the 1870s shifted mining interest to the extraction of barytes.[10] Other Barytes mines occurred in Schull and Dunmore near Clonakilty which was reopened for short spells in the twentieth century.

Stone and brick clay

There were numerous stone quarries across the county of varying sizes and shapes. These provided the much needed raw material for the construction of buildings and other industries such as ceramics and sand for glass manufacture. They generally occurred close to end use owing to the cost of transportation - in this way the buildings reflect the local geology. For the most part they were opened on an ad hoc basis to minimise transport costs, especially in isolated areas and away from good communication networks.

There were two basic types of quarry, those which supplied *dimension* or *freestone* (i.e. good quality stone, which could be freely cut in any direction and could be cut to any size) and *rubblestone* - this latter variety being used for walling and as a road building material.[11] The quarrying of freestone was a delicate process which required hand tools such as crow bars, plugs and feathers, as well as saws for cutting. Such care was not needed for Rubble stone and could be was blasted out.

Quarries open on a continuous basis tended to supply the general needs of the building industry although some quarries, such as those involved in millstone manufacture, met specialist requirements. During the later eighteenth and nineteenth centuries, new quarries were opened near large towns while existing ones expanded to take advantage of favourable building trends. Most quarrying operations were labour intensive. Stone intended for cut stone work was freed from the quarry face using picks, wedges and chisels. Moving large blocks of stone around the quarry generally involved a lot of hard labour, aided only by simple ropes, pulleys and wedges; although in some instances metal tramways were used to transport stone in metal trucks to a quayside, as at Carrigrenane quarry on Littleisland. Blasting with gunpowder became common in the nineteenth century for providing road aggregate; rough stone walling and ballast for ships. This material could be moved around the quarry on iron rails and was transported by boat if access was available to a river frontage, or by cart. The abandonment of a quarry, more often than not, was a function of diminishing returns, brought on by the increasing depth of the workings; reduced demand, and a lack of space for the removal of waste rock and flooding.

Limestone

Limestone had many uses such as a road aggregate; base for lime and cement but it was its qualities as a building stone that created the greatest demand for the stone. Cork Limestone was a prized building material for elite building as it took a polish when sawn and was used throughout the County both as building material and for detailed carved work. Cork limestone has a crisp distinctive grey tone that is part of the character of the County. The limestone quarried within the environs of Cork City produced high quality stone which was extensively used for public buildings such as the Court House (1835); the Cork Savings Bank (1842) and St. Fin barre's Cathedral (1865-79).

St Fin Barre's Cathedral, Cork, built between 1865-79 with stone from the Carrigmore quarries near Blackrock.

Kilshannig Church, near Mourneabbey. Built of random rubble limestone with cut-stone detail.

Limestone quarries and quayside at Littleisland.

In 1892, the Carrigmore quarries, located on the Mahon peninsula to the east of Cork City and covering a total area of some 120 acres, were the largest limestone quarries in Ireland. The Rock farm quarries on Littleisland covered extensive areas of the shoreline of Lough Mahon, and these, along with those at Garrigrenan, were also provided with quays and limekilns.

The limestone of the Carrigacrump quarries near Cloyne, which, retained the same basic properties as Carrigmore stone ('Beaumount Dove'), could also be raised in large blocks - preferred in certain instances for steam engine beds.

The distinctive Cork 'red' marble, quarried at Littleisland, Buttevant, Fermoy and Midleton, was widely used as a decorative stone in both churches and public buildings throughout

Carrigacrump limestone quarry, near Cloyne.

Red marble from Midleton used in tomb of 1611 in St Colman's Cathedral, Cloyne.

Britain and Ireland. Technically this was not real marble, but its composition allowed it to be used for work for which real marble was normally employed. Red marble from Little Island was used in the Liverpool and Manchester exchanges and in St. John's College, Cambridge, whilst both Little Island and Fermoy 'reds' were also used in St Fin Barre's Cathedral in Cork.[12] Other notable uses of Midleton marble, from the Baneshane quarry (just to the east of Midleton) include St Colman's Cathedral, Cloyne; St Colman's Cathedral, Cobh and in the Chapel of St Patrick in Westminster Cathedral London.[13]

Lime kiln at the Rock Farm Quarries, Littleisland.

The limekiln, in which limestone was calcined for a wide variety of uses, is Cork's most numerous and widely distributed industrial monument. They occur across the County save for West Cork where only a handful occur on the coast, with the main concentration in limestone areas of the county. The primary use of lime was agricultural, where it was employed as an alkali to neutralise acidic soils, but it was also a key raw material for many industries. The lime kiln was generally built into a slope to enable both limestone and fuel to be easily barrowed into the bowl mouth at the top. Alternate layers of fuel such as wood, coal or turf were fed into this opening, and the fuel ignited at the base of the kiln bowl. The flame from coal, however, could be short and aggressive and it could prove difficult to control the burning, whereas wood burnt more slowly. Nonetheless, coal was clearly more fuel efficient. The manufacture of a cubic metre of lime in the nineteenth century took some 230kg of coal, whereas the same quantity required 1,420 kg of hardwood or 2,285kg of peat. Over a period of 3-4 days the stone was gradually reduced to lime in the kiln.

In a process called calcining, the calcium carbonate in the limestone is subjected to high temperatures in the kiln to form calcium oxide or *quicklime*. The burnt limestone was removed from the kiln and slaked off in pits with water, with which it acted exothermically to form hydrated or *slaked* lime. A further chemical reaction with carbon dioxide and moisture in the atmosphere, which caused it to *recarbonate* (i.e. revert to calcium carbonate), enabled it to be used as a cement (*lime putty*) when mixed with sand. The resulting mortar does not 'go off' in the conventional sense but continues to harden in a hydraulic set when exposed to the air over a number of years. Up to the 1820s lime-based mortar was the only bonding material available for most purposes. The type of quicklime used as fertiliser, on the other hand, while generally unslaked into a fine powder, could be incorporated into the soil in any number of different ways. Lime was also used as a flux in blast furnaces; in the purification of town gas, in the production of bleaching powder and in de-hairing hides in the tanning process. Lime kilns were commonly located in quarries, at the roadside or at coastal locations to facilitate transport. Many were either built into a slope or were provided with a ramp to assist the charging process. At coastal sites coal could be shipped in and the quicklime taken out by sea. The larger more elaborate kilns were often provided with a parapet occasionally castellated for decorative effect.

Sandstone

Sandstone, with its many hues of brown, yellow and distinctive red was also extensively quarried and used throughout Cork as building stone. As a stone it is not as easy to identify as limestone, as it has many colours and shades of yellow; brown, muddy grey and the more discernible, distinctive red. The combination of both the local red sandstone with local limestone quite frequently occurs and creates an attractive polychrome effect.

Alternate courses of red sandstone and limestone created a pleasing effect in some buildings; however, even in formal buildings where the principal facing stone was sandstone, limestone was nearly always used for quoins, window and door dressings in Cork City. 'Flaherty's' or the Brickfield Quarry on the eastern outskirts of the city was the principal source of sandstone in Cork up until the early 1860s and was used in a number of important buildings such as the North Cathedral and St. Peter and Paul's Church and Convent.[14] By the late 1850s large sandstone quarries were in operation within the environs of Clonakilty, Monnerour (Bandon), Mardyke and Theaval (Bantry) and Rathmore, (Kinsale).[15] Conglomerate sandstone was also used for millstones and there are extensive remains of a millstone quarry on Ballyhoura Hill in north Cork, which include several unfinished millstones.

Slate

Slate is a fine grained metamorphic rock. In addition to being almost chemically inert, compact and non-porous, slate can readily be split into thin or thick sheets – properties that led to its widespread use as a roofing, flooring and cladding material.[16] Irish slates, however, unlike their Welsh counterparts, were generally only of average quality for use as a roofing material but were, nonetheless, well-suited for heavier items such as flooring slabs and architectural pieces such as lintels and chimneys. In Cork nearly all of the large slate quarries were in operation in the west of the county, most notably at Benduff near Rosscarberry (c. 1830-1952) and at Curraghlicky (1841-1962), near Drinagh. Slate quarrying in the east of the county, as at Trabolgan in the nineteenth century, was much rarer. Underground quarrying for slate as practised on Valentia Island and in the Penrhyn slate quarries is recorded only at Connagh in west Cork. Elsewhere, as at Curraghlicky, slate was cut from the quarry face in blocks and cut to manageable sizes with mechanical saws, before being raised with wooden cranes from the bed of the quarry. Here craftsmen known as splitters, working in open sheds, split these into roofing slate sizes of 24 x 12in and 24 x 14 in sizes. These quarries also employed a blacksmith to make chisels for the tradesmen. However, as quarry operations continued it became harder to remove the enormous waste created by manufacturing roofing slates, and time was lost in removing waste material to allow operations to continue. The N71 between Leap and Rosscarberry cuts through the enormous spoil heaps from the Benduff quarry. The 'Eastern' and 'Western' Curraghlicky quarries came to rely on Free State government grants by the 1930s, by which time the Irish slate industry was experiencing a severe recession. In the 1920's Benduff was supplying slates to Dublin's housing schemes but the slate was subsequently deemed *of* unsuitable quality. By 1938 around 500 hundred County Cork slate quarry workers were out of work, while post-second world war competition from cheaper Welsh slate eventually brought about an end to the west Cork slate industry.[17]

TOP: St Mary's RC Church, Carrigtwohill, with the polychrome effect by using Old Red Sandstone and limestone.

ABOVE: Sandstone quarry ('Flaherty's' or the Brickfield quarry), Lower Glanmire Road, Cork.

BELOW: Curraghlicky slate quarry, near Drinagh.

Brick

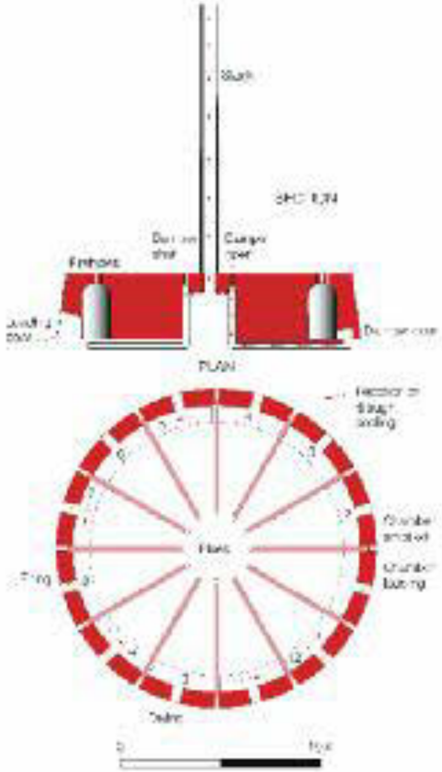
Brick becomes a popular building material in County Cork in the nineteenth century. Its use as the sole building material was not that common, however, and mostly reserved for public or workers' housing such as the workers' houses in Clonmult terrace, Midleton, or houses provided for soldiers in Buttevant, although it was favoured in railway architecture. Brick was commonly used in architectural features such as chimney stacks and flues, and surrounds around doors and windows, both as functional and decorative features.

The principal advantage of brick used in building construction was that it allowed the quantities required for a particular task to be more accurately calculated, than for example, with the use of rubblestone. Bricks could also be made in standard sizes and were cheaper for use in decorative work than cut stone. However, poorly fired brick, could vary in shape and colour and if used for domestic houses it had to be plastered over. With the introduction of more efficient kilns its quality and appearance could be substantially improved, and by the end of the nineteenth century. brick with a smooth exterior finish, was widely used in building projects.

Brick 'clay' is often found around river estuaries, which had the added advantage of facilitating the transport of bulky cargoes of finished brick. Brick making involved the digging of clay by hand; a crushing process, pugging (stiring), moulding to standard shape and firing in a kiln. Brick making was generally a seasonal activity on the smaller Irish brickfields, where brick makers could be casual workers or even farmers - the main period of production being around April to September. Many of these were established on relatively large acreages of brick clay such as the Ballinphellic brickworks near Ballinhassig, which was set within 45 acres of clay soil owned by the company. At large brickworks outside major urban centres, workers' housing was sometimes provided, as at Ballinphellic in late 1890s, and remains of the late nineteenth century workers' housing at the Belvelly works on Great Island in Cork Harbour still survive.[18]

In many parts of Ireland from the seventeenth century up to the early twentieth century, bricks were traditionally fired in a *clamp kiln*, a rectangular arrangement consisting of alternate courses of bricks. The construction of the clamp, which on the smaller brickfields was usually undertaken by the owner, could take up to two weeks, and involved the building of a series of pillars with unfired brick, which were gradually formed into a series of 8-12 arches. The arches, which were at right angles to the long axis of the clamp, served as fire settings, into which either coal, culm or turf were placed and ignited. Towards the middle of the nineteenth century many of the basic processes involved in brick manufacture were already becoming mechanised. Traditional

Provincial bank, Schull, built c. 1900, using brick with limestone details.



Hoffman brick kiln, showing principal of operation.

wooden moulds were dispensed with and new, mechanical (*powered first by horses and later by steam engines*) means of forming the bricks were introduced, while vast improvements in the firing process were made possible by the introduction of new kilns. By the 1880s machine made bricks were manufactured throughout Ireland, and the Bridgewater bricks imported from England were beginning to be replaced by native products. There were a number of brick works in Cork at the turn of the nineteenth century. These included pottery works in Kinsale, Bantry, Doneraile, Liscarroll, Ballinadee, Douglas, Ballinhassig and Belvelly, with the main concentration around Youghal where there are still significant remains.

The Hoffman kiln, in which both brick drying and firing became a series of uninterrupted processes, was the first *continuous* brick kiln to be widely used in Ireland. Friedrich Hoffman, a German engineer, had acquired an English patent for his kiln in 1859, and by the mid-1860s they were being built for lime and brick burning in Britain and Ireland.

The early forms of this kiln were circular in plan, but rectangular types were later introduced, although both are termed annular as the limestone or the raw bricks were fired in an *annulus* or continuous chamber.[19] The best surviving example of a Hoffman brick kiln in Ireland is the rectangular kiln at Youghal Brickworks, built in 1895.

The underdevelopment of internal communications in Ireland, in the pre-railway era, had an important bearing on the location of many brickfields. Brick was a bulky cargo and the cheapest way to transport it was by water. For this reason, many of the brickfields established in Ireland during the late eighteenth and early nineteenth century were situated on or near rivers, estuaries or canals. At Ballinphellic, county Cork, an aerial ropeway was built to connect the works to Ballinhassig railway station on the Cork and Bandon line in 1902; at about one third of the cost of a narrow-gauge railway.[20]

Manufacturing industries

Manufacturing industries involve a series of processes in which the raw materials were converted into a usable commodity. The textiles industry involved the manufacturing of wool, linen and cotton into usable cloths.

Wool

For centuries wool production was a small home based craft and continued as such into the twentieth century. However the opportunity to industrialize the process was seized by a number of industrial entrepreneurs. The main steps necessary to process wool from the sheep to fabric involved shearing, cleaning and scouring to remove grease and dirt; grading and sorting, carding (combing), weaving and finishing.

There are two basic types of cloth manufactured from wool, *woollen* cloth and *worsted* cloth, the home-produced wool of Ireland being essentially of the latter type.[21] Woollen cloth was manufactured with short fibre or short staple wool, the fibres of which had to be carded prior to spinning. Worsted cloth manufacture, on the other hand, involved the use of long staple wool, which had to separated from the short staple wool in a process called *combing*. In this latter process heated combs were used to form 'slivers' from the long woollen fibres, which were wound into a ball prior to being drawn and spun. Woollen cloth such as fustian, broadcloth and flannel was used for all exterior working garments, as it was cheaper and retained heat better than worsted cloth. Worsted cloth, or *stuff* as it was called in the eighteenth century to distinguish it from woollen cloth, was generally employed for tailored garments such as suits. At the end of the nineteenth century, tweed - the main worsted cloth produced in County Cork - was exported world-wide.

Marcus Lynch's woollen mill of 1793 at Midleton, now part of Midleton Distillery.

In 1793 industrialist Marcus Lynch built a multi-storey mill at Midleton, which was the most advanced of its type in the region, however, the earliest recorded mechanized wool-spinning mill in the county was at Riverstown near Cork, sometime before 1814. Combing was not successfully mechanized until the 1840s.

In 1815 the Mahony brothers brought over a specialist from the Yorkshire woollen industry to set up a steam-powered worsted factory near Cork, and by the 1820s had converted a former cotton mill at Blarney for the mechanical spinning of woollen and worsted yarns.[22] Smaller, water-powered spinning mills were also set up at Glanworth, although larger spinning and weaving mills did occur in the county such as at Blarney, Dripsey, Ballincurrig, Douglas and Donnybrook. With regard to carding – a mechanical process involving the cleaning and intermixing of fibres – the Archaeological Inventory for County Cork shows the existence of 5 such mills, all located in West Cork with the exception of one.

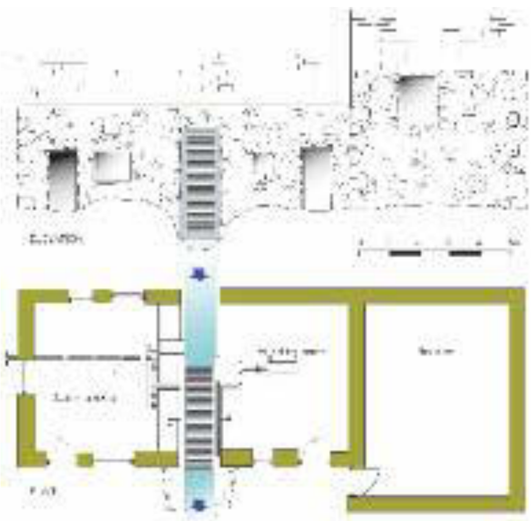
The finishing processes for woollen and worsted cloths were different, not only to those employed for linen and cotton, but to each other. For woollen cloth a preliminary scouring was required in an alkaline solution (either fullers' earth or urine), which was pounded in water-powered fulling stocks. This absorbed any grease, oil, or dirt which had lodged in the cloth when it was woven, whilst simultaneously thickening the fabric. The cloth was then fulled, that is, continually pounded in a soapy solution by wooden fulling stocks, which imparted a felted finish. *Fulling* or *tuck* mills were in use in Ireland from the Anglo-Norman period onwards, but the vast majority of the surviving sites date to the eighteenth and early nineteenth centuries. The term 'Tuck mill' (which is also common in the English west country) is the one most frequently used for such mills in Ireland, where their creation and use is closely linked with the domestic woollen industry. There were a number of small Tuck mills across the county servicing the needs of the local community. In some cases a single waterwheel would often power both a fulling stock or a pair of millstones such as at Inchinagotagh; Newmills near Rosscarbery and Rossmore, as the occasion or season demanded. There are twenty five remains of Tuck mills identified and described in the Archaeological Inventories for County Cork located across the county.

After fulling the woollen cloth was then *tentered*, a process during which the fabric was stretched under tension in the open air, on wooden racks, and then dried. Native Irish wool fabric was only suitable for items such as blankets and coarser woollen cloths and from the second half of the nineteenth century there was an increasing reliance on raw Merino wool from Australian and New Zealand, from which finer cloths were manufactured.

Linen

There was a long tradition of growing flax in Ireland and linen manufacture mainly for home consumption. In the eighteenth and nineteenth centuries it became one of the most important industries in Ireland and in this period it thrives in West Cork. It was the success of the Ulster linen industry that encouraged landlords in south Munster to revive the growing of flax and invest in the establishment of linen manufacture. County Cork landlords such as Sir Richard Cox at Dunmanway (1735) and Thomas Adderley at Inishannon were already involved in such enterprises in the first half of the eighteenth century. Cox encouraged his tenants to grow flax by giving them seeds supplied by the Linen Board; giving weavers generous options for housing and spinning wheels and looms, and by providing a market where yarns could be bought and the finished cloth sold. Thomas Adderley, encouraged Ulster weavers to settle at Innishannon and provided workers' housing. The growth of the Cork industry was such that landlord-sponsored textile villages were already in existence at Blarney, Doneraile, Clonakilty, Macroom and at other locations before the 1770s.

Flax was quite a lucrative cash crop and was particularly suited to the mild Irish climate. The cultivation of flax, the spinning of the yarns and the weaving of cloth was all well suited to the economy of rural small holdings. It did, however, require considerable effort to convert it into linen. After harvesting, flax was soaked in water for about two weeks in *retting dams* or *flax ponds* - a process which loosened the useful part of plant from the *shous* - the waste or non-usable portion. The retted flax was then taken to be scutched by hand using a *scutching blade* and later, from the eighteenth century onwards, in water-powered *scutching mills*, where the flax fibre was separated from the *shous* by the action of rapidly rotating wooden scutching blades.[23] In the 19th century scutching remained predominately a hand operating process with only a few scutching mills in the county. Cork was one of the main flax growing areas in the south, but had only four in the county in 1860 - half of the total for the entire province of Munster. Even when water-powered scutch mills were constructed in rural areas of the county, the skills involved were normally imported from Ulster. In 1848, for example, George Robinson engaged Belfast workmen to supervise the construction of his flax-scutching mill at Drimoleague, while in 1853 Edward Smyth of Newry built a scutching mill, powered by a water turbine, near Ballineen.[24] Later County Cork scutching mills could also be powered by oil engines, as at Castleview.



Scutching mill.

Following scutching the fibres were then *hackled*, i.e. drawn through metal combs to straighten and separate the fibre according to length in preparation for spinning. This became a skilled process in the nineteenth century, but was originally performed by women in the home. This process only became mechanised in the second half of the nineteenth century and was generally undertaken on hackling machinery installed in linen spinning mills. The fibres were then ready to be woven into cloth on a loom, which, for the most part, was carried out at home on hand looms by independent weavers. By the 1820's, 2,500 looms were at work in west Cork, with 500 of these in Clonakilty town alone. In 1822 this cottage industry extended from Bandon to Dunmanway, Clonakilty, Rosscarberry, Skibbereen and even as far south as Oileán Chléire (Cape Clear island). The loom workers worked in simple cottages, generally with a room built at one end to accommodate the loom and its operator. Clonakilty had its own linen hall- still largely extant- established by the earl of Shannon in 1817, which became the principal market for linen cloth in the county in the early decades of the nineteenth century. Over half of the linen cloth manufactured in the county was sold here by 1821.[25]

Scuthers at Newmills, County Donegal. Source: Wikipedia.

The mechanization of both spinning and weaving was a slow process. Early flax spinning machinery, which was introduced into Cork in around 1800, could only produce coarse linen yarns, although these were suitable for making commodities such as sailcloth, tents and sacking. By about 1810 water-powered flax spinning mills had been established at Douglas, Blarney, Tower Bridge and Springville on the northern outskirts of Cork City. Mechanised or power looms were first used successfully in Cork in 1814, but this initiative was short lived, and it was not until the 1860s that these were used in again in Cork linen mills. These were situated around Cork City and its environs, where two large spinning and weaving mills were established at Millfield and at Donnybrook, Douglas in 1866.

The weavers produced 'brown' unbleached linen cloth, which was sold at local markets to linen dealers. The 'brown linen' was sold on for ordinary use or taken to Bleaching mills for the final phase of the production. This process made the material smoother, bleached to a white colour and giving it a nice sheen. By the end of the eighteenth century Bleaching mills had become the most centralized and mechanized process in the industry. There were only three servicing the West Cork area: two in Dunmanway and one in Innishannon.

Linen cloth could also later be finished by *beetling* and *calendering*. Beetling involved the hammering of the cloth to tighten the wave and make the cloth smoother. *Calendering* involved rolling the cloth between cylinders, to produce a sheen. Steam calendars were in widespread use in Ulster's bleach yards during the second half of the nineteenth century - a good example has been preserved at the Coalisland spinning mill, county Tyrone. At Poullacurry near Glanmire, William Thorley's establishment in about 1863 had both steam calendars and beetling engines for finishing linen, but this was quite rare outside Ulster.[26]

The final process was the bleaching of the linen, which took place on a *bleaching green*. Here in the large open space the linen cloth was spread out and whitened by the action of the sun. The two Bleach greens in west Cork: one at Innishannon (now the GAA pitch) and the other near Dunmanway, must have been quite a sight when all the linen was laid out.

Traditionally linen was used for items which were regularly laundered such, as aprons, tablecloths, underwear and bedlinen. Its manufacture has all but ceased in Ireland, while the garments and items with which it was commonly used for are now made out of cotton, since the middle of the twentieth century.

Cotton

The cotton industry in Cork was very much a passing phase of industrial activity, being introduced into the environs of Cork City in the eighteenth century. The raw cotton, as was the case elsewhere in these islands, was imported into the county from the southern states of the United States of America. As early as 1787, a five-storey, water-powered cotton spinning mill had been set up at Blarney, although ultimately this venture was to prove unsuccessful. However, one manufacturer, George Allman of Bandon, led the way by setting up a horse-powered spinning mill in Bandon town in the 1780s. Thereafter, Bandon became the centre of the Cork cotton industry, and in 1802 Allman built a state-of-the-art water-powered cotton spinning mill at Overton, just a few miles away from the town. By the 1820s upwards of 2,000 cotton weavers were employed in Bandon, of whom 1,500 were involved in the manufacture of corduroy (a cotton fabric with distinctive ridges or wales, which run the length of cloth). As in the linen industry both the Bandon cotton spinners and weavers operated out of their own cottages. However, the Bandon industry experienced a rapid decline in the mid-1820s, brought on by an economic recession in England and increased competition from cheaper English imports. The Overton mill was closed by 1830, by which time some 2,500-3,000 cotton workers were unemployed.[27] The only other cotton spinning mills in the county were operated by George Allman's brother, William at South Main Street Bandon and with regard to Cork City, there were only a handful of such operations in existence.

Food-processing industries

Malting

Eastern county Cork was one of the principal malt-producing regions of Ireland for the greater part of the nineteenth century. Malted barley, which provides the sugars which in the brewing process are fermented with yeast to create alcohol, is one of the main ingredients of both beer and whiskey. The process by which it is manufactured essentially involves a partial germination of barley grains to encourage enzymes in the grain to convert some of their starch into sugar. The degree to which this germination was allowed to proceed was carefully controlled, and was arrested at a critical point in order to conserve the amount of saccharine in the sprouting grain. At the brewery and the distillery the sugar was then chemically transformed into alcohol in the fermentation process. Dublin breweries such as Guinness' bought malt from independent concerns all over Ireland, but in Cork and in smaller county towns, brewers generally preferred to have all their malting facilities within the brewery complex.

Guinness, unlike many Cork breweries, did not make all of their own malt, but also purchased large amounts from the Ballynacorra Maltings, near Midleton. In the 1790s the Scottish-born, Fermoy based entrepreneur, John Anderson, built a malthouse at Charleston, on Ballynacorra bay in Cork Harbour, and thereby initiated what was to become one of the largest malt manufacturing and grain distribution centres in Ireland.[28] The original Charleston Maltings of c. 1791, which formed the nucleus of a much larger malting complex developed between 1897 and 1924, still survives. Early in the nineteenth century a second malthouse was erected by John Halloran, which was at work up to quite recently, directly across the bay in Ballynacorra townland.

Malthouses are generally multi-storey buildings which facilitated, on a large scale, the flooring process employed in malting. The cereal grains are first steeped in water and then spread on the malting floors, heated by the furnace below, where they were regularly turned with large wooden shovels to encourage them to germinate. Each malt floor was provided with shuttered, regularly spaced windows, which were the principal means by which the temperature of the malting floor was controlled. Once the sprouting process had advanced to a particular point, the malter then killed it off by shovelling the grain on the floors of a malt kiln, built on to one gable of the maltings. The Ballynacorra maltings were built on quaysides to enable barley to be easily brought to the site and the finished product to be dispatched by water transport.

The Charleston Maltings of c. 1791, at Ballynacorra.

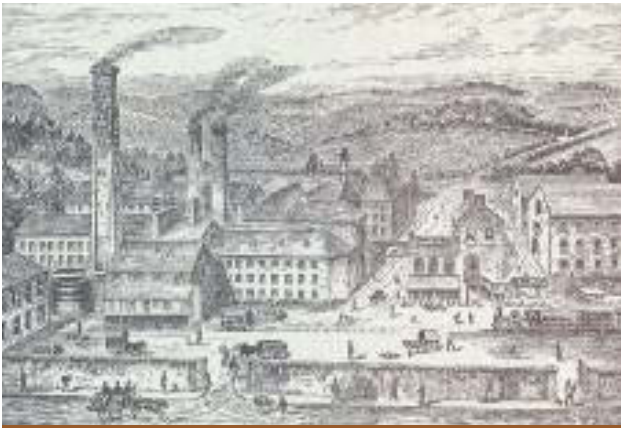
Brewing

By the end of the eighteenth century, porter - a dark beer originating in England - had become the main product of most Irish breweries.[29] Porter was highly hopped but, while it was stronger than most beers, it was somewhat weaker than ales. It also had a creamy head which lasted much longer than that of other beers; its characteristically darker colour resulting from the use of heavily roasted malt. For the industrial brewer, however, its most important characteristic was that it improved in the cask, and its capacity to be stored directly facilitated mass production and industrial scale breweries.[30] Ireland's larger mid- to late- eighteenth-century breweries required immediate access to an urban population, a barley supply and preferably some form of water transport for the supply of bulky raw materials such as barley, hops, and coal for their coppers and kilns (and later its steam engines). For the most part, eighteenth century breweries and distilleries, particularly those established in built up areas, employed horse-powered machinery, and were actually able to begin their initial phases of large-scale, industrial production without being tied down to a site which could be serviced by a hydraulic head. Thus, from the outset, breweries could comfortably occupy prime urban locations, unlike water-powered grain mills and many other mechanized industrial units which had to await the introduction of rotative steam engines. Nonetheless, smaller courtyarded breweries, such as Watergate Brewery (1843) in Bandon, continued to be built, while new breweries could still be established in converted buildings.[31] In 1837 Bandon alone had five breweries, while Midleton had four.[32]

Deasey's Brewery, Clonakilty was built around the year 1805.

Distilling

Irish whiskey was originally distilled from malted barley mixed with a certain amount of raw barley and other cereals such as oats and later maize. At the distillery beer was brewed from the malt and was then distilled into a spirit from it. In Ireland two basic varieties of still were used in whiskey distilleries: the *pot still* (by far the most common) and the *patent* or *continuous still*, which was predominantly used in Ulster. The pot still is a flat-bottomed copper vessel, from the head of which extends a spiral copper tub called the *worm*. The greater extent of the worm is coiled around the inside of an adjacent wooden vessel filled with water, known as the *worm tub*, which acted as a condenser. The spirit collected at this stage was by no means pure, and it was necessary to refine it in a series of three successive re-distillations. The first of these was called the *low wines*, which passed on to the *low wine receiver* and from thence to the *low wines still*, where it was re-distilled. The resulting distillate was then passed on to the *feints receivers*, and the purest of the feints was then conveyed to a third still from which it emerged as whiskey.[33] The distinctive flavour of Irish whiskey is the fact that it is distilled three times and the use of coal for malting, unlike Scottish whiskey which is distilled twice and generally uses peat.



Allman's Distillery, Bandon; from A. Barnard, The whiskey distilleries of the United Kingdom (London, 1887).

A number of County Cork distilleries were deliberately built into sloping ground to facilitate the movement of liquids by gravity, as at Allman's Distillery at Bandon, completed in 1826.[34] The Allman family, who had been heavily involved in the Bandon cotton industry, successfully transferred capital from their failing cotton business into distilling. James Murphy set up one of two distilleries at Midleton in 1825, which was to become one the most successful in County Cork. The most extensive distillery maltings in Ireland were built at the Bandon Distillery. The Bandon maltings was 168ft long by 42 ft wide, with floor heights of 8ft, and was the second largest (after Guinness') in either Britain or Ireland.[35]

Grain milling

Large numbers of small water-powered grain mills operated throughout Ireland during the eighteenth and nineteenth centuries and, in some instances, well into the twentieth century. In essence, these were vernacular structures, which were created to serve the needs of rural communities, but in terms of their technology and operation these were often a throwback to the later medieval period.

Most corn and flour mills have at least some floor space in which to store cereals. In larger mills, five storeys might be involved, the two upper storeys being used for grain storage; the middle floor for the winnowing machines and bolter (sieves), the second floor for the millstones, and the ground floor for bagging meal or flour and for offices. Where possible, this arrangement was employed to ensure as much movement as possible using gravity of the stock between the various mill floors, hence the upper storeys being used for grain storage. As most Irish cereals contain a lot of moisture after being harvested, any grain brought in by local farmers was first dried in a kiln. The kiln, usually built up against one wall of the mill, consisted of a furnace to create a warm draught of air for a floor supported above brick arches, and upon which were laid perforated brick tiles. The grain was then spread on the kiln floor and the heat passed through via the perforations in the tile, to exit the kiln through a hood, the grain being periodically turned to complete the process. Kilning removed excess moisture and allowed the smooth passage of the grain through the rotating millstones, without clogging them up. The grain was then fed into a hopper, suspended over a pair of millstones, usually made from conglomerate sandstone, whose distance was carefully set to remove the husks. In a set of millstones it is the upper millstone (the runner stone) that rotates, while the lower millstone (the bedstone) is stationary. After passing through these stones, the husks and the cereal berries were then fed into a winnowing machine - a mechanical fan which blew off the lighter husks. The grains were then fed into another set of millstones, frequently called burrstones, made from a special type of stone imported from France, which did not flake (as did sandstone), or overheat easily. After passing through these stones, which reduced the grain to flour or oatmeal, these products were either lifted manually to an upper floor or by means of mechanical elevators, powered by the waterwheel, to be dressed, i.e. rotated in rotating cylindrical sieves called bolters. The flour or meal was then ready to be lifted downwards to the ground floor to be weighed, bagged and dispatched to the customer. Unlike modern flour, stoneground flour cannot be stored for long and so return visits to the mill were required. The rural mill thus became almost a public building were one could meet and chat with one's neighbours. The miller was also a local repository of knowledge about the type of land his customers grew their grain crops on, as its relative dampness had an effect on the amount of time it would need in the kiln.

In Ireland the large-scale mechanization of grain milling began in the mid-eighteenth century, when a government bounty, offered between 1758 and 1797 on flour brought to Dublin, provided the impetus for widespread structural and technological changes in the Irish grain-milling industry.[36] Unlike many other industries in either Britain or Ireland, virtually all of the processes involved in grain milling had already been mechanized, which encouraged the concentration of production in increasingly larger units of production. The Irish flour mill was one of the first in Europe to expand vertically, with extra stories being provided for both more

St Patrick's Mills, a multi-storey flour mill near Glanmire.

Belgooly Flour mills.

processing plant and additional storage. This development pre-dates Arkwright's multi-storey textile mills of the later eighteenth century. From the second half of the eighteenth century onwards the means by which cereal grains were cleaned preparatory to milling became increasingly more sophisticated.

The mechanical *bolter* was the first of a series of power-driven devices employed in mills for more efficient flour dressing and it is from its widespread application in early Irish industrial mills that the contemporary eighteenth and nineteenth-century term 'bolting mill' originates. According to Charles Smith, Samuel Pike of Cork, ran a 'curious' bolting mill near the town around 1750. In the final decade of the eighteenth century two further technological innovations were introduced into Irish milling. The first was the introduction of cast iron gearing - an early example of which was installed in a mill near Youghal in 1792.[37]

In traditional flour mills the use of millstones for manufacturing flour tended to produce more coarse household grades than fine white flour. This affected its keeping quality and, in consequence, even the larger steam mills within the immediate hinterlands of Irish and British ports tended to supply local rather than national markets.

The introduction of the roller milling system created a much superior product. In this system - still used today - the different components of the wheat are carefully reduced and separated between sets of roller.[38] The first moves towards the adoption of this process in Ireland were made by S. S. Allen at Midleton, in 1867, but he abandoned his attempt because of difficulties encountered in adjusting the rollers.[39] John Furlong's Lapp's Quay Flour Mill, originally built as a steam flour mill in 1852 was probably the first Irish flour mills to change over to the roller process in 1874, and was followed by other mills in the Cork region in the early 1880s.

Farming and fishing

The increased adoption of the potato in rural Irish diets, from the late seventeenth century onwards, enabled large amounts of butter manufactured throughout the dairying regions of Munster, to be increasingly sent to market. By the 1730s, the port of Cork had become the centre of Ireland's export trade in butter based, largely, on English and Dutch colonial demand. However, by the second half of the eighteenth century, the burgeoning industrial population of Britain was becoming the main target market for Irish butter exporters, whose principal centre was the city of Cork. Here, in 1769, was established what was to become, by the turn of the nineteenth century, the largest butter market in the world. In its essentials, the Munster butter trade was a domestic industry, in which the butter was manufactured by hand in the farmhouse dairy, packed in 56lb wooden barrels bound with sally hoops, and dispatched by road to highly organized markets in Cork, Limerick and Waterford.[40] Mechanised churns, powered by waterwheels, are known to have been used in a limited way by the end of the eighteenth century, but for the most part almost all Irish butter was made by hand up to the closing decades of the nineteenth century.[41]

Mechanical separator.

The development of centrifugal separators, in the 1870s by de Laval and others in Denmark and Germany, enabled the manufacture of butter to move from the farmhouse to the factory.[42] In Ireland, the first de Laval separator was exhibited in a display of butter and butter-making held in the Corn Market; in Cork in June 1879. The basic, working principle of the mechanical separator, involved rotating the milk in a container at extremely high speeds, in which the butterfat and buttermilk were more efficiently separated in accordance with their densities. De Laval's model turned at 2 - 4, 000 rpm and was capable of separating the cream of 30 gallons of milk in 50 minutes: a process which had traditionally taken about two days could now be accomplished in minutes.[43] From the 1880s onwards co-operatively owned creameries, in which butter could be manufactured in large mechanised churns, powered by water turbines or steam engines, as at Drumtariffe spread throughout Munster.

Prior to the second half of the eighteenth century, Ireland's fisheries were developed with private capital, by magnates such as Richard Boyle, the Earl of Cork (who developed the south Munster fisheries in the 1620s); the Earl of Stafford on the Mayo coast and Sir William Petty, who set up fisheries in Kenmare Bay and Dursey Island.[44] The remains of seventeenth-century fish palaces, in which pilchards were pressed and cured, have survived on the west Cork coast at locations such as Sherkin Ireland.[45] Fish palaces, indeed, continued to operate well into the eighteenth century, Bishop Pococke of Ossory noting the existence of 'places for curing fish, commonly call'd fish palaces' in 1758.[46] While at Scilly Point near Kinsale, 'a compleat Fishing-palace with Linnys and sheds for pressing fish' was advertised for sale in 1761.[47]

Creamery at Kilcorney.

The Industrial Training School at Baltimore was established under the auspices of Baroness Burdett Coutts (1814-1906), who set up a fund in 1880 that eventually led to the opening of the fishing school in 1887, managed by Fr Charles Davis. Baltimore had by this period succeeded Kinsale as the main fishing port on the Cork coast, after the shoals of fish began to concentrate closer to Baltimore, which became more convenient for landing the catches. In 1887 a survey by the fisheries inspectorate found that fish curing in Ireland had experienced no appreciable development, a need to which the Baltimore training school was able to immediately respond to by the construction of a purpose built curing house for its students.[48] The development of the Baltimore fishing industry was further boosted in 1893, with opening of an extension line of the Cork, Bandon and South Coast Railway to Baltimore, funded under the Light Railways Act of 1889.[49] Many of County Cork's smaller harbours, such as Baltimore, Ballycotton and Kinsale were developed during the nineteenth century for the fishing industry.

Engineering industries

Spademaking

In northern and western Ireland, particularly in areas of marginal land, the spade was an almost universal tillage implement, while the availability of cheap labour tended to encourage the use of the spadesman.[50] Each locality often had its own set preference for a particular type of spade, and the often bewildering regional variation of Irish spade types - there are in excess of 1,100 varieties and sizes of the one-sided spade alone - attests to the doggedness with which people adhered to their individual preferences.[51] In consequence, when water-powered spade mills became established in the eighteenth century, they were obliged to keep patterns for the different types of spade used within their intended catchment areas.[52] The Irish spade mill was essentially a water-powered forge which, in its most basic form, comprised a water-powered tilt-hammer and forge, the forge itself often being serviced by a water-powered bellows. In some of the County Cork spade mills (the largest concentration outside Ulster) the waterwheel was used to power three mechanisms: the trip hammer; the grindstone and a

Interior of the Coolowen spade mill in the 1940s.

guillotine via an eccentric connected to a fly wheel on the waterwheel's driveshaft. Of the larger and older Irish spade mill complexes the best surviving example is the Monard and Coolowen Ironworks, near Cork City, which operated between c. 1790 and 1960.

Car and Tractor manufacture

In 1919 Cork became the location for Henry Ford and Son's first manufacturing presence outside the United States of America. Wharves were built 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. 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 First World War I Europe slumped alarmingly. 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 to Cork. 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 and Ballinascarty, West Cork, claims the home place of Henry Ford's parents, before they moved to Detroit, Michigan.

The location that the Ford Motor Works occupied on the Marina in Cork City.

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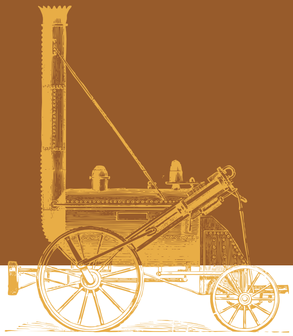


Chapter 5

Transport, Communications and Utility Industries

The development of industry in Cork, as elsewhere in Ireland, relied heavily on the existence of a reliable network of transport and communications. From the beginning of the seventeenth century, Richard Boyle, 1st earl of Cork, had already begun to improve land communications within the county, by building a series of new roads and bridges. These facilitated commercial and military transport across his vast estates in Cork and Waterford, and also with Youghal, his seaport of choice. The Cork Grand Jury built substantially upon Boyle's transport infrastructure, by constructing and maintaining over 2,000 miles of toll-free roads and several bridges.

The sea approaches to the city of Cork from Cork Harbour also saw improvement and were gradually improved during the eighteenth and nineteenth centuries, enabling increasingly larger and more heavily laden ships access to the city's quaysides all year round. The rise of the port of Cork, was to eclipse the importance of both Kinsale and Youghal. The arrival of steam ships in the 1820s, served not only to further cement trading links with ports such as Bristol, but also speeded up communications with England.

By the middle of the eighteenth century, County Cork enjoyed an extensive and relatively well-maintained network of inter- and intra- county roads. By this stage there were three main agents involved in the construction and maintenance of roads. These were the Grand Juries; the Turnpike trust and the Board of Works. However, most road journeys continued to be conducted either on foot or on horseback up to around 1800; said existing roads allowing most local farmers to expedite their goods to market. The so-called 'butter roads', which were essentially formalised by Richard Griffith in the 1820s, also facilitated the long-distance transportation of butter in *firkins* (56 pound butter barrels) from counties such as Kerry and Limerick to the Cork Butter Market at Shandon, Cork. The advent of railways in the 1840s, however, truly revolutionised the consumer economy of the county, by prising open previously remote areas to both national and international influences. Railways now enabled fresh milk to be brought to Cork City from the western dairy regions within hours, while farmers could now buy a greatly expanded range of consumer goods in local towns, or even from mail order catalogues. Bulky goods such as imported slate or brick manufactured near Ireland's port towns could also, on the other hand, be transported inland to challenge vernacular building traditions. Yet Irish railways were also to become the principal conduit for those seeking to emigrate. The development of transatlantic liner trade with Cobh was to become the focal point of Irish emigration to the USA.

The growth of towns in the eighteenth and nineteenth centuries necessitated the creation of centralized distribution networks for public utilities such as water supply and street lighting.

The provision of public water supply networks, by both local authorities and private individuals, was closely linked with a heightened appreciation of the relationship between sanitation and public health and order. Likewise the creation of networks of street lighting was also linked to the maintenance of public order or, more precisely, the reduction of crime.

Transport and Communications

Roads and Bridges

Given the low population and lack of centralized urban centres prior to the 12th century most journeys tended to be short and made on foot along paths or trackways. The trackways gradually became more formal roads of earth and gravel due to more frequent use by mounted or carriage traffic, especially between the medieval urban centres. It was from the seventeenth century onwards that a more formal network of building started, with 1615 having seen the introduction of the Highway Act, under which each parish was responsible for the roads in its area.

From the early seventeenth century onwards, Irish Grand Juries of assize were empowered to levy direct taxes for the repair and construction of roads; causeways, toghers and bridges that were 'broken or decayed'. The membership of the grand jury was chosen by the High Sheriff, usually from the county's influential property owners, and thus it became, for the most part, an instrument of the wealthy protestant ascendancy. In 1710, Grand Juries were empowered to undertake the construction and repair of roads by presentment - a system under which almost anybody could make a proposal to the Grand Jury to build or repair a road. If the Grand Jury accepted this proposal, it could make a presentment that monies were allocated from the county *cess* (tax) to pay a contractor to build the road. Further legislation followed, beginning with an Act in 1720, aimed at preventing abuses in the system, under which every presentment henceforth had to be accompanied by a sworn affidavit, to the effect that the works involved were actually necessary, while an Act of 1727 obliged Grand Juries to appoint surveyors to oversee individual projects.

The powers of Grand Juries to influence road development increased substantially over the eighteenth century. Under a further Act of 1739 the Grand Juries were enabled to buy land on which to build new roads, but were now required to 'facilitate the laying out of roads in straight lines from market town to market town' - this was to ensure that local landlords did not try to divert roads to increase the value of their land. The Act of 1765 transferred the task of building and repairing of main roads from the parishes system to the Grand Juries. An Act of 1777-8 further enabled the Grand Jury to grant contracts for the repair of roads, by which time the repair and general maintenance of most of the county roads had become its complete responsibility. In this way the Cork Grand Jury became responsible for the bulk of the roads constructed in the county over the eighteenth and nineteenth centuries.

The 1727 Act specified that all roads built by presentment had to be gravelled to a width of 12ft and be at least 30ft wide, which was increased to 30ft between the fences (of which 14ft was to be gravelled) in the 1759 Act. More attention was also given to proper foundations, surfacing and adequate drainage. Gravel or broken stones (to a certain size) were the main road surfacing material until mechanized stone-crushers and steamrollers were introduced at the end of the nineteenth century.

When compared to the roads built by the Board of Works, from the early 1820s onwards, the surfacing of early eighteenth-century presentment roads often left much to be desired. Yet the general lightness of the wheeled traffic using them was such that they fared tolerably well during the winter months, whilst many appear to have been able to dry out quickly after wet spells. The steep gradients of many presentment roads, however, became a major problem in the second half of the eighteenth century, with the increase in the volume of wheeled traffic on the county's roads, and the increased length of journeys. The necessity of reducing road gradients, indeed, was manifest in the new turnpike road legislation of the 1760s and 1770s, which encouraged the construction of level roads, practices that began to be followed by presentment roads. The increased use of carts in road transportation also required not only improved road gradients, but also betters road surfaces, while at the same roads and the bridge associated with them now required to be wider.[1]

The Grand Juries' responsibility for county road networks increased steadily throughout the

Cast iron milepost, made at the Barnes foundry on Hanover Street, Cork City (later the Hive Iron Foundry) in the 1820s, and erected by the Cork Grand Jury on the Cork-Skibbereen mail coach road outside Clonakilty.

Cast iron turnpike milepost on the Cork-Dublin turnpike.

nineteenth century, as did the road mileage created by them. In County Cork the length of road under contract in the East Riding (the area to the east of the city of Cork and extending to the border with County Waterford) increased from 1,599 miles in 1834 to 2,300 miles by 1844.[2] According to Edmund Leahy, who had been appointed Cork's first county surveyor in 1834, the Cork Grand Jury was responsible for a total mileage of 3, 365 in 1843.[3] Irish Grand Juries were also responsible for the erection of mile-posts and, when new roads were constructed, for the erection of fences.[4] The Cork Grand Jury was responsible for the construction of the coach road from Cork to Skibbereen, on which it expended over £12,000 between 1810 and 1815. Several of the original cast iron mile posts, cast at Barnes Iron Foundry on Hanover Street, Cork City (later the Hive Iron Foundry), survive in situ on the main route of this road from Cork to Skibbereen.[5] The Carrigrohane Straight, completed in the 1840s, and which was originally intended as part of a new mail coach road from Cork to Macroom and Kanturk, was also built by the Cork Grand Jury.

Under the conditions of the Local Government Act of 1899 the responsibilities of the Cork Grand Jury were transferred to the newly constituted County Council. The cess (tax) was replaced by rates which were, up until 1979, struck on a yearly basis by Irish County Councils.

Restored Cork-Dublin turnpike toll house at Glenduff, near the Cork-Tipperary border.

The system under which roads were built by *turnpike trust*, which had been in existence in England since 1663, was not introduced into Ireland until 1729. For the most part, turnpike roads, like presentment roads, were a product of local initiative. A turnpike road was built and maintained by a turnpike trust, usually run by local landowners who could raise the finance necessary to obtain an act of parliament. The turnpike act invested powers in named trustees to erect gates and toll houses with which to collect tolls, but most importantly of all, advanced a loan with which to build the road. These tolls were collected from most road users, save pedestrians and local farmers who had to use the road on a daily basis, and these were used for the upkeep of the road and to repay the parliamentary loan. Toll houses were built near large towns or important cross roads, and a gate (*turnpike*) was built across the road. On payment of the requisite toll, which varied in accordance to the size of the vehicle and the type of wheel it employed, the toll house keeper would open the gate.

Turnpikes which covered long cross-country routes, were invariably major undertakings. The undertaker of the Cork-Tralee turnpike completed in 1748 - John Murphy of Castleisland - undertook to construct bridges, toll houses and so forth for the entire route. Under legislation enacted in 1857, all Irish turnpikes trusts were dissolved and all turnpike roads in Irish turnpikes came under the jurisdiction of the county Grand Juries. The single, surviving turnpike toll house within the county, on the former Cork-Dublin turnpike at Glenduff, on the Cork-Tipperary border, has been restored.

Direct government intervention in Ireland's road infrastructure remained mostly notional until around 1817, when bad harvests and an economic downturn brought on, for the most part, the agricultural depression that followed in the wake of the Napoleonic wars. In Munster, this culminated in the Whiteboy Insurrection of 1821, whose aftermath finally convinced the British Government to undertake essential public works as a form of relief, under which public funds were to be expended on such works in the Munster counties most affected by the disturbances. Richard Griffith was dispatched to survey the area and direct the necessary works. His immediate concern was to improve these vital arteries of commerce between the principal towns of Kerry and Limerick and the port of Cork. Between 1822 and 1836, Griffith was responsible for the construction of some 243 miles of road in counties Cork, Kerry, Tipperary and Limerick.

Roads built by Richard Griffith in Cork and Kerry during the years 1822-36.

With the many rivers and streams in County Cork any road network had to overcome these obstacles and early paths used stepping stones or shallow ford crossings. The earliest bridge forms surviving in the county are *clapper* bridges and arched narrow *packhorse* bridges, which rarely survive in more remote areas, where they mark earlier and long defunct communication routes. Clapper bridges consist of narrow, rough masonry piers or large boulders, surmounted by stone slabs that form a deck or walkway. One of the better surviving examples of a medieval clapper bridge spans the Awbeg river at Ballybeg, near Buttevant, although there are two likely post-medieval examples which span the River Lee, within 150m of each other, at Dromanallig, south of Ballingeary, County Cork.[6]

Packhorse bridges are a feature of upland areas of both Ireland and Britain, in the era before the road improvements of the eighteenth century which enabled wheeled vehicles to traverse most areas. In this period, carts and carriages were rare, and the transportation of goods across country was undertaken on foot with packhorses. Indeed, most of the butter brought by Munster farmers to the Butter Exchange in Cork in the second half of the eighteenth century - and prior to the improvements carried out by Griffiths to the road networks in Cork, Kerry and Limerick - was carried by packhorses.[7]

With the increase in wheeled traffic, however, bridges with narrow carriageways became a liability, and in the period 1729-1856, various turnpike acts began to stipulate that bridges on

Pack horse bridge on old butter road near Schull.

these roads should be widened.[8] The period c. 1820 – c. 1865 witnessed the widening of most of the more important existing multi-span semi-circular ached bridges such as Ballineen and Conna or their replacement with new more efficient segmental arches such as Fermoy, Bandon and Mallow, and more occasionally, with elliptical arches such as St. Patrick's Bridge in the Cork City.[9] Richard Griffith, alone, was responsible for the construction of some 128 new single and multi-span bridges in counties Cork, Kerry and Limerick.

Railways

From the 1840s onwards a series of national and county rail links, were created in County Cork, even extending as far west as Skibbereen. Many previously remote areas became part of national networks which enabled local goods to reach national and international markets. The railways, however, also allowed foreign commodities and luxuries to reach into the most remote parts of the county and thus acted as a stimulus for cultural change and the cultivation of new tastes in consumer goods.

The construction of Ireland's railways required often staggering new feats of engineering which became wonders of their age. Yet most of Ireland's railways were actually designed and built by Irish-born engineers who had garnered experience in England, and in consequence there was, unlike the canal era, considerably less input from English consultants. Indeed, although former assistants of I. K. Brunel, one of the famous British civil engineers of the time, names such as Nixon and O. E. Edwardes (who became engineer for the Cork-Youghal line) did work in Ireland. Brunel's involvement in Irish railway development was largely

Great Southern & Western railway viaduct under construction over the Monard Glen, in 1846. Watercolour by R. L. Stopford, courtesy of the Crawford Art Gallery, Cork.

confined to promoting the English Great Western Railway's abortive scheme to build an east coast line, linking Dublin, Wicklow, Wexford, Waterford and Cork, and as consultant to the Dublin and South Eastern Railway (1845-59).

On early railways, the *ruling gradient*, or the steepest climb, which steam locomotives were permitted on any section of the route, was kept as near level as possible, owing to the more limited haulage capacities of early steam locomotives. The pursuit of a near-level track bed necessitated large and expensive-scale civil engineering works, which included deep cuttings and high embankments to maintain the level through high and low ground, along with bridges and viaducts to carry the line over steep river valleys and existing routeways. Deep cutting and high embankments, for example, are very much in evidence on the Great Southern & Western line (the present-day Cork Dublin line) between Mallow and Cork. However, when many of Ireland's mainline routes were under construction in the 1840s and 1850s, newer and more powerful varieties of locomotive enabled ruling gradients to be increased, which in turn saved on the expense of large earthworks. Material excavated from cuttings would be carried on a temporary track to a section of the route where embankments were to be formed, while both cuttings and embankments were provided with stone or brick-lined drains, to facilitate the run-off of water. The use of the skewed arched bridge, a technological feat developed earlier during the construction of canals that allow a bridge to cross the river at an angle, was necessary and widely used.

Rail track is usually referred to as permanent way - a term originating in a distinction made between the finished track and the temporary one laid by contractors to facilitate railway construction. By the 1840s permanent way was being laid on a solid bed of broken stones and gravel called *ballast*, which distributed the load of the train and also prevented the build

A skewed arched bridge in Bandon.

up of water underneath the track. The set distance between the inner faces of each rail is called the *gauge*, and the Irish *standard* or broad gauge was set at 5ft 3in in 1846. The Irish narrow gauge of 3ft largely consisted mainly of rural services, built to serve the needs of often remote communities, by acting as feeder lines to the standard gauge network. The essential rational of narrow gauge lines in Ireland is that the cost of their construction would be significantly less than standard gauge railways. Indeed, less land was required for their routes, while lighter permanent way, and smaller locomotives and rolling stock, did actually reduce establishment costs. Furthermore, additional railway infrastructure, such as railway stations, was also cheaper. The main disadvantage was that there was no interconnectivity between lines. The Irish narrow gauge peaked during World War One, but was among the first Irish railways to be closed in the 1920s and 1950s under pressure from road haulage.[10] The last Irish narrow gauge railway, the West Clare line, closed in 1961.

No less than ten county-and national- based railway networks were created in Cork from the 1840s onwards. Of these, three lines - the Schull and Skibbereen; the Cork and Muskerry Light Railway and, from 1900 onwards, the Cork Blackrock and Passage Railway - were built to the Irish narrow gauge of 3ft. In this regard, the Cork Blackrock and Passage Railway was remarkable in that it began its life as a standard gauge line, before being re-gauged to 3ft in 1900. The Cork lines, five of which had termini within the city of Cork, were as follows:

1. The Great Southern and Western Railway (Cork to Dublin line) 1846-; **2.** Mallow-Fermoy (1860-1967); **3.** Fermoy to Mitchelstown (1891-1947); **4.** Mallow to Tralee 1843-; **5.** The Cork and Muskerry Light Railway (1887-1934); **6.** The Cork and Macroom Direct Railway (1866-1953); **7.** The Cork, Bandon and South Coast Railway, (1849-1961); **8.** Schull, Skibbereen and Bantry (1886-1947); **9.** The Cork, Youghal and Queenstown Railway 1862-; **10.** The Cork Blackrock and Passage Railway (1850-31)

ABOVE: **The Kilcummer Viaduct of 1860, on the Mallow to Waterford and Rosslare Harbour line.**

BELOW: **Railway bridge in Mallow with rusticated ashlar stone work.**

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.[11] 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 City. 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 near Blarney.

BELOW: **The Chetwynd viaduct, designed by Charles Nixon, on the Cork and Bandon Railway, completed in 1851.**

The Ballydehob viaduct, which carried the Schull and Skibbereen line over an inlet of Roaringwater Bay, completed in 1884-6.

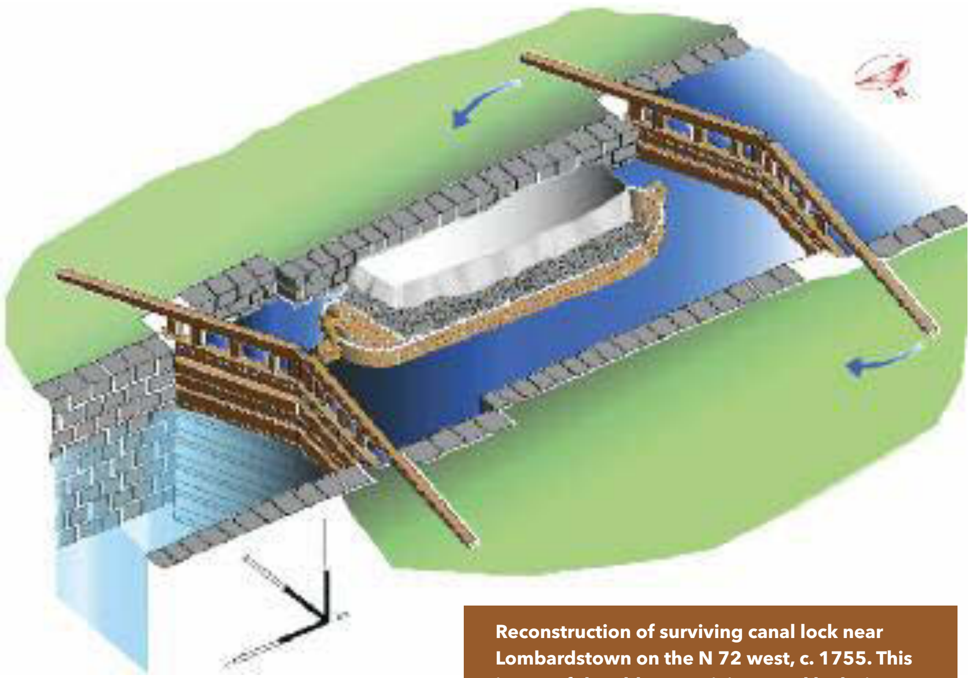
The first railway tunnels in Ireland were completed on the Cork and Bandon railway, beginning with the Kilpatrick tunnel, completed in a little over a year using day and night shifts. The tunnel was 170 yards (155.44 m) long, too short for a ventilation shaft, but in the second tunnel at Gogginshill, which was to be 900 yards (1.097 km), three air shafts were sunk in 1847. Upon its completion in 1850, this was, for a short period, the longest in Ireland. 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. The superstructure, which consisted of 1, 000 tons of wrought and cast iron, spanned the main Cork to Bandon road and the valley of the Glasheen River, and 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.[12] Nonetheless, while iron railway bridges were being built contemporaneously, they did not wholly supplant masonry-arched bridges or viaducts. A twelve arch masonry viaduct, with a concrete core, was built to carry the Schull and Skibbereen line over an inlet of Roaringwater Bay, near Ballydehob, in 1884-6. In the 1840s three substantial masonry viaducts were built to span the River Blackwater at Mallow, and the Monard and Kilnap glens near Cork, on the Mallow-Cork section of the Great Southern & Western Railway. However, the vast majority of railway bridges were single stone arched with distinctive rusticated ashlar stone work.

Inland Navigation

Cork, Ireland's largest county, has only one fairly short-lived navigation, the Mallow and Lombardstown Canal, begun in 1755 and completed as far as Lombardstown in 1759; pre-dating the commencement of the Grand Canal of Ireland by one year and the Bridgewater Canal in Lancashire by four years. The surviving pound lock at Lombardstown is similar in dimensions to contemporary European examples, as were those originally constructed for the Grand Canal and for the River Nore Navigation. However, while the latter were eventually reduced in size to preserve water, the Lombardstown example is unique in these islands as it retained its original dimensions during its short, working life.[13]

The Ballincollig gunpowdermills complex was provided with an internal network of canals for transporting raw materials and the finished product. The manufacture of gunpowder was an especially hazardous activity and water-borne transport was perhaps the safest way to accomplish this, although these canals also doubled up as a source of hydraulic energy for over 30 water powered installations spread across the complex. As early as the seventeenth century there were plans to make the River Lee navigable as afar as Macroom, but none of these proposals were ever carried out. Large stretches of the River Blackwater also flow through the county, but few attempts were made to improve navigation. Indeed, the only canal system associated with this system was built by the Duke of Devonshire, who created a canal to bypass shoals near Lismore, county Waterford between 1793 and 1796.



Reconstruction of surviving canal lock near Lombardstown on the N 72 west, c. 1755. This is one of the oldest surviving canal locks in either Ireland or Britain.

27th lock on the Grand Canal near Tullamore, county Offaly.

Ports and Harbours

With the exception of the upper and lower harbour, all of County Cork's harbours were generally small and often underdeveloped. Even important seventeenth- and early eighteenth-harbours such as Youghal and Kinsale tended to fade into insignificance relative to the port of Cork, which acquired immense strategic significance to the British navy on account of the provisions trade. The Board of Works in the early nineteenth century built a number of fishing piers along the coast and improved existing harbours such as Ballycotton; Baltimore and Glandore. However these were geared towards meeting the needs of local fishing industries, and not international trade. The provision of storage facilities, wharfage and cranes was often basic, while the harbours themselves generally served as breakwaters for small fishing vessels. A notable exception was the British Admiralty's victualling yards on Haulbowline Island, built between 1816 and 1822, complete with multi-storey storehouses and, later, with a naval dockyard.

The Board of Works built quays to service local fishermen along the coast and later the Congested District Board, established in 1891 to encourage economic growth in the poorer western regions, built additional piers, slips and landings along the West Cork coastline.

However indifferent and underdeveloped County Cork's harbour infrastructure was, the sheer extent of its coastline, at over 1,100 km, still required navigational aids such as lighthouses. Lighthouses were in private hands until 1717 when the land they stood on was vested in the crown. Central control of lighthouses took place with the establishment of the commission of Irish Lights in 1867, who erected 15 Light houses in strategic locations along the Cork coastline with different identifying lighting signals. However, an early eighteenth-century Irish cottage lighthouse survives at the Old Head of Kinsale. This consists of 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. For the most part these early lighthouses, as in the case of that on the Old Head of Kinsale, were erected on high headlands.

Oileán Chléire (Cape Clear) lighthouse (built in 1818) and Napoleonic War period signal tower. This was replaced by the first Fastnet lighthouse

Fastnet Lighthouse, completed in 1904.

Perhaps the most famous is the Fastnet lighthouse built on the Fastnet rock, 13 km from the mainland, replacing an earlier one on Oileán Chléire (Cape Clear). It was designed by George Halpin senior, and constructed with flanged cast iron plates between 1848 and 1853, and was 28m high. It had five cast iron floors, although the keepers were housed in a unique single storey cast iron, brick-lined shelter. However, the tower tended to sway in extreme conditions and its foundations (which were bolted into the rock face), were modified in 1867. In 1896 work began on its eventual replacement, the present-day tower, constructed with Cornish granite to a height of over 179ft, which was completed in 1904.[14]

In 1833 a self-taught Belfast engineer called Alexander Mitchell (1780-1868), who had been blind from the age of 23, patented a new fixing device for moorings - commonly referred to as the screw pile. Mitchell's invention, involved a wrought iron pile up to 20ft in length, with a cast iron helical screw. By this means the pile could be 'screwed' into position into most varieties of seabed, save solid rock, and its advantages for fixing permanent structures on shifting sand banks, such as light beacons, were quickly realized. One of these was installed on the Spit Bank at Cobh (1852), one of two which survive in Ireland.

Public Utilities

Utility industries provide what are now considered to be vital public services such as the provision of water, gas and electricity for both lighting and heating, and sanitation. During the nineteenth century, both water supply and sanitation, came to be firmly linked with the improvement of public health in Ireland but was mainly confined to urban areas. In 1866 the Sanitary Act was passed which effectively applied the main provisions of the English statutes of 1855 to Ireland, although from the outset the expense of their implementation saw to it that they had little initial effect.

By the eighteenth century the provision of water and sanitation already required intricate planning on the part of municipal authorities. Some essential services such as water supply were ideally, kept under public control, but this was by no means always possible. In Clonakilty for example, the Earl of Shannon initiated a public water scheme in the nineteenth century to provide clean running water for the townspeople. Part of the scheme was the installation of the cast iron water pump known affectionately today as the Wheel of Fortune. The gas and electricity companies invariably began their operational lives in private hands.

In 1858 the Corporation of Cork built one of the most advanced municipal water-pumping stations in the former United Kingdom, using water turbines and steam engines to pump water to storage reservoirs to supply the city of Cork. But elsewhere in the county smaller towns such as Mallow, Kinsale and Fermoy employed less advanced means to provide public water supplies, either through basic storage reservoirs (as at Cobh) or through the provision of cast iron pumps. At Ballincollig, a waterwheel (backed up by a horse wheel in the summer months) was installed sometime before 1834, to pump water to the artillery barracks, from a millrace in the adjacent gunpowder mills. In more ambitious schemes as at Midleton, the Urban District Council directed water from the Leamlara River to storage reservoirs a few kilometres to the north-west of the town. It was also commonplace, in the absence of municipal supplies, for private dwellings and businesses to sink their own artesian wells.

In rural Ireland, up to very recent times, water for cooking was taken from a local well or spring, while water for washing and other purposes, was captured in barrels from the gutter downpipes of the house. These practices were almost universally replaced when the widespread availability of electricity enabled householders to bore deep wells and abstract water from these using electric pumps. However, at the end of the nineteenth century cast iron, hand operated force pumps, became common in rural Ireland. These were generally surrounded by a stone (or later concrete) wall on three sides, and were installed by the Cork

Grand Jury and later by Cork County Council, as at Ballincurrig. A small number of Irish foundries appear to have produced these, but many were also imported from England.

All of the principal county towns were provided with gasworks for street lighting by the end of the nineteenth century. These included Youghal (1830), Mallow (1844), Bandon (1845), Skibbereen (1867), Cobh and Midleton. The Castle Bernard estate near Bandon also had its own private gasworks. The process of turning coal to gas is called *carbonisation*, whereby bituminous coal with a low ash content was distilled in a refractory vessel called a *retort*. The coal was heated in the retorts at temperatures in excess of 1000 degrees centigrade, the effect of which was to drive off the gas and other substances. The gas itself was also cleaned, in a series of processes that facilitated the extraction of important by-products such as tar and ammonia. Gas retorts were typically D-sectioned tubes, that were originally made with cast-iron, and later (after 1853) with refractory clay and, from the 1920s onwards, with silica.

By 1934, five of the main county towns still had operational gasworks. In the 1890s in Ireland there was a wider appreciation of the advantages of electric lighting and in 1890 Morrough's woollen mill near Douglas, connected a generator set for lighting to the mill's 250hp engine.[15] The earliest recorded street lighting for a rural county Cork town is at Macroom, where the mill race of a flour mill at Bealick, was used, from 1898, to power an electric generator set for public lighting.[16] The newly installed water turbine at Castleview Mills, near Clonakilty, was also provided with an electrical generator set, which was used to light the mill. In 1922 the Skibbereen gasworks was converted to electricity generation.

The Electricity Supply Board initiated a phased process of rural electrification in Ireland, in the years 1946-1965. The 26 counties were divided into 792 rural areas, which connected households across the country with a network of imported Finnish electrical poles. Local halls were also hired to demonstrate aspects of safety and to demonstrate the use of the electrical appliances which were transforming rural homes and kitchens. By 1975, 99% of rural homes in Ireland had a supply of electricity; the last part of Ireland to be connected up was the remote Black Valley in County Kerry, in 1978.

Control panel for electricity generating set, installed in Castleview Mills in 1918.

[1] Rynne 1999, 176-7.

[2] Hamond 1997, p. 602; Rynne 1999.

[3] Leahy, E. 1844 *A practical treatise on making and preparing roads*. London, pp. 37-8; O'Donoghue, B. 1993 'The office of county surveyor – origins and early years' *Trans IEI* 117 (1992-93), pp. 127-230.

[4] Rynne 1999.

[5] C. O'Leary 'The cast-iron milestones of the Cork-Skibbereen coach road', *Clonakilty Historical and Archaeological Jnl.*, 2017, 29-54.

[6] Power et al, vol.3, pp. 410-11, McCarthy, C. J. F. 1999 'An antiquary's notebook 20' *JCHAS* 104, pp. 147-53 at 149.

[7] Rynne 1998.

[8] O'Keeffe and Simmington 1991.

[9] Cork County Council, 2013 *Heritage Bridges of County Cork*. Cork.

[10] Prideaux 1981, p.

[11] Murray and MacNeill 1976, 17-18.

[12] Shepherd 1984a, 210 Creedon 1986, p. 14.

[13] J. Jackson, 1987 'Mallow-Lombardstown Canal', *Mallow Field Club Jnl.* 22-29.

[14] C. W. Scott 1906 *History of the Fastnet lighthouse*. London; Beaver 1971; Hague and Christie 1977.

[15] Rynne 1999.

[16] D.D.C Pochin-Mould 1991 *Discovering Cork*. Dingle, 163-4.

Chapter 6
Industrial Buildings of County Cork and their Main Architectural Features

This chapter examines the distinctive architectural features of eighteenth and nineteenth-century industrial buildings in County Cork.

Given the wide variety of industrial activities that developed during this period, an interesting and distinctive industrial building form emerged. Generally, the design of industrial buildings offered few frills or architectural embellishments, in that the design was largely driven by the buildings' intended functions: to provide a place to work; storage for raw materials and finished products, covering for machinery, and access for wheeled vehicles. Over time, many industries developed a need for special distinctive features, such as wide loading doors in iron foundries, or steam engine houses with their iconic chimneys, or cast iron internal framing/fireproofing in multi-storey textile mills. These all had an influence on design but for the most part, rural industrial sites continued to rely on vernacular building traditions and building materials, even when mutli-storey structures became common in the late eighteenth century. Many of these structures, with small modifications, not only stood the test of time, but continued in use well into the twentieth century. Nonetheless, the vernacular design and arrangement of these basic features could still be aesthetically pleasing and make a valuable contribution to the historic landscape. In addition, the height of these buildings, their watercourses, tall chimneys for steam engine exhausts or furnaces and large arched openings, often are landmark features that stand out from either domestic or public buildings. This chapter on industrial architecture examines the types of building material; building design, layout and location.

Building Materials

For the greater part of the eighteenth and nineteenth centuries industrial buildings in county Cork continued to be constructed with traditional materials, in what was essentially a vernacular tradition, using local skills and materials. Building stone was acquired locally and used to erect the main load-bearing and internal walls with rubblestone bedded in lime mortar; the corner stones, arches and surrounds around windows and doors were often squared off and lightly dressed stone. The masonry walls were generally un-rendered leaving the stone work exposed. Window openings were either lintelled with wood or stone or arched or on occasion, as at Castlview mill near Clonakilty, a combination of both. The windows were generally made of timber sliding sash or casement (side hung) type.

The more important industrial buildings in the larger towns especially in Cork City were more likely to have some more formal design, particularly on street frontage elevations to convey a sense of commercial respectability. From the mid nineteenth century onwards industrial building

Late eighteenth-century, using the combination of stone lintel under an arch at Castleview Mills.

Brick dressed windows at Lee Mills, Cork City, completed between 1824 and 1832. Tail race arch and quoins of cut grey limestone in contrast with random rubble red sandstone walls.

design took great advantage of the cheaper mass produced materials such as brick, tiles and cast iron, which were decorative in their own right and could have decorative features inbuilt.

In the early decades of the nineteenth-century hand-made brick was commonly used for window and door dressings - the brick itself being used both for decorative effect and as a form of fireproofing. The increasing availability of machine-made brick, fired in more efficient kilns and producing a higher quality brick, led to the more widespread use of brick for all building forms during the 1860s such as workers and artisan dwellings; public buildings and Victorian terraces. The Model School on Anglesea Street, Cork City (1864), built with good quality facing brick manufactured at Ballinphellic near Ballygarvan, was the first major public building in the city to be built with a brick comparable to the best English types. Wallis and Pollock's flax spinning mill (later Morrogh's woollen mill), followed in this stead in 1866, with its main walls being constructed with Youghal brick and finished externally with Ballinphellic brick (which was of better quality).[1]

Brick was also used as fireproofing in some of the larger mill's internal floors, after established Belfast linen mill practice. However, brick as a building material never overtook stone which continued to be used as the building material of choice until it was replaced by concrete in the 1920's and 30's. However, mass concrete (i.e, without reinforcing bars) was used from the mid nineteenth century onwards but reserved for specific projects. The earliest recorded in

Cork for its use, in which shutters of timber were used to create a mould, into which the concrete was poured, is in the foundations of the original Great Southern and Western terminus at Cork, designed by Sir John Benson and completed in 1855. Benson also used concrete in the construction of the new reservoirs for Cork Corporation Waterworks completed in 1858-60, in the piers of St Patrick's bridge in 1860 and in the roadway on the new North Gate Bridge in Cork completed in 1863. Reinforced (or *ferro*) concrete, in which steel bars are incorporated to increase its tensile strength, was used by the Cork architect Samuel Hill in buildings constructed (recently demolished) at the Cork City terminus of the Great Southern & Western Railway on Penrose Quay).[2] Reinforced concrete was also used in the core of the Ballydehob viaduct, completed in 1884-6, which carried the Schull and Skibbereen railway over an inlet of Roaringwater Bay near Schull. However, it was rarely used in Cork County's industrial buildings until the early years of the twentieth century.

Concrete was used in the Ballydehob Viaduct. Image courtesy of the National Library of Ireland (L_ROY_10264).

Like most buildings of the time, industrial buildings were generally roofed with slate thus giving them a similar and unifying external appearance with other buildings. Slate from the Benduff and Drinagh quarries was often used throughout the county from the mid-1830s, but

Weather slating on Brinny Mills.

The presence of corrugated iron roofing can be seen on many of the buildings located within the Lombardstown Coop and Creamery, circa 1892. Image courtesy of Donie O'Sullivan.

blue and grey Welsh slate was also imported for use as roofing material and for weather slating. Weather slating was used to prevent water ingress. It was used in all building types and mainly confined to coastal areas. The slates were applied to the exterior walls of buildings to prevent water ingress and the individual slates were bonded with lime mortar. Another material that came into popular use towards the end of the nineteenth century was corrugated iron. It was relatively cheap; it came in good lengths, it was easily worked and, if maintained, had a long life. It was used in a wide range of less formal buildings and was particularly popular where roofs were being repaired or replaced such as thatch, and on small industrial buildings; workshops and creameries.

Timber was in huge demand for roofing material and in the absence of native woodland which had been stripped away by the voracious appetite of the British ship builders and as fuel for their iron works in the sixteenth and seventeenth centuries, an alternative source was required. From the middle of the eighteenth century onwards, Baltic ('pitch') pine began to be imported in large quantities into the port of Cork for use in building projects, principally for roof, stanchions and flooring timbers. But unlike hardwoods such as native Irish oak, the softer

Baltic pine used for roof trusses, stanchions, and floors in former British Naval storehouse on Haulbowline Island, Cork Harbour, c. 1818.

imported fir and pine used externally needed to be protected from the elements. It was painted with 'red lead' paint, which was manufactured from *litharge* (lead monoxide, PbO, an extremely toxic substance). This has a distinctive bright red paint that can still be seen on the windows and doorways of many old industrial buildings.

Iron was mainly confined to decorative work prior to the eighteenth century. Following improved casting techniques in the seventeenth and eighteenth century, it began to be used for structural and decorative works, particularly in the nineteenth century. Cast iron columns or stanchions provided the much needed support for the floors with heavy machinery and facilitated wider roof spans, providing more internal operational space. In addition, the casting process allowed intricate design and interesting details that could be repeated at reasonably low cost. Railway architecture made much use of it in building design, both structurally and decoratively, to great effect.

Industrial Building Design, Layout and Location

Industrial buildings of the eighteenth and nineteenth centuries were designed to accommodate machinery for various industrial activities. Consequently, the design and layout was driven by the need to accommodate a lot of heavy machinery along with the power transmission; storage for the raw material and end product, and with adequate operational space.

Many buildings involved in food processing industries required extra storeys for storing bulky items such as grain, and for the housing of machinery and plant. Separate buildings were also occasionally provided such as offices, workshops, workers' accommodation and stabling for horses. In the age of the steam engine, the tall stack, which created a draught for the steam engine's boilers and a means for exhausting fumes from the engine, could be seen for miles around. The earliest steam engines also required the support of the building housing them, which itself could have been three storeys, while the boilers were also housed separately. And while later beam engines, which were supported on independent columns, did not require an elaborate engine house, the engines installed in textile mills after 1850 were always provided with large engine houses. These were commonly finished with coloured brick dressings and string courses, while the internal walls and floor could also be finished with shiny ceramic tiles. Other buildings such as rural creameries were equipped with a platform to facilitate the easy lifting of creamery churns off carts or lorries.

Even the most basic water-powered rural industries required intricate planning in relation to the position of the mill building, and the manner in which water was delivered onto the waterwheel. For bucket waterwheel types, such as breastshot and overshot, a typical 4m diameter wheel required that the specially built pit in which it rotated be least 2m below the level of the axle's bearings. For an overshot waterwheel, of this diameter, the trough or launder which directed incoming water into its buckets had to be at least 2m above the waterwheel's axle. In order to accommodate this, some of the larger mills were built into a slope, parallel to the wheel pit, but with a sufficient fall to facilitate water exiting from the waterwheel into the tailrace. This arrangement commonly resulted in the creation of a storey either completely or

Bealick Mills, Macroom, showing position of waterwheel relative to mill building. Note the height of the stone aqueduct directing water onto the wheel, and the slope away from the wheel.

partially below ground, although at least one side of the mill had to be cleared to facilitate an access doorway. In practice this meant that the lower storey would accommodate the mill's gearing and the equipment used for bagging the flour or meal; a weighing scale and perhaps an office. However, one of the main advantages of this arrangement was that the floor housing the millstones would be at ground floor level.

A pair of 4ft 6in diameter millstones could weigh over 3 tons. Access to the mill's courtyard, at ground floor level, minimized heavy lifting when new millstones had to be installed. In some instances, the larger eighteenth- and early nineteenth-century flour mills were also situated close to where a stone bridge provided access across a river, in other words, an important node of communication near a settlement. Good examples of this type of location include the mill at Bealick Mills near Macroom located near the bridge over the River Laney, or indeed, the Bridge Mills in Castletownroche on the River Awbeg.

In larger grain mill complexes, breweries and distilleries, ancillary buildings such as grain drying kilns; maltings, storehouses, workshops and offices, were often arranged around the main building to form a courtyard, as at the Bridge Mills, Castletownroche; Deasy's Brewery, Clonakilty and Midleton Distillery. This facilitated access to horse drawn vehicles which brought raw materials in and which transported the finished product out to customers. In towns, access from the main street into the courtyard, as at Deasy's brewery, Clonakilty and the Bandon brewery, was accommodated through the provision of an arched opening. Large, cut stone arches, were also commonly provided for iron foundries to enable bulky items such as large castings, steam engine components or even steam boilers and the like, to be dispatched. Similar openings are also in evidence on the boiler houses associated with stationary steam engines, again to facilitate the maintenance and installation of steam boilers.

Midleton Distillery, showing grain stores and malt kilns arranged around a central courtyard, to facilitate vehicular access.

In multi-storey buildings, such as grain stores or general warehouses, loading doors were provided either on the gable end of the buildings or centrally to the courtyard. At the peak of the gable a projecting sack hoist, often covered with a wooden awning called a *lucamb*, allowed sacks or other heavy items to be lifted up to the individual loading doors on each floor level, as at Midleton Distillery.

The first purpose-built, multi-storied industrial buildings in Ireland that could facilitate power transmission from a waterwheel to each storey, were the *bolting* or flour mills, which began to appear around the middle of the eighteenth century. This facilitated the use of gravity in the industrial process. The grain was stored on the upper level, fed down to the millstones on the floor below and the ground flour in turn fell to be bagged on the lower floor.

Sack hoist and lucamb, and loading doors for individual floors on grain store of c. 1825, at Midleton Distillery. Note the use of brick dressings (made with clamp-fired brick), and the painting of loading doors and window shutter with red lead paint.

In the pre-steam age these were very much the prototype for multi-storey textile mills in Ireland, and it is clear that early cotton and flax spinning mills were constructed along similar lines using local materials. Such mills, up to the introduction of iron frames, were usually laid

King post truss roof in former British Naval storehouse on Haulbowline Island, Cork Harbour, c. 1818 (Exemplar 25).

out on a rectangular ground plan and did not exceed widths of about 9m, which was around the maximum that unsupported roof trusses could span. The roof and the timber floors relied on the mill's enclosing walls for support and, when it became necessary to widen the spans between the load-bearing walls, intermediate timber upright supports or stanchions were introduced to provide support for the floor joists along the length of the building. Internal lighting was generally assisted by rows of regularly-spaced windows on each floor and in keeping with the rhythm of the architectural style of the time.

In rural buildings simple collar beam roof trusses would suffice, but in larger, multi-storey buildings or single storey railway warehouses, more elaborate king post trusses were often employed, as in the early nineteenth-century naval storehouses on Haulbowline Island. In many eighteenth- and early nineteenth-century industrial buildings in county Cork, the external roof shape was commonly a simple gabled form. However, as such buildings tended to be narrow, the basic structure could be extended, by creating a *double pile*, in which the building was effectively doubled up by erecting a building of the same proportions alongside it, as at Castleview Mills. By this means the building could now be at least two rooms deep, with two gabled roofs separated by a valley in between them. Hipped or pitched roofs were also used but not as common as the gable end, while half hips were also employed in larger structures as for example on St Patrick's Mills, Glanmire and the Lee Mills, Cork City, to create an extra loft space.

Mixture of gable and hipped roofs at Midleton Distillery.

The increasing demands which early industrial structures in Britain and Ireland placed on the repertoire of the vernacular building tradition grew from the need to accommodate a wider range of industrial machinery. In textile industries, as new mechanical means were developed for all of the individual preparation and spinning processes, it became no longer practical to link all of the machinery to a single power source within the same building, without the addition of extra storeys. Up to the 1780s in Ireland the various preparing, spinning, weaving and finishing processes involved in textile manufacture were often undertaken at different installations. Indeed, before the adoption of the power or mechanical loom in the cotton and linen industries, the manufacture of cloth could still involve three separate production units: the spinning mill; the weaver's house and the bleach mill and green.

The integration of these processes at a single site had already taken place at Douglas, near Cork City, in 1750, but appears not to have been attempted elsewhere again until the early 1780s. In the years 1781-1801 the Sadlier brothers at Glasheen and Riverstown, had attempted to integrate all of the main processes, although their efforts ended in financial failure. Marcus Lynch was the first to integrate the processes used in woollen manufacture in his factory at Midleton in 1793, but again his efforts were short-lived. Purpose-built late eighteenth and early nineteenth Irish textile mills tended to be four to five storeys high. The earliest multi-storey Irish textile mills were built in the latter part of the eighteenth-century to house cotton spinning machinery, such as that near Blarney built in 1787. Marcus Lynch's six storey woollen mill at Midleton was, in 1793, the largest of its type to have hitherto been erected in Ireland.

As industrial buildings increased in both width and height so also did the danger of serious fires, as the internal flooring and their supports were all constructed with timber. In the event of a fire in a multi-storey building, flames could quickly spread from floor to floor. In buildings with machinery on several floors, oil dripping onto wooden floors created a further fire hazard. Early attempts to remedy these dangers included applying a coat of lime mortar to exposed timbers, or sheathing these with copper plates, to act as a flame retardant. The only real solution to this dilemma -the internal use of cast iron framing – did not come into use in Ireland until the early decades of the nineteenth century.

There can be little doubt that the increased width of industrial buildings was facilitated by the introduction of cast iron supporting columns, which were beginning to replace timber stanchions as intermediate floor supports at the end of the eighteenth century in England. On Haulbowline Island in Cork Harbour, six former British naval victualling stores, completed in 1816-22, were provided with what appears to be an early form of transitional fireproofing, unique in Ireland. Internally, the wooden pine floors are supported on a unique cast iron framework. The cast iron columns on each floor form a three-bay interior division, set around a *ca.* 11ft square grid. These columns support a series of large beams, set at right angles to the main walls, which have slots in their upper faces in which the main flooring joists (the beams that support the floorboards) are positioned. This arrangement was clearly not completely fireproof, but did provide some protection from fire, while at the same time allowing heavier loads to be stored in the warehouse.

Internal cast iron framing in former British naval storehouse on Haulbowline Island, c.1816-22.

By the 1830s internal iron framing, in which the internal loading of the building was largely transferred from the external walls to a fireproof, free-standing cast iron frame, was beginning to be employed in Irish textile mills. The principle had first been used by Charles Bage at a flax mill in Ditherington, Surrey in 1796, and was further developed in the early years of the nineteenth century. It was a standard feature of large Irish linen mills constructed in the second half of the nineteenth century, where each of the internal floors of the mill was laid upon a matrix of brick, segmental *jack arches*, which were supported upon tiers of cast iron girders. Jack-arched floors were the principal means by which textile mills of this period were rendered fireproof, and in some instances individual floors were also finished with fire clay tiles. In County Cork only two industrial buildings employed jack arch floors as their principal means of internal fireproofing; both large flax-spinning mills dating to the 1860s and both occurring on the outskirts of Cork City. These were Donnybrook, near Douglas and Millfield in Blackpool, which was destroyed by fire in 2003.

The eighteenth and nineteenth centuries witnessed an explosion of new infrastructural works to improve communications and trading. New roads and bridges were built with new improved design and along the coast new harbours and piers were built or rebuilt. Bridge design moved from the many arched bridge of the eighteenth century towards wider spanning segmental arches in the nineteenth century.[3] Railway line required straight routes which led to the use of the technically brilliant skewed arched bridges. Harbours and piers were also a major feat of engineering skills. They were simple in design, solid in construction and built with fine quality stone work, which have stood the test of time in rough and stormy waters. The tall elegant lighthouse design was again driven by its function, to provide light to passing ships and provide accommodation and storage for long periods for the light house keepers. Many of these are magnificent and aesthetically pleasing.

Finally, new types of industry brought new design requirements and layout. For example, railway stations were a new concept and required a new design that needed to be attractive yet functional. They required a formal entrance, a booking office, rest rooms, storage facilities and engine and carriage houses, all sitting comfortably with each other. The early railway stations of the 1840s and 1850s were well designed to meet these requirements. They used high quality materials, employed highly skilled craftsmen and created a pleasant and attractive complex that we still enjoy today. The architectural style was very much dependent on the owners and the appointed architect tastes and displayed several features of the prevailing architectural canon, be it classical or gothic revival.

Mid nineteenth century Burren pier, near Timoleague.

Internal cast iron framing and jackarch fireproofing in former Lansdowne flax-spinning, Limerick, built in 1853.

Now after examining the various types of industry, the raw materials, energy sources, technology required and industrial building styles, the following 30 Exemplars should make for informed reading, selected to give a good understanding and to broaden interest in the fascinating Industrial Heritage of County Cork.

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[1] Rynne, 1999, *The industrial archaeology of Cork city and its environs*. Dublin, 103.

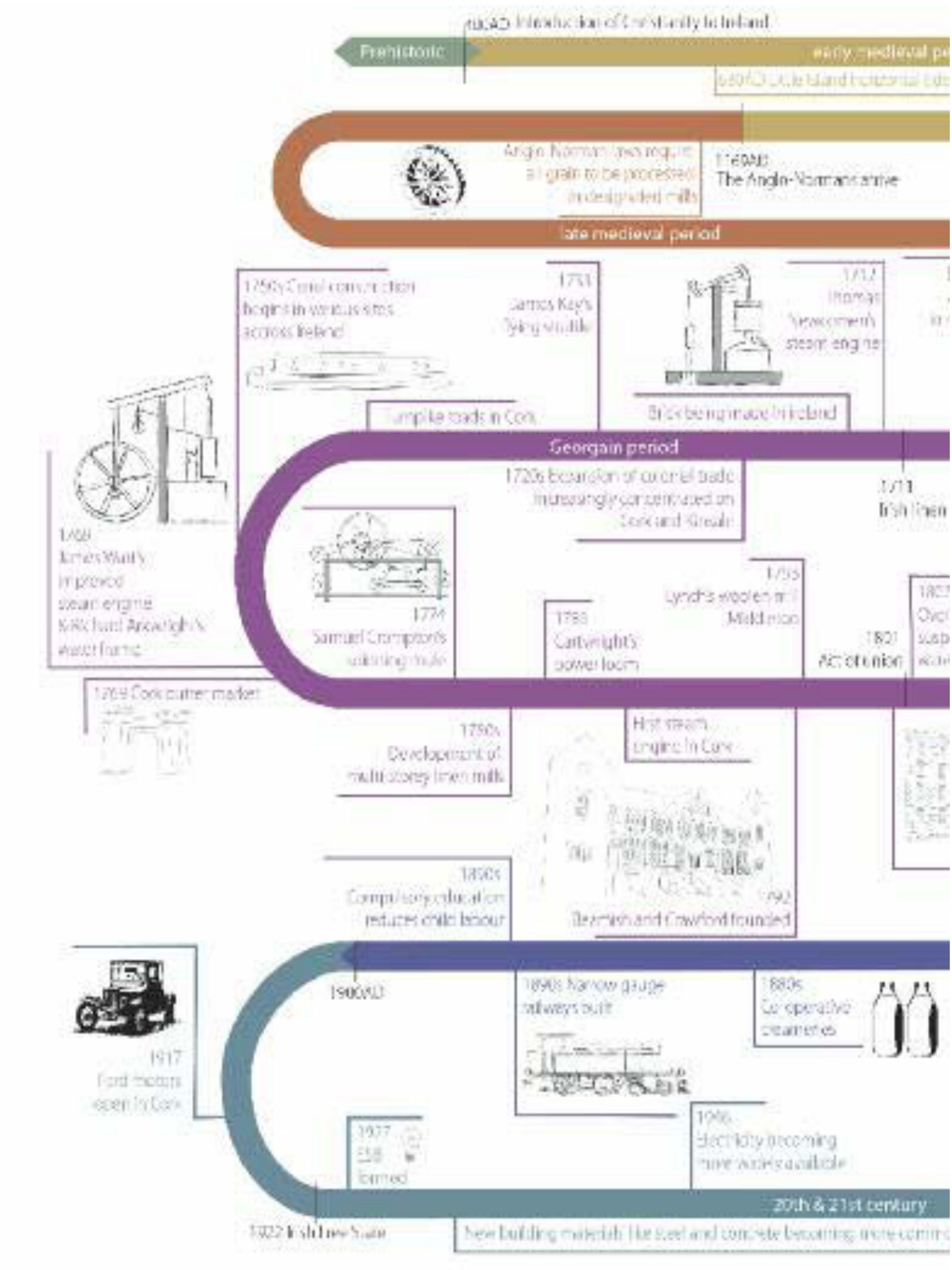
[2] C. Rynne, 2006, *Industrial Ireland 1750-1930. An archaeology*. Cork, 173.

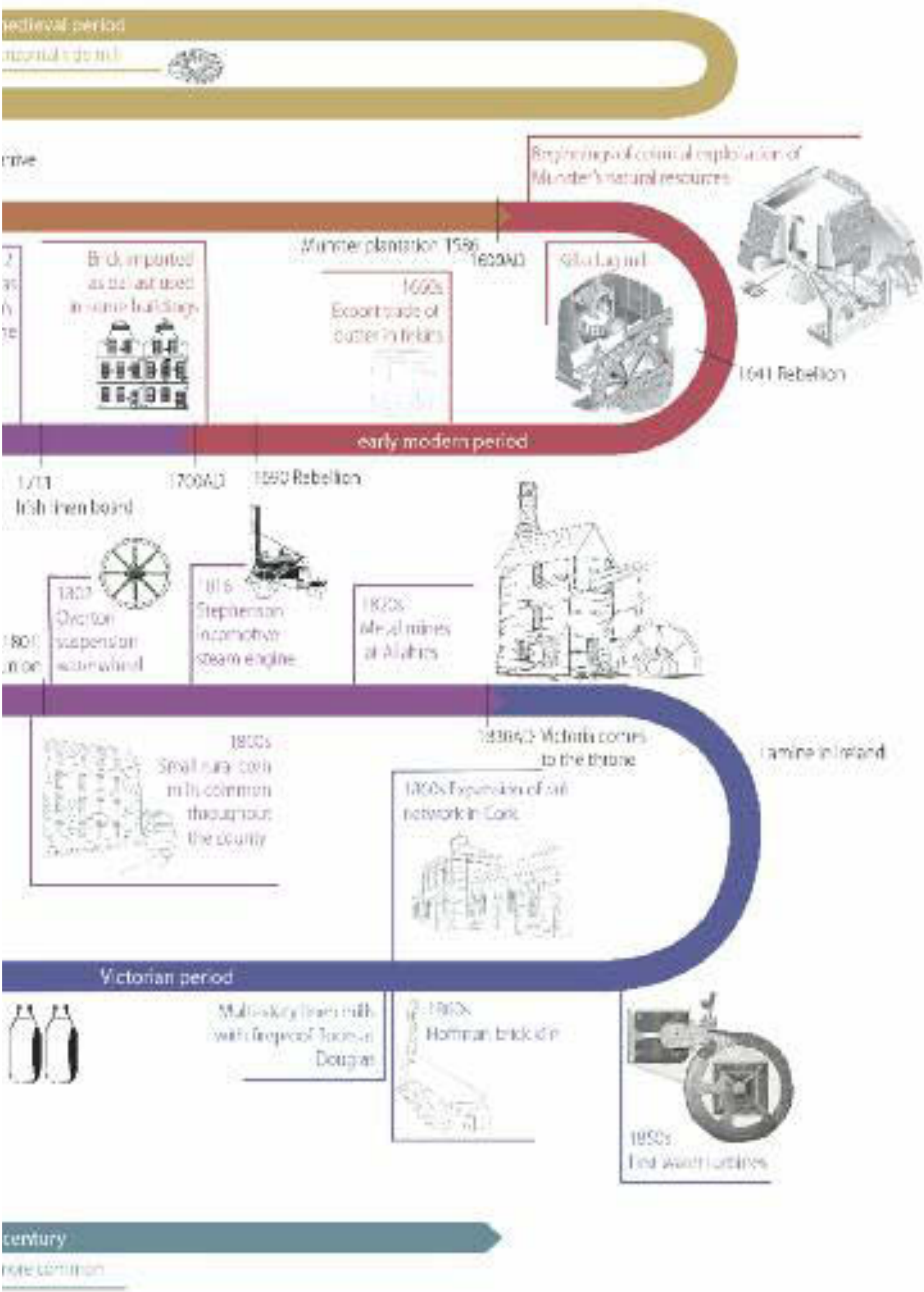
[3] Cork County Council, 2013, *Heritage Bridges of County Cork*. Cork.

Timeline and Exemplars: A Timeline of Key Events and a Selection of 30 Sites from County Cork's Industrial Past

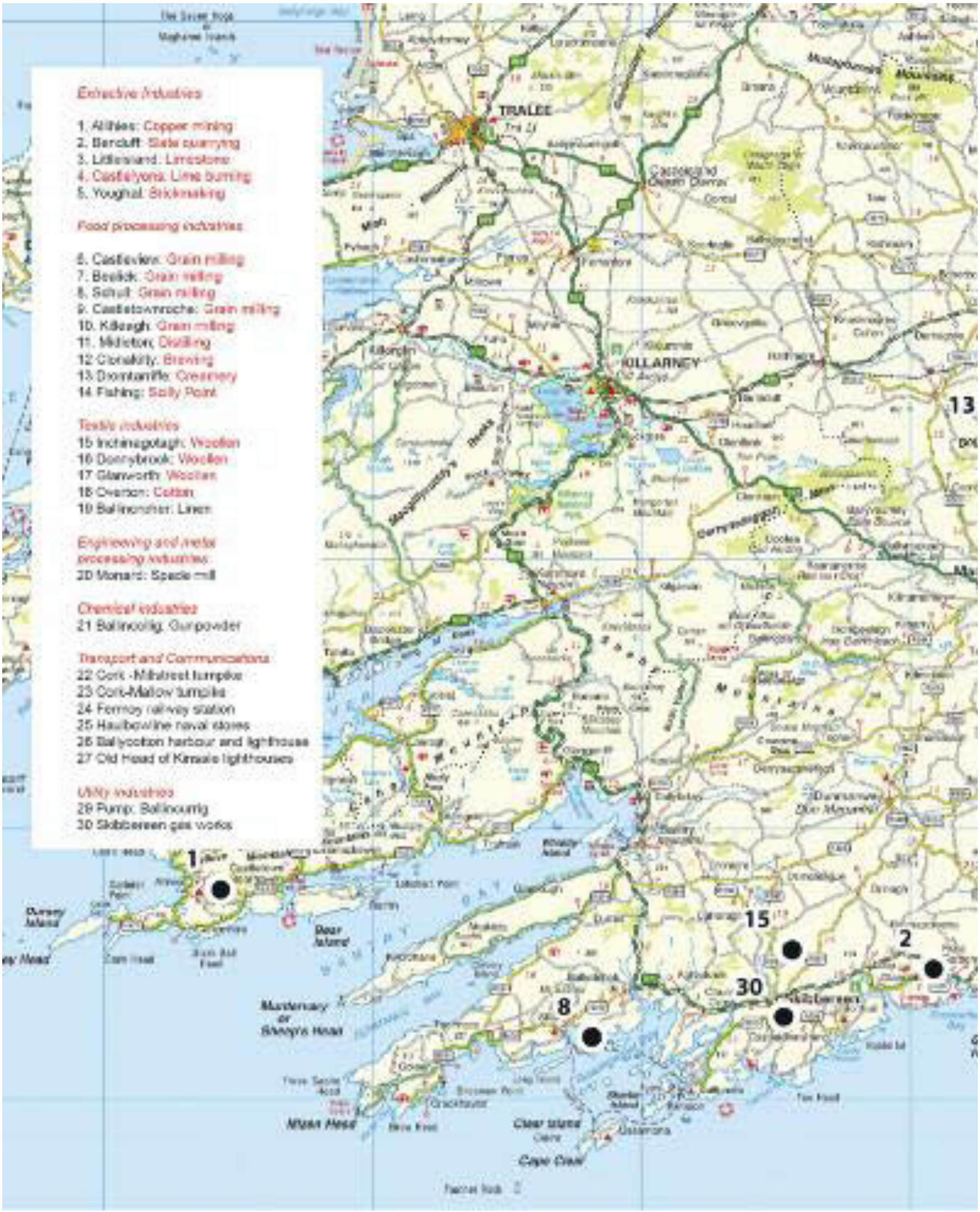
As the preceding chapters have conveyed, County Cork's industrial past is not only a fascinating one, but a past that nearly every parish can relate to, with so many of the industries having operated at the local level. Given the vast range of industrial sites that have existed within the county it would be quite a difficult task to include them all in one chapter. However, a selection of 30 sites has been specifically chosen, to give the reader an informed overview and indeed appreciation, of the county's industrial heritage.

The examples selected, as one can see from the accompanying map (pp. 108-109), give a good geographical account of the county's industrial past and a timeline has also been provided (pp. 106-107), detailing some of the key moments in the development of industry in County Cork over the years. The chapter begins with Allihies Copper Mines; a most stunning heritage site in a similarly stunning setting.


Introduction of Christianity in Ireland
Prehistoric
early medieval pe
Anglo-Norman laws require all grain to be processed in designated mills
1169AD The Anglo-Normans arrive
late medieval period
1750s Canal construction begins in various sites across Ireland
1733 James Kay's flying shuttle
1712 Thomas Newcomen's steam engine
Turnpike roads in Cork
Brick being made in Ireland
Georgain period
1720s Expansion of colonial trade increasingly concentrated on Cork and Kinsale
1768 James Watt's improved steam engine
1774 Samuel Crompton's spinning mule
1785 Cartwright's power loom
Lynch's woollen mill Midleton
1801 Act of Union
Irish linen
1769 Cork butter market
1790s Development of multi storey linen mills
First steam engine in Cork
1850s Compulsory education reduces child labour
1792 Beamish and Crawford founded
1900AD
1890s Narrow gauge railways built
1880s Co-operative creameries
1917 Ford motors open in Cork
1927 ESB formed
1946 electricity becoming more widely available
20th & 21st century
1922 Irish new State
New building materials like steel and concrete becoming more comm



Beginnings of colonial exploitation of Munster's natural resources
Brick imported as ballast used in some buildings
Munster plantation 1586
1600AD
1660s Export trade of butter in firkins
1641 Rebellion
early modern period
1700AD
1690 Rebellion
Irish linen board
Stephenson locomotive steam engine
1820s Metal mines at Allihies
1800s Small rural corn mills common throughout the county
1838AD Victoria comes to the throne
Famine in Ireland
network in Cork
Victorian period
Hoffman brick kiln
1850s
century


Extractive Industries
1. Allihies: Copper mining
2. Benduff: Slate quarrying
3. Little Island: Limestone
4. Castlelyons: Lime burning
5. Youghal: Brickmaking
Food processing industries
6. Castleview: Grain milling
7. Beelick: Grain milling
8. Schull: Grain milling
9. Castletownroche: Grain milling
10. Killeagh: Grain milling
11. Midleton: Distilling
12 Clonakilty: Brewing
13 Dromtarriffe: Creamery
14 Fishing: Scilly Point
Textile industries
15 Inchinagotagh: Woollen
16 Donnybrook: Woollen
17 Glanworth: Woollen
18 Overton: Cotton
19 Ballinoncher: Linen
Engineering and metal processing industries
20 Monard: Spade mill
Chemical industries
21 Ballincollig: Gunpowder
Transport and Communications
22 Cork -Millstreet turnpike
23 Cork-Mallow turnpike
24 Fermoy railway station
25 Haulbowline naval stores
26 Ballycotton harbour and lighthouse
27 Old Head of Kinsale lighthouses
Utility industries
28 Pump: Ballincurrig
30 Skibbereen gas works
TRALEE
KILLARNEY
13
1
15
2
30
8
Bear Island
Mizen Head
Clear Island
Cape Clear

Ballyhoura Mountains
Nagles Mountains
Mallow
Carrigaline
Kinsale
Midleton
Old Head of Kinsale
22 Cork-Millstreet Road
23 Cork-Mallow Road
25km
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Exemplar 1

Allihies or Berehaven Copper Mines

The Engine house at the Mountain Mine, Allihies, completed in 1862. The engine's beam extended through the opening at the top of the bob wall and powered the water pumps and man engine.

The rocks in West Cork are rich in minerals, particularly barytes and copper, which were in high demand by the beginning of the nineteenth century. During this period the development of steam pumping engines enabled mines to be worked to much greater depths. Many of the larger copper mines were established in the Allihies area, which became one of the premier and financially rewarding copper mining districts of Ireland.

The main mining sites are located around the village of Allihies - mining operations for copper ore began by John Lavallin Puxley in 1812. The first mine was established on the coast at Dooneen, to the north of Allihies village. Puxley bought a steam-powered winding engine from

the Cornish foundry Harveys of Hayle, to raise the ore. The mining technology originated from the mines in Cornwall, where all of the key technical staff and the *mine captains* or engineers originated from. Here, like in Cornwall, the engine mechanism was housed in the iconic Engine house, a tall rectangular building with a tapering high chimney. On the side facing the mine shaft, called the *bob wall*, there was a rectangular opening on top to accommodate the extended rocking beam powered by the steam engine inside. In the case of the water pumps, the beam was attached to the top of the pump rods - the back and forth motions of the beam set the pumps at the base of the mineshaft in motion and pumped the water out.

The mining process entailed the sinking of a vertical access shaft down to the veins or lodes of copper ore. The lodes were mined though a series of horizontal tunnels called levels, which led off the vertical shaft. These were usually below the water table and, therefore, water was a constant issue. The water pumping rods or the *kibblees* (lifting buckets) extended down the vertical shaft. The rock was blasted with black gunpowder which created a series of steps or *stopes*. This enabled the ore to be removed horizontally by the miners with their hammers, picks and shovels. The ore was transported either in wooden trucks on rails or in wheelbarrows to the vertical shaft to be raised to the surface by the kibbles. On the surface the ore was taken nearby to be sorted and cleaned. Women and young girls worked at the dressing floors, exposed in all weathers, separating the ore from the rock with a sledge and spalling (small hammers) and into smaller sizes. When ready it was taken to Ballydonegan Bay and shipped to Swansea in Wales where it was smelted to extract the copper.

Magazine with Coom Engine house in distance.

Further mining operations were established nearby, the Mountain Mine in 1813 and at Caminches in the 1820s. Around the same time, a large gunpowder magazine for storing the volatile gun powder was erected close to, but at safe distance, from the Mountain Mine. Puxley also provided housing for his immigrant miners from Cornwall, to the east of the Mountain Mine, which is still known as the 'Cornish village'. Indeed, a school had also been built for the children of these miners by 1838, along with a Protestant chapel by the early 1840s, which is now the home of the Allihies Mining Museum. In 1860 the total workforce at the Allihies mines was between 1,200-1,500, which included people of all genders and ages.

Puxley had enjoyed a large degree of success in his mining ventures up to his death in 1856, although the Doneen mine had been abandoned in the 1830s. In an enlightened move, Henry Lavallin Puxley, John Puxley's grandson, installed a *man-engine* in 1862, a kind of primitive elevator, to lift miners safely from the depths of the mine. Prior to this the miners descended into the mines via wooden ladders every morning. Then, after a long shift, they had to climb almost half a kilometer, while exhausted, wet and carrying their hammers, picks and shovels, to the surface.

The engine house at the Coom mine, Allihies, c. 1871, powered the winding machine. Note the Mountain Mine in the background.

In 1870 the Dooneen mine was reopened and a steam engine was provided for the mine at Coom, just east of the Mountain mine. However, the 1870s was a lean period for Irish copper mines and the Coom mine and Kealogue to the south of it were closed sometime before 1875, followed by the Dooneen mine in 1878. All of the remaining mining operations had ceased by 1884, and all plant and machinery was auctioned off late in 1885. Many skilled operatives were out of work, but a large number eventually emigrated and found employment in the copper mines at Butte, Montana in the USA.

The Mountain Engine house that powered the man engine was conserved by the now defunct Mining Heritage Trust of Ireland in 2006. The Engine house of the Coom mine, and that at Kealogue, south of the Caminche mine, now forms part of a walking heritage trail. Today, the Engine houses stand majestically in the stark beautiful landscape around Allihies as a reminder of an interesting industrious past in this remote part of the world.

Did you know? The US Navy Seal, Robert O'Neill, from the state of Montana, involved in the capturing of Osama bin Laden, is a descendent of Allihies miners who emigrated to the US in the 1880s?

Exemplar 2
Benduff Slate Quarries

The Benduff slate quarries, from their opening in 1830, up to their closure in 1954, were the largest slate quarries in County Cork and perhaps the third largest in Ireland. They are located between Rosscarbery and Connnonagh on the old Roscarberry-Skibbereen road. The road that replaced this, the N71, actually cuts through a section of the waste material from the quarry workings to the west of the site. The extensive slate deposits appear to have been discovered when the Cork-Skibbereen coach road was under construction in 1812.

As in other Irish slate quarries, as at Valentia Island and Portroe and Clashnasmut in county Tipperary, the local landlord who began quarrying operations at Benduff, imported Welsh expertise. The methods employed in Welsh slate mines, to detach slate from the quarry face and to cut into the requisite sizes, were very much in evidence at Benduff up to its closure in the 1950s. The slate was first cleaved from the rock using wedges and picks, where skilled operatives, working on the floor of the quarry in the open, called *splitters* and *dressers*, split and shaped the rock into roofing slates. Splitting involved the use of hammers and chisels to separate a thin section of the slate by prising open the laminae or thin, sedimentary layers in the slate, to form roofing slates. Dressing created the basic rectilinear shape of the piece by skillfully trimming the edges. One of the main problems encountered at Benduff, as in other slate quarries, was the rapid buildup and disposal of waste rock, for in slate quarrying around 90% of the rock ended up as waste.

The Benduff slate quarry today.

By the 1860s, the quarry was being worked to a depth of about 70ft (c.21m). In order to facilitate the movement of finished slate from the quarry, two steam engines were installed. These were apparently used to draw metal wagons, presumably with a chain, up from the quarry floor to a store house adjacent to the road. This same method was also employed at the Portroe quarries. The steam engines at Benduff, however, were probably standard horizontal engines and not Cornish. Once quarried, the slate was then transported by road to Glandore, some 5km away where it was shipped to the customers in the larger Irish ports. At its peak of production in the nineteenth century the quarry employed 100-150 people and produced upwards of 2,600 tons of slate per year. There was a serious accident in the quarry in 1892, which killed 8 men and resulted in its closure for about eight years. In the 1950s quarry workers were still being paid only for the slate that they brought to surface, working in arduous conditions from 7am in the morning to 5pm.

Miners house in 1986 by Cork Archaeological Survey, now in ruins.

In the years immediately following Irish independence there was pressure on the new Irish government to decrease its reliance on imported building materials in general which, for a brief period, created a boom period for Irish slate quarries. By 1923, the Killaloe (Portroe) and Benduff quarries were busily occupied, producing slates for Dublin's housing schemes. Indeed, even when the Benduff slates were deemed to be of an unusable quality, Dublin Corporation opted for Welsh rather than English slates. By the early 1950s the number of workers at Benduff had declined to around 36, and the quarry finally closed in 1954.

The eastern half of the Benduff quarry in recent times has been used as a landfill site, and has now been almost completely covered over, but the base of one of the engine houses has survived along with a well preserved chimney. A large section of the western half of the quarry remains open but is dangerous and closed off to the public.

Photos taken in 1986 by the Cork Archaeological Survey showing Miners houses as well as a fitting memorial to those killed in 1892.

Did you know? The old graveyards in the surrounding area often used headstones made from Benduff Slate.

Exemplar 3

Littleisland Limestone Quarries

Rock Farm East quarry, Littleisland.

Carboniferous limestone has been employed for more industrial purposes than any other variety of stone. Apart from its most common use as an important building stone and aggregate for road-building, it was also widely used as mortar and render; as fertilizer, for de-hairing hides in the tanning process, the purification of coal gas and for creating carbon dioxide for early fizzy drinks. It was therefore in much demand in the eighteenth and nineteenth centuries for a wide range of industrial activities.

In the early nineteenth century there were two main quarries on the south shore of Littleisland called appropriately, Rock Farm East and Rock Farm West. Later in the nineteenth century a quarry was developed at Carrigrenan to the east of Rock Farm East quarry. There were two varieties of limestone that were extracted at the Littleisland quarries. The more famous is Cork red marble. Although technically not a true marble, this was a variegated form of limestone with an attractive reddish colour, which was also capable of taking a polish like true marble if sawn. There is no clear evidence where this was quarried. The second, and the bulk of what was quarried, was a pale grey limestone, which could be used for most building purposes.

Did you know?
Many of the quarry workers and lighter men who transported the stone to Cork lived in Clashavodig; a small settlement of single storey vernacular houses beside the quarries.[1]

For the most part, the stone was selected for its working properties: generally its hardness; colour and its reaction to tools. Many sedimentary rocks such as limestone and most varieties of sandstone have horizontal or *bedding lines* running through them (similar to the grain in wood). At the quarry face these provided natural lines of breakage along which large blocks of stone could be freed from rock outcrops. The Littleisland quarries at Rock Farm East and Rock Farm West, supplied *freestone*, a good quality stone, which could be cut in any direction and to any size, and *rubblestone* - this latter variety being used for walling; as a road building material and ballast for ships.

Freestone was carefully quarried using the *plug and feather* technique. The feathers were two half-round iron bars which were inserted into a crevice in the rock face and a wedge (the *plug*) driven between them to cleave the rock apart. The stone was then lifted out of the quarry either by sledges pulled by horses, by crane or by tramway, and removed to stockpiles near

Carrigrenan quarry adjacent to the coast with jetty, the quarry mainly supplied ballast for ships.

the stone cutters' working areas. The stonecutters were also known as *banker masons* after the stone benches at which they worked. These banker masons were highly skilled stone workers whose job it was to cut and finish the rough stone to the desired shape, using a series of moulds.

Quarrying of rubble stone on the other hand did not require the same finesse. It was blasted using black gunpowder, and later using gelignite. In order to prevent the rock from being completely shattered the quarrymen would prepare a charge hole with a drill, into which the gunpowder charge and fuse could be inserted. After the charge had been set and ignited, the large lumps of stone were freed from the rock face and were then broken up by the quarrymen into more manageable sizes.

From the eighteenth century onwards, one of the most important factors in the development of Rock Farm quarries, and later at Carrigrenan, was immediate access to the shoreline of Lough Mahon, and thence to Cork Harbour at large and to the quaysides at Cork City. Loading jetties, projecting out into Lough Mahon, were provided for both the Rock Farm and Carrigrenan quarries, which also had an iron tramway for transporting stone for ballast in wheeled, metal trucks to the waterside, completed in 1897. Both the Rock Farm and Carrigrenan quarries operated limekilns producing burnt lime for agricultural fertiliser; the Rock Farm West one has a date stone of 1811. Rock Farm quarries are incorporated into the Little Island Golf Course and provides an interesting background for the players. The Carrigrenan quarries, to the south of Rock farm, appear to have been primarily involved in the supply of ships' ballast to the Cork Harbour Commissioners. The trade in ballast from Carrigrenan had seriously declined by the 1920s, principally because the use of wooden ships with sails, which required ballast to maintain buoyancy when sailing without a cargo, was entering its final phase.

Stone from Littleisland was used in the construction of many of Cork City's quaysides during the 1820s and in County Cork churches such as the Star of Sea at Ballycotton (1880), and in the cut stone dressings of the Catholic Church at Glounthaune.

Did you know? A recently discovered document indicates there was quarrying activity on Littleisland in the seventeenth century. It records a 'marble' quarry on Littleisland in the possession of John Matthews who sold it to Roger Boyle in 1610. In November 1617 Boyle *'Paid Der Water of the lyttle Iland for bringing 25 tonne of Ranse stoan [Cork red marble] for her Majesty from the quarry to the sea syde'*. However, there is no record of its use at Greenwich in Jones' building accounts of 1616-18, or indeed of this red marble ever leaving Cork harbour.[2]

[1] pers. Com. Patrick Twomey, 23/04/19.

[2] Rynne 2018.

Exemplar 4
Castlelyons Limekiln

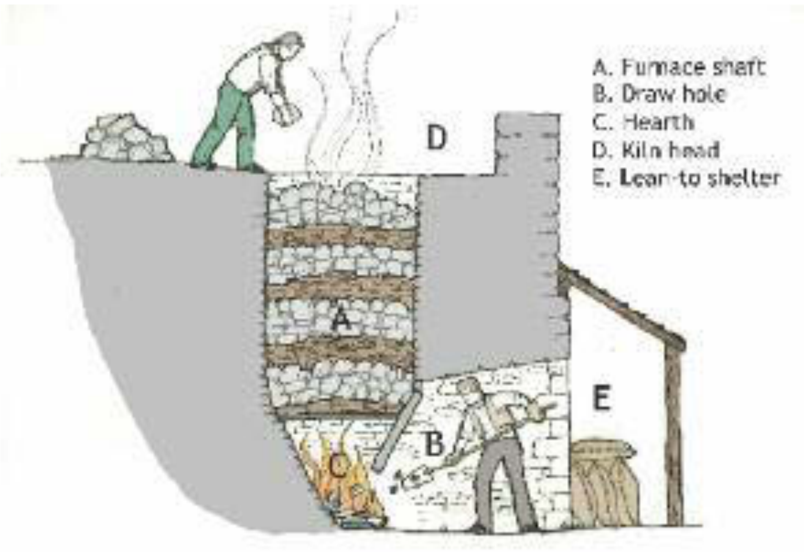
Castlelyons limekiln built into a slope to facilitate charging.

Lime was used for a binder in mortars and plasters since medieval times, however with the encouragement for land improvement in the eighteenth and nineteenth centuries by improving landlords, lime was very much in demand.

Many Irish soils are acidic, and from at least the seventeenth century, lime, which is alkaline, was spread on the land to reduce its Ph and thus its acidity. This helped to create calcium and magnesium which promoted the growth of plants. However, lime, while not a fertiliser, did help to make the use of fertilisers more effective. The use of lime, indeed, in conjunction with nitrogen based fertilisers, could actually increase crop yields by as much as 30%. Cork is well endowed with limestone - the raw material to make lime - and thousands of limekilns were used frequently in or beside small quarries. The number of limekilns that are shown on the 6" OS map of 1842 exemplifies the quantities that existed, mainly in rural areas of the county (apart from West Cork). Many survive, like this example, which is now a valued heritage feature in Castlelyons.

The limekiln was built between the two settlements of Castlelyons and Bridebridge. It is one of three original limekilns in the same area, one half a kilometer to the east and a pair of kilns at Bridebridge. Their existence within close proximity to each other provides a good indication of the importance of tillage agriculture in the general area during the nineteenth century. Its location also tells us that access to local roads was an important factor in the choice of this site for limeburning, in addition to the opportunity to exploit a limestone outcrop.

The kiln is built with limestone rubblestone, and built up against a steep slope of the quarry. This allowed its upper section to be easily accessible, which facilitated the filling or charging of the kiln by wheelbarrow with both fuel and limestone. Where such an easy incline was not available it was common to build a ramp of earth up against the rear of the kiln for charging the kiln. A low parapet was built along all of the upper edges of the kiln to prevent those



Cross-section of the limekiln in operation, the man on top is at the kiln head charging the kiln shaft or bowl with limestone and fuel, the man below is in the draw hole (B) adding fuel to the fire. Drawing by Rhoda Cronin, provided courtesy of Castlelyons Tidy Towns committee.

tending it from falling off the edge, either at nighttime or when blinded by dense, choking smoke rising from the kiln bowl.

The Castlelyons kiln is a *continuous draw* kiln, where a mixture of fuel and limestone was continuously fed into and burnt in the kiln bowl. They generally used locally available fuel, here it was likely to have been wood. The central body of the kiln has a stone-lined *pot*, in which the layers of fuel and limestone were burnt, the sides of the pot profile section being roughly egg-shaped to prevent the charge from settling or sticking to the sides. The recess in front is called the *draw hole* or *kiln eye* and for the vast majority it was either arched or lintelled. It was usually high enough to accommodate at least two men standing up to remove the burnt lime, now called quicklime, through a small opening at the base of the bowel. Above this opening was also a poke hole where the kiln workers could insert a stick into the bowel to assist in the burning process by dislodging ash. A ledge above the recess arch indicates the position of a lean-to structure built to protect the freshly burnt lime raked out at the base from the rain. This was a common feature of limekilns as the burnt lime emerged from the kiln as solid stone but when mixed with water turned into slacked lime (calcium hydroxide) – a soft putty like substance. Both slaked lime and quick lime was used as agricultural lime; slaked lime was also used as lime putty for building and today is still used for repairing and conserving old buildings.

As with the vast majority of lime kilns in rural areas, this Castlelyons kiln would have been used *intermittently*, when the firing campaign was usually tied into the agricultural cycle. During this time the lime burners added more fuel and stone over a period of at least 48 hours, during which temperatures of between 900-1,200°C were reached within the kiln.

The Castlelyons kiln was restored by the Castlelyons/Bridebridge Tidy Towns and Heritage Group in 2008, and has an excellent interpretive panel, explaining how the kiln operated.

In the absence of limestone, only a handful of limekilns were built in West Cork. They were confined to the coast where limestone could be delivered. They were slightly different in design to the others with two narrow lintelled recesses and a larger bowel. A good example occurs in Rineen woods, near Skibbereen.

Limekiln as viewed from the south.

Did you know? Fota wildlife park uses their limekiln as the viewing platform in the tiger section.

Exemplar 5

Youghal Brick Company Works

Aerial view of the Youghal Brickwork Company's works at Muckridge near Youghal.

Youghal was an important seaport, that together with an abundance of pottery clay, made it an obvious base for pottery production in the eighteenth and early nineteenth centuries. Brickmaking on the estuary of River Tourig as it enters Youghal Harbour was well established in the late eighteenth century, where the bricks were made by hand in wooden moulds and fired in clamp kilns - the traditional method where unbaked clay was stacked with fuel under and amongst it and set alight. A more sophisticated kiln was invented by Fredrich Hoffman in 1859 where drying and firing of the brick was one continuous process and produced large volumes of good quality facing brick suitable for most building purposes, while also consuming much less fuel.

The Youghal Brick Company, founded in 1895, began work with a 12-chamber Hoffman kiln, built by Vaughan of Belfast, which operated between 1895 and 1912. The Hoffman kiln could dry and fire as many as 20,000 bricks at a time. However, it had one main disadvantage: it required a very tall chimney or stack to create a draught, which was very much affected by weather conditions. If the air pressure dropped, then this limited the extent of the draught and upset the firing process.

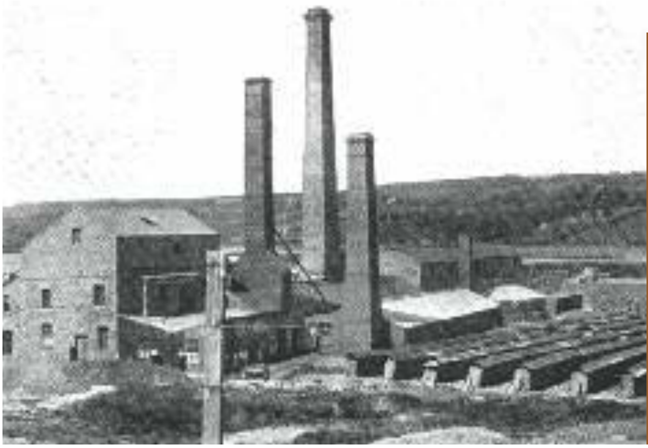
Hoffman kiln of 1895 and stack, at the Youghal Brickwork Company's works at Muckridge near Youghal.

Clay for the works was dug by hand in clay pits immediately south of the kilns, and loaded into steel clay wagons, which were set on narrow rail tracks. A mechanical chain belt pulled these along the tracks and up a 45° incline into the mill house, where the clay was macerated in a pug mill and ground into a fine consistency. A Roby's of Lincoln horizontal steam engine provided all of the motive power for these processes. Before 1912, the clay was formed into bricks in a machine press, in which it was mechanically pressed into moulds to create bricks with straight sides. Machine pressed bricks also had a distinctive indentation or *frog* on the lower face, which provided a key or grip for mortar applied to it and the name of the company was often applied.

After 1912 Youghal bricks were wire cut, where the clay is extruded (i.e. squeezed) through a die or mould to form a column, which is then cut with wires to form the appropriately sized brick to a very high standard. This process is still commonly used today. In 1913 the company installed a state-of -the-art Bührer brick kiln, which

Drying chambers, Youghal Brickwork Company's Hoffmann kiln.

Interior drying chamber in the Hoffmann kiln.



Youghal Brickwork Company's works at Muckridge near Youghal, c. 1920. The complex had grown considerably, the Hoffman chimney is the tallest with the two in the foreground belonging to the Bührer kiln and a steam engine.

facilitated greater control over the firing process, and produced better quality brick with an over 50% reduction in fuel costs.

Although the Youghal brickworks was situated near the only bridging over the River Blackwater in the Youghal area, it was, to a certain extent, disadvantaged with the arrival of the Cork and Youghal Railway in 1861, whose terminus was sited some three miles away. This necessitated the use of 30 Clydesdale horses to draw brick to the town of Youghal and its immediate environs. Water transport, via the River Tourig to Youghal Harbour thus became very important. Lighters, small boats with a shallow draught, which enable one to negotiate shallow water, were commonly used to transport up to 14,000 bricks at a time to the Youghal quaysides, from which the brick could be more widely distributed by sea. The Youghal Brick Company (now the Youghal and Monard Brick Company) also acquired one of the first steam wagons in Ireland, in 1912. This was in effect a steam-powered truck, which required both a driver and stoker to shovel coal into the steam boiler. This speeded up road transport to Youghal and even facilitated daily road trips to towns such as Fermoy.

The company's closure, in 1929, was brought on by a number of factors, including rising fuel costs and the increasing popularity and cheapness of concrete blocks. Youghal facing brick was used in the North Monastery Schools in Cork (1903), the Munster and Leinster Bank, Youghal (1915), the Cottage Hospital, Youghal and in many of the buildings at the eastern end of Hanover Street in Cork City.[1]

Youghal and Monard Brick.

Did you know? There was a British government brickyard at Muckridge to the east of Youghal which operated between 1809 and 1815 and supplied the brick used in the vaults of the five Martello towers in Cork Harbour.

[1] T. Breslin, 2002, *The claymen of Youghal*. Midleton.

Exemplar 6

Castleview Mills

Castleview Mills with its double pile gable end weather slated; door into residential section on the left.

The Castleview Mills complex, near Clonakilty, is a five-storey, weather-slated flour mill, originally constructed in the late eighteen and early nineteenth centuries, which was in almost continuous operation until 1995. Thereafter, it was operated on a seasonal basis by Gerry O'Leary, father of the current owner Joe O'Leary. Originally an overshot waterwheel drove three sets of millstones and ancillary plant, but in 1918, Mr O'Leary's grandfather replaced the waterwheel with an extraordinary American water turbine. The turbine, which has just been repaired, also drove an electricity generating plant, along with a water pump and a woodworking lathe. All of the latter survive *in situ*. On the east side of the mill courtyard there is a number of small single-storey workers' cottages, and to the west is the original two storey grain store, which had three large arched openings to facilitate the loading of grain carts. This has recently been converted to a dwelling by the current owner. Unusually, a substantial three-storey house for the miller and his family was also originally built into the main mill building, with a front door at ground level facing the yard. This house also had a kitchen basement, which intercommunicates with the mills and was lived in by the last miller up to 1995. The individual floors of the mill are constructed with timber and are supported on stout wooden stanchions.

The milling process at Castleview is similar to that carried out in Flour Mills throughout the county. Grain brought to the mill by cart was stored either in the upper two floors of the mill building or in the large grain store in the courtyard. It would first be brought to the kiln to be dried – an essential procedure before milling. However, the location of the grain drying kiln at Castleview on the second floor level is rather unusual and appears to be unique in either Ireland or the UK. Usually the grain drying kiln is in a building attached to or near the mill, with the furnace on the ground floor level to facilitate the stoking of the furnace, which provided the hot air for drying the grain, spread out on the ceramic floor overhead. Fragments of these perforated ceramic tiles are often all that survives of the kiln. After drying, the grain was ready to be ground. Castleview has a pair of conglomerate millstones and two pairs of French Burr stones. Each pair has an upper millstone known as the *runner* which rotated; the lower one was fixed and called the *bedstone*. A pattern of grooves, called furrows, was cut in the opposing surfaces of the stone to guide the ground flour to the periphery. The grinding takes place on the flat surfaces between the furrows. These surfaces had to be re-cut or dressed about every two to three weeks of constant use by a skilled stone dresser, or often by the miller himself. The millstones were housed inside a wooden box called a *tun*, which had a chute directing the flour into a waiting sack on the floor below.

The American water turbine at Castleview Mills, installed originally in 1918 and still working.

General view of millstone floor at Castleview Mills. The set of stones in the foreground are the sandstone shelling stones. The two sets at the rear are the French burr stones. The one on the right has its wooden box with a hopper set on top delivering the grain into the millstone. The runner stone on the left pair has been lifted by a crane and the stones are ready to be dressed.

Mechanically activated sieve on ground floor, set in motion by a fanbelt. Note wooden chute extending from base of set of millstones above to direct flour into sieving device.

The siege of Hurley's mill as depicted in the *United Irishman*, of 3rd October 1886.

The dried grain was first fed into a hopper suspended over the conglomerate pair. These stones are often called shelling stones, or 'Irish' or 'common' stones in the nineteenth century sources. These millstones removed the outer shell of the cereal grains, and the waste material was then blown off by a mechanically activated fan called a winnowing machine. The clean grain was then fed into the hoppers of one of two other sets of Castleview's millstones for grinding into flour. These sets of millstones were French burr stones which came from France. They were made up from several pieces bound together in iron hoops. They did not overheat or fragment when the grain was passed through them or wear down evenly. The flour emerging from the periphery of the millstones fell automatically to the basement via wooden chutes, and into the sieving devices. It was then bagged and ready for dispatch from the mill. If finer flour was required it was sent back up and run through the third set of millstones, whose stones were set closer together giving a finer flour.

The ground floor of the mill houses all of the belt pulley wheels and fan belts driving the millstones and a series of other devices, including an early twentieth century roller mill and mechanically activated wooden sieving devices for dressing the flour and meal. The water turbine drove the three sets of millstones along with the other milling plant. The other devices powered by it, electrical generating set, a lathe and also, in later years, a water pump, are housed in an adjacent workshop. The Castleview mill today is well preserved.

Did you know? Castleview Mills also features prominently in the history of the Irish Land War of the 1880s, as the site of a notorious eviction in 1886. Joe O'Leary's ancestor, Tim Hurley, was the tenant of the mills. Tim was unable to come up with half of the mill's annual rent, and his offer of paying the balance of this - some £5 - was brusquely refused by the landlord. After a highly publicized resistance, a small army of bailiffs and RIC constables eventually evicted the Hurley family, who later emigrated to Wales. Local people also took part in resisting the eviction, being summoned by a horn (still in the O'Leary family's possession), standing around the mill to thwart the police and bailiffs. The event became known locally as: The Siege at Castleview Mills / The Siege of Hurley's Mill.[1]

[1] Pers. Com. Diarmuid Kingston, 13/05/19

Exemplar 7

Bealick Mill, Macroom

Bealick Mills, Macroom.

Bealick Mill is located 0.5km outside Macroom, near the juncture of the Laney and Sullane rivers and close to *New Bridge* over the river Laney which facilitated easy access to both Macroom and the road to Cork City. The original Corn Mill was built in 1797, by the Hardy family, who lived nearby in Firville house, and was substantially enlarged and extended into its present form in the mid nineteenth century.

The original mill had an L-shaped plan and by 1848 it was operated by Edward Hardy and had three pairs of millstones of 4ft 6in diameter, which suggests it was powered by an overshot waterwheel of modest size. Although it was a modest power source it did appear to have considerable storage space which indicates a large output and that its source of water was reliable. However, in the pre-railway era, it seems likely that most of its custom would have been local, especially from the town of Macroom, despite the fact that there was another flour

mill in the town at Masseytown. The mill race, an impressively engineered feature, was diverted via a weir from the River Laney, about a kilometer to the east of the mills. The bed of the millrace channel carefully follows almost the same level along its course, either cutting into rock or being carried on low embankments to maintain a gradual fall towards the waterwheel along the east end of the mill. The mill race also powered a Tuck mill 400m to the east, which no longer survives.

The installation of the suspension waterwheel that survives today tells us that the internal arrangements of the mill were substantially modified sometime before 1860. The mill was probably enlarged into its present form at this time. The suspension waterwheel is one of the best-preserved suspension waterwheels in the county. It was cast by McSwiney's Foundry at Kings Street (now McCurtain Street), Cork, which was situated where the Imperial Hotel now stands. Paul McSwiney's foundry was taken over by his nephews, H. and C. Smith in 1860, and thereafter the McSwiney stamp on castings was no longer used, so the waterwheel must date to sometime before that, possibly the mid-1850s. The wheel was also equipped with a flyball governor - a device that regulated the speed at which its axle could rotate. This device survives in situ and is one of only a handful of waterwheel axle examples known to be still in existence

McSwiney's of Cork foundry stamp on the Bealick suspension waterwheel. This indicates that it must have been installed before 1860.

Watercourse immediately north of the waterwheel. Image courtesy of Eoghan Nelligan.

Bealick Mill in 1983 from the Cork Archaeological Survey archive.

Bull nut engaging with segment gearing attached to the rim of the Suspension waterwheel at Bealick Mill.

in Ireland. A waterwheel like this could generate up to 40hp, so there seems to have been a clear intention to upgrade the mill's plant. One pair of 4ft 6in millstones requires at least 5hp, so the mill would now have had the capacity to run at six pairs, along with other machinery for dressing flour. Around this period a new bypass channel was added, to direct water away from the waterwheel either when it was not working to prevent a backup of water, or as a defence against flooding over the winter months.

The layout of the mill suggests that the millstones were housed on the first floor, with the basement section being used to bag the ground products of the mill. The third floor would then have accommodated the flour screening and winnowing machines, with the upper two stories being used to store grain. The west elevation has a series of loading doors with original sack hoists. The original mill had a grain drying kiln in 1848 but there are no indications as to where this might have been located.

The Hardy family became promoters and directors of the Cork and Macroom Direct Railway Company in 1861, and the line itself opened in 1866. This opened new markets for their products, which could now be distributed along the new line as far as Cork City itself. In 1899, Macroom Town Commissioners and the Macroom and District Lighting Syndicate acquired rights to use the mill to generate hydro-electricity, using a water turbine, with which to power street lighting in the town of Macroom. The generating station at Bealick Mills continued to operate up and until the ESB network was brought to Macroom in 1933. In 1936 the new owner of Firville, Francis St. Aubyn, used the mill to generate electricity for the newly established Macroom Engineering Works. The products of this venture - everything from manhole covers to toilet cisterns - can still be seen all over the county, and the works remained in production up to 1964.

Bealick Mills was restored by the local community in 1993, and it is now a heritage and community centre, which is open to the public.

Did you know? Macroom became one of the first towns in Ireland to have electric street lighting in either Ireland or Britain.

Exemplar 8
Schull Corn Mill

Aerial view of the Schull mill, showing location of the two mills in foreground adjacent to the post-1850 bridge. The road diverging off behind (to the lower right-hand corner of the picture) is a former butter road.

The small, picturesque, vernacular, mid nineteenth century Corn Mill near the town of Schull is an example of a small rural corn mill that occurred throughout the County serving local communities. Its use was probably intermittent; operating on demand to serve local needs, grinding flour for both human and animal consumption. A second mill used for carding stood adjacent (now a dwelling), which provided additional service to the local community.

The construction date of both of these buildings is likely to have been after 1851, a time when the surrounding countryside was experiencing death, destitution and widespread depopulation. In other words, this mill and its adjacent wool carding mill, were built during a time when one would least expect them to thrive. Yet they appear to have done so, against the odds, even in an area with poor soils, generally unsuited to the cultivation of grain crops.

The mill is located where its feeder stream enters Schull Harbour, a site at which the stream had to be forded as late as the 1850s. Indeed, the construction of a bridge at this point may well have been a powerful incentive to establish the mill here. There is also a section of the 'butter road' which also has the remains of a packhorse bridge a few hundred metres to the north of the mill. Immediate proximity to an established cross-country route is also likely to have influenced the choice of mill site.

In relative terms, the mill building is a small structure, which could only accommodate one pair of millstones. It is rectilinear in plan and built into a rock face to create the requisite fall for its small diameter wooden, compass arm, breastshot waterwheel, in which the use of iron was kept to minimum. The single storey building immediately behind it, may originally have housed a small grain drying kiln. The mill gearing and the bagging section of the mill survive

General view of the mill, showing the waterwheel, millhouse and miller's dwelling.

The mill basement with its gearing system. The cast iron bevelled pit wheel (which had wooden cogs), engaged the wallower which rotated the millstones overhead. The wooden chute directed the meal from the millstones into the meal bag.

The millstone floor, showing the single set of millstones and the simple collar beam rood truss.

in the basement. This includes the cast-iron bevelled pit wheel, which transmitted the motion of the watewheel's axle to the upper millstone, along with a flywheel, which appears to have activated a sieving device. As there was only one set of millstones, both shelling and grinding, were performed in two separate operations with the same stones. In this arrangement the upper rotating millstone is of French burr, while the lower, stationary millstone is of conglomerate sandstone. However, as this mill would have been grinding mostly oatmeal, the quality of the stones would not really have mattered. Yet, it is also a much slower operation than in mills with two or more sets of millstones. This clearly indicates, small, local intermittent operation of the mill, perhaps during harvest time. Likewise, the carding mill directly across from the mill seems likely to operated seasonally. The rationale behind their location may well have been, therefore, to ensure that the miller would have been occupied for as much as possible over the year. The miller's house is a two-storey dwelling, which adjoins the mill building at the west.

In isolated parts of rural Ireland, small mills such as this, with one or two sets of stones, could remain viable into the twentieth century because they were perfectly attuned to local needs and irregular cropping patterns. Its patrons, who might arrive with a couple of bags of grain at harvest time, were mostly unconcerned about the amount of time involved. They would have also enjoyed a chat with the miller and would catch up with local news. The Schull mill has now been sensitively converted into a private dwelling by its current owner.

Did you know? To reduce the noise and friction and to facilitate repair, the cogs of some of the gearing were made of hardwood pegs, carefully shaped and securely mortised into slots in the wheel.

Exemplar 9

The Bridge Mills, Castletownroche

General view of the Bridge Mills Castletownroche, showing general arrangement of mill buildings and watercourses.

The Bridge Mills began as a flour mill in the second half of the eighteenth century, and was extended sometime in the 1820s by Robert Webb, whose family owned the mill for the greater part of the nineteenth century. It is situated on a bridging point of the River Awbeg in Castletownroche, between Mallow and Fermoy.

The original mill building was five storeys high, and its width, as recorded in the Valuation Office House Books in 1847, was 24ft (c. 7.3m). In all likelihood, it originally supplied a local market for flour and meal in the locality. The mill burnt down in 1828, whereupon its millrace was widened and the main building was extended to the west. The quoin or corner stones of the original building are clearly visible, with the new extension abutting it. In this new configuration, the millwheel was now positioned centrally, with the building itself effectively straddling the new millrace.

According to the Valuation survey conducted in 1847, the waterwheel was undershot; 10ft (3.048m) in diameter and 10ft wide, with 26 floats or paddles. The waterwheel emplacement is marked by a cut stone arch, with the remains of an inclined sluice, which directed incoming water on to the floats of the waterwheel at the upstream end. A rough inscription on the western wall of the wheel pit declares that the present arrangement was installed in 1912 by

J & R Webb. The curved lower profile of the wheel race, dates to the late 1820s, with the inclined sluice and surviving segments of the waterwheel indicating that a Poncelet type waterwheel was employed at this site from at least 1828 onwards. On present evidence, this is the oldest example of its type to have come to light in Ireland, which makes it a feature of some importance.

The ground floor of the main building is divided into two by the wheel pit. In the original arrangement the movement of the waterwheel was transferred vertically upwards through the various floors, by means of bevelled gearwheels, and horizontally along each working floor by line shafting driving belts. The original arrangement of the mill no longer survives. The undershot waterwheel is likely to have operated no more than three sets of millstones on the first floor. The upper floors were used for storing and cleaning the grain. A tall early twentieth century grain drying kiln stood on the north side and was removed when the mill was converted into offices in 2002. These offices are now used by the Avondhu Blackwater Partnership Ltd.

General view of 1820s millrace at the Bridge Mills Castletownroche, leading to arched waterwheel emplacement.

The multi-storey layout of the present mill was designed to both accommodate the bulk storage of grain; flour and meal and a wide range of grain processing machinery. Such mills belong to the merchant milling tradition, which had become well-established in Ireland before 1815. The layout of the present mill is largely typical of other multi-storey

Mill was in use in 1984 when the Cork Archaeological Survey visited it.

mills in the county of similar date. A number of ancillary buildings are extant, forming a courtyard around the main mill buildings, and include a grain drying kiln, nineteenth century in date; an office, a store and a weighbridge. The weighbridge consists of a large cast iron plate onto which a cart was drawn. The weight of the cart pressed the plate downwards and this activated a balance scales (located in a small concrete structure built at the western end of the office building), which indicated the weight of the load.

In 1887[1] the 'old fashioned millstones' were replaced by a modern roller plant and extended the life of the mill, which continued to grind corn into the late twentieth century. It was taken over by Paddy Farrell in the 1940s and continued to function until its closure in 1990. It was subsequently bought by the Castletownroche Community Council in 1997 and restored, bringing new life back into the building.

Did you know? The mill inspired the famous Dublin song writer and showman Thomas P Keenan, who was a regular visitor to Castletownroche, to write his famous song "The Old Rustic Bridge by the Mill"

[1] Grove White 1905-25, vol2, 142

Exemplar 10
Killeagh Mills

Aerial view of Killeagh Mills, showing its location relative to the village of Killeagh and the Cork-Youghal road.

The surviving remains of the mill in Killeagh, near a bridge over the Dissour River, are iconic of the plight of near derelict, multi-storey industrial buildings of the industrial revolution.

The Killeagh Mills are a late eighteenth - early nineteenth - century complex of buildings, which are described in contemporary sources as a *bolting mill*, i.e. a mill in which mechanized flour sifting machinery had been installed. Its millrace was fed by the Glenbower Lake immediately to the north, which had a substantial fall towards the waterwheel. It is five storeys high and although it survives as a roofless shell, its internal arrangements would have been similar to other mills of similar size. The upper two storeys provided storage for grain; the middle storey for housing flour sifting machinery, and the first floor accommodated the millstones. There are a series of cast iron tie plates in a line on the exterior of the building, parallel to each of the upper floors. Tie plates were used to secure steel tensioning rods in industrial buildings,

which extended across the building at right angles to the main walls. This was to prevent excessive weight, in this instance the grain lying on the floors of the building from causing the main walls from buckling outwards. The plates were added in the second half of the nineteenth century.

The main building is not very wide, which would seem to suggest an eighteenth or early nineteenth century date for construction. However, all of the windows have brick segmental arches - more typical of early nineteenth-century industrial buildings. Extra space was provided with the construction of annexes and lean-to buildings to the north and west of it. The mills would also have substantially benefited with the arrival of the Cork-Youghal railway in the 1860s.

View of Killeagh Mills, from courtyard, showing current use as car park.

Killeagh Mills, west gable of main buildings. Note the use of tie plates to prevent external wall of building from buckling outwards under the weight of grain formerly stored on upper floors.

The mill at Killeagh represents one the key conservation challenges facing all such sites, which do not retain their original floors or roofs. Exposed to the elements in this way, deterioration will likely continue unless a modern, alternative use can be found for the building, despite the fact that it is a protected structure and a Recorded Archaeological Monument. Many Industrial archaeological sites recorded by the Cork Archaeological Survey during the 1980s, have experienced significant deterioration over the last thirty years.

Did you know? The mill was in use as a grain store until it was burned in 1971. You can now walk along the mill race, which is part of the beautiful public walks in Glenbower woods.

Exemplar 11

Midleton Distillery

Aerial view of Midleton Distillery showing main buildings. The malt mill and mash house complex is situated within Marcus Lynch's woollen mill of 1793.

It is believed that whiskey was introduced to Ireland by medieval monks and used for medicinal purposes. The name 'whiskey' is derived from the Irish *uisce beatha*, meaning water of life. It was not until the end of the eighteenth century that it became a popular beverage and the number of distilleries began to grow, mainly in towns, to satisfy this new demand.

Midleton Distillery was established by James Murphy in 1825, incorporating Marcus Lynch's former woollen mill of 1793 at a cost of £30,000; an enormous outlay at the time. By any standard its subsequent growth was spectacular. In 1826 it was responsible for just less than 4% of the combined production of whiskey in Cork (city and county), but by 1834 this figure had risen to 16%. Upwards of 400,000 gallons of whiskey were produced here in 1850, by which time it had become the largest distillery in the county, employing 180 workers. In 1887 its output was 1 million gallons.[1] Murphy went on to create the Cork Distillers Company (CDC) in 1867, under which Midleton and four city distilleries were amalgamated. CDC was to merge with the Dublin based John Jameson and Son and John Powers and Son in 1966 to form Irish Distillers Ltd.

Traditionally, whiskey in Ireland has been distilled from malted barley mixed with a certain amount of raw barley and other cereals such as oats and later, maize. In its essentials, whiskey distillation involves brewing beer and then distilling a spirit from it - the basic brewing processes being common to both industries. Whiskey distillation essentially involves the separation of alcohol from fermented wort, or *wash* as it is called by the distiller. Wort was made by immersing malted grain ground between millstones (*grist*) and warm water in a *mash tun*. The mash tun was equipped with rotating arms, which assisted the infusion of the grist and water. The suspension of the grist in the mash tun facilitated the release of the enzyme *diastase*, which had been cultivated in the malting process, thereby transforming the starch in the malt into maltose. After mashing, the process common to both brewing and distilling was completed, the residues from the bruised malt, now termed *spent grains*, were collected in the false bottom or screen near the bottom of the mash tun, that aided the separation of the sweet wort from the mash. The spent grains - an important by-product of ale breweries and whiskey distilleries - were generally sold as cattle feed.

Main pot still at Midleton Distillery, installed in 1826 with a capacity of 31,648 gallons. This is reputedly the world's largest pot still.

As alcohol has a lower boiling point than water it is given off first and in the large heated container called a *still*, the wash is converted into a vapour which is subsequently condensed into a liquid and collected in a vessel called a *receiver*. In Ireland two basic varieties of still were used in whiskey distilleries; the *pot still* (by far the most common) and the *patent* or *continuous still*, which was predominantly used in Ulster. Both types were in use in Midleton Distillery by the middle of the nineteenth century, although it is better known for its pot still brands. The pot still is a flat-bottomed copper vessel, from the head of which extends a spiral copper tub called the *worm*. The greater extent of the worm is coiled around the inside of an adjacent wooden vessel filled with water, known as the *worm tub*, which acted as a condenser. The spirit collected at this stage was by no means pure, and it was necessary to refine it in a series of three successive re-distillations. The first of these was called the *low wines*, which passed on to the *low wine receiver* and from thence to the *low wines still*, where it was re-distilled. The resulting distillate was then passed on to the *feints receivers*, and the purest of the feints was then conveyed to a third still from which it emerged as whiskey. The whiskey was ready for casking and set down to be matured.

Inside late nineteenth century *mash tun* at Kilbeggan Distillery, county Westmeath, showing rotating arms and the copper plates at the base, designed to retain heat.

Interior of malt kiln at Midleton Distillery. The furnace was in the centre of the ground floor and the grain was laid on the brick tiled first floor. The weight of the grain and the tiled floor was substantial and needed the support of cast iron stanchions. The tiles had several perforations, allowing heat from the kiln to pass through and thus dry the grain.

Low wines and feints stills, at Midleton Distillery, installed in 1949.

The surviving range of buildings dates from the 1820s onwards and includes three malting kilns, and is dominated by a six-storey grain store of c. 1830. In this store, 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, is now open 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. The existing 22ft diameter waterwheel is by William Fairbairn of Manchester and was installed in 1852 an 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 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.

The building housing the 1826 pot still at Midleton Distillery.

The old distillery is now a popular tourist destination. *Jameson Experience*, *Midleton*, opened in 1992 when the Distillery moved to a new modern complex immediately to the north.

Did you know? The Midleton distillery has the largest pot still in the world with a capacity of 31,648 gallons, installed in 1826, which required 4.06 tonnes of coal every twenty-four hours.

[1] A. Bielenberg, 1991, *Cork's industrial revolution 1780-1880. Development or decline?* Cork, 64ff.

Exemplar 12

Deasy's Brewery, Clonakilty

Barley store at Deasy's Brewery, Clonakilty.

During the eighteenth century and nineteenth century there was rapid expansion of the brewing industry which tended to be urban based with a ready market of consumers. The existence of a successful brewery in an Irish county town was indicative of two things: an ample supply of barley and clean water, and a good-sized population. Deasy's Brewery, established on a bend in the Fealge River at the south-western end of Clonakilty in 1807, by Richard Deasy, fits well into this characterisation.

The Deasy family had originally brewed on a site at Astna Street from as early as 1786. As late as the 1840s the brewery appears to have derived all its motive power from horse wheels; the use of either water or steam power was not recorded by a valuation surveyor. The brewery buildings are built around a courtyard to facilitate a spacious working yard in the confines of the town and easy access to the buildings. Good examples of this arrangement include many Cork city breweries, such as Drinan's (c. 1760) and Cowperthwaite's (c. 1780), and the River Lee Brewery, built in the closing years of the 1790s. The Watergate Brewery (1843) in Bandon, is a later example of this courtyard arrangement.

The south range of buildings appears to include a maltings with possibly two malting kilns. The northern range of buildings were a long, continuous structure, used a barley store. The L-shaped, eastern range, was probably a malt store, while the slightly taller building at the north west corner of the complex, which originally had four, tall brick chimneys, (two have been temporally dismantled), was the brew house. One of the northern chimneys has a datestone plaque, which tells us that it was built by McCarthy of Bantry in 1837, providing a likely date of construction for the brew house.

The brewing process at the start is similar to whiskey, where, in the malting process, the grain is partially germinated, converting the starch in the grain to sugar. The malt manufactured on site was first lightly screened in rotating mesh drums and then bruised between millstones to form grist. The bruised malt or *grist* was then immersed in water in a *masher* - a vessel with internally mounted revolving arms, which mixed the grist and water in a cylinder outside the mash tun. In the next process, a false-bottomed vessel called a *mash tun*, was filled with the contents of the masher, and a series of revolving arms within the mash tun assisted the infusion of the grist and water. The suspension of the grist in the mash tun facilitated the release of the enzyme *diastase*, which had been cultivated in the malting process, thereby transforming the starch in the malt into maltose. After mashing - a process common to both brewing and distilling - had been completed, the residue from the bruised malt, now termed *spent grains*, were collected on the false bottom of

Brewhouse chimney with date of 1837, Deasy's Brewery, Clonakilty.

the mash tun. Up to the middle of the nineteenth century many breweries produced *small* or *table beer* by mashing the grist for a second time, to manufacture a cheaper but much weaker beer which was consumed by poorer people.

The liquid drawn off from the mash tun was a sweet liquid called *worts*, which at this stage in the process would have a light head. After mashing, the worts were conveyed to a large, domed copper vessel called a *copper*, in which the liquor was boiled for a couple of hours with dried hops and sugar. Sugar added to the colour, flavour and body of the beer while the boiling of the hops imparted the characteristic bitterness to the porter or beer. When this had been completed, the worts were then conveyed into a vessel called a *hop back* - a false-bottomed receptacle which collected the spent hops and allowed the now clear liquor to pass into the coolers. It was important to cool the wort quickly in order that fermentation could begin, and until mechanical means of refrigeration became available, the summer months still presented problems for breweries.

After the worts were allowed to cool they were then conveyed to a fermenting vat, where excise officers measured its specific gravity (quantity) in order to calculate the amount of duty owed by the brewery. Fermentation was then induced by the addition of yeast which converted maltose into alcohol and produced carbon dioxide. The brewer would also check the specific gravity of the liquor (the level of which fell as the wort was converted into alcohol) to determine the progress of the fermentation, which could take up to eight days depending on the type of beer involved.

Deasy's Brewery produced a number of beers. The most famous was a porter, a dark, top-fermented beer made with roasted malt, called *Clonakilty Wrastler* and in the early 20th century it produced the very popular *Amber Ale*. Deasys and Co. won a bronze medal for its stout at the Chicago World Fair in 1893, which can be seen in the West Cork Regional Museum in Clonakilty.[1]

Did you know? Deasy's Brewery controlled a large number of tied houses in west Cork, during the second half of the nineteenth century.[2] Tied houses were licensed public houses which were owned by a brewery, but which only sold the brewery's products. Deasy's continued brewing up to 1940, but survived as a soft drinks manufacturer and drinks distributor up to quite recently.

[1] Tuipéar, T (1988) Historical walk of Clonakilty and its sea front. Clonakilty: Cumman Seanchais Chloich na Coilte

[2] Ó Drisceoil and Ó Drisceoil 2015, 150); personal communication, Dr. Caen Harris.

Exemplar 13
Dromtarriffe Creamery

Dromtariffe Creamery. Image courtesy of Carol Stack.

Dromtarriffe Creamery was established in 1915 midway between Dromagh and Cloonbannin Cross, on the main road from Mallow to Killarney. In rural Ireland the co-operative movement in the late nineteenth century began the modern industrialisation of butter making and transformed Irish agriculture. It involved pooling of small capitals to create new enterprises, which were democratically owned and controlled by the shareholders-farmers - quite different to what went before. The Co-operative movement is best exemplified by the development in the late 1800s and early 1900s of cooperative creameries, replacing the time honoured home craft of butter making, now having a more central local location. Here the milk could be delivered by the farmer and mechanically turned into butter and other dairy produce. Originally, they would have served the needs of the local parish, an ambit of influence initially created by the limitations of horse-drawn transport. But even when motorised transport became more widely available in rural Ireland in the 1960s, most dairy farmers continued to deliver their milk to the local creamery.

The surviving single-storey buildings at Dromtariffe were designed, with few frills, to facilitate the butter making process, which involved milk delivered by the local farmers; the weighing of their milk to establish monthly payment for it, milk separation, and milk churning to make butter. The Creamery faces onto the main road (N72) and has a raised door on its west- gable, which would originally have had a ramp/platform, to facilitate the loading of creamery churns into building.

The floor inside this building was also raised, and on this platform there would have been a large steel pan sunken into the ground, which was attached to a spring balance weighing scales. The farmer or the creamery assistant would pour the milk into the pan and its volume would be recorded in a ledger.

The first process in the making of butter involved the use of a mechanical separator, in which the milk would be spun around in a container at extremely high speeds. This process efficiently separated the butterfat and buttermilk in accordance with their densities. The butter fat was used to make the butter and the buttermilk was traditionally fed to pigs. The power for the original Dromtariffe machinery was probably derived from a small oil engine and, from 1956 onwards, when this locality was connected to the national electricity grid, by unit-driven electric motors.

Large steel weighing pan at Emly Creamery, county Tipperary. The loading door can be seen in the background, which would have had a ramp or stepped platform to facilitate the lifting of the heavy milk churns from carts.

Dromtariffe Creamery showing the west elevation with raised door where milk was delivered into the creamery. Image courtesy of Carol Stack.

Mechanized churn powered by oil engine, at Emly Creamery, County Tipperary.

Queues were a regular occurrence outside of creameries such as here in near-by Lombardstown in the mid 1950s. Image courtesy of Donie O Sullivan.

At least one mechanised churn, resembling a large barrel laid horizontally and rotated by a driveshaft, would have been in use at Dromtariffe to make the butter. Upon completion of the churning process, the resultant butter grains were placed on a rotary butter worker, which worked the grains into a regular consistency. Finally, the butter was either packed in distinctive wooden boxes or in brightly coloured paper wrappers.

The Dromtariffe creamery, like most others of its size and type, was quick to take advantage of the large daily footfall of farmers, by diversifying into the sale of machinery and manures. According to a newspaper advertisement of 1957, the creamery sold butter both in one-pound rolls (wrappers) and in boxes, as well as its own pasteurized milk. It also sold agricultural machinery, eggs and live poultry. Further buildings were regularly added to provide both storage and retail space for this side of the business. Indeed, many co-operatives, after the end of the butter making era, continued to function as retailing businesses. Creameries were also important social centres where the news for the parish was discussed and disseminated.

With the advent of bulk collection tankers in the 1980s, which could collect milk directly from the farmer, the milk collecting rural creamery lost out to the larger creameries, leading eventually to the widespread closure of creameries. The Dromtariffe Creamery, like many others, could not keep up with these changes, nor were its retail operations sufficiently developed to compete with those of larger creameries.

Did you know? The nearby creamery at Lombardstown was founded on 20th September 1890 at a meeting which was attended by Sir Horace Plunkett who founded the Irish Cooperative movement in 1889.[1] The creamery was the first in County Cork and beaten by Dromcollogher, in County Limerick, by just over one week, to be the first co-operative creamery in Ireland. It was very proactive in developing a programme for prospective creamery managers in the late 1890s, and opened a shop in 1895. In later years Lombardstown was the oldest co-op creamery in Ireland until it closed on the 31st of December, 1966.

[1] Pers. Com. Donie O'Sullivan, 29/04/19

Exemplar 14
Scilly Point, Kinsale

Fish store of c. 1860, at Scilly Point, Kinsale. Up to quite recently the windows on this building were louvred. A cast-iron crane, for unloading boats can be seen on the quayside.

With its extensive coast line the fishing industry was very important in the coastal area of the county and an important part of the economy. Kinsale became one of the most important ports catering for this industry, and a large fishing settlement was already becoming established there on the small promontory, known as Scilly Point, in Kinsale Harbour, early in the eighteenth century.

From the seventeenth century onwards, two principal varieties of fish were caught. These were *demersal*, or bottom-feeding fish such as cod, hake, haddock and the white and flat fishes and *pelagic*, or surface swimming and shoal-forming fish, such as pilchards, herring and mackerel. The advantage of the demersal variety was that this species of fish tended to remain in the same general area, even when spawning, and thus provided a localized resource. Pelagic fish, on the other hand, formed enormous shoals in the same general areas off the Irish coast, at specific times, thus facilitating commercially important catches by Irish and foreign fleets. Vast shoals of pilchards (sardines), for example, had begun to form off the south coast of Ireland as early as the sixteenth century. Pilchards were an important source of oil which was used for lighting and in the tanning of leather. From the seventeenth century onwards, fish *palaces*, in which pilchards were pressed and cured, were created on the south coast and at locations such as Sherkin Island, by colonial entrepreneurs, such as Richard Boyle and Sir William Hull.[1] These continued to operate well into the eighteenth century, and one is recorded in 1761 at Scilly Point. However, the ad hoc nature of the development of the fishing settlement here had begun to create problems early on in the eighteenth century, as there were no proper quaysides for fishing boats until 1735. In addition to fishermen, the fishing industry provided a lot of business for ancillary trades in the Kinsale area, such as coopers, who made barrels for salted fish, along with sail makers, net makers and boat builders.

Pilchards, herring and mackerel were all caught in drift nets; the former being a summer industry on the east coast, the latter a spring activity on the south coast. Drift nets are suspended from floats and 'drift' below the surface to catch herring and mackerel- with those used for mackerel, made from a coarser and bigger mesh. Mackerel arrived off the south coast twice a year, the first season commencing in the spring around 17th March, but ending before the April storms. But whereas the spring mackerel season generally involved larger fishing vessels, fishing for mackerel in the autumn was carried out in rowing boats using seine nets because of the tendency of the shoals to lie in nearer to the shore. Seine netting involved two row boats, which were used to skilfully manipulate a purse-like net around a shoal of fish. On the south coast, seine nets were up to 120 yards long and 30ft deep, manufactured from small mesh cotton, and once the fish were encircled in the net, which could weigh up to one ton when wet, it could be closed shut by pulling a rope. By this means, enormous amounts of fish could be taken at one time, but by September these were replaced by gill (i.e. mesh nets), which could be either drifted or anchored out at dusk.

The three most important surviving structures associated with the nineteenth century fishing at Scilly Point are the two-storey, fish box making factory; a small graving dock, and a fish warehouse/store to the south of this - all located at the tip of the promontory. The box factory was most likely to have been constructed in the 1820s, but the graving dock and fish stores were probably constructed shortly before 1860, on a section of reclaimed land which effectively extended the promontory further out into the harbour. Graving docks were essential for the maintenance of wooden boats, whose hulls required to be periodically 'graved', i.e. cleaned of accretions and re-tarred. The sides of the dock, as at Scilly Point, would normally be formed with cut stone steps, which could be used to wedge wooden props around the vessel once the dock had been drained. At Scilly point such operations could only have been performed when the tide was out.

After capture, the fish had to be processed as quickly as conditions allowed, either by being immediately dispatched in ice to a fresh fish market, or by *curing* in salt. From 1869 onwards, steamers were used to transport mackerel packed in ice (nearly all of which was imported from Norway) to English ports such as Milford Haven, from which they were distributed inland by rail. Curing was generally carried out on tables set on the open quayside by young women, a process in which the fish was split, gutted and thoroughly washed in fresh water. This latter process was essential, as all of the blood had to be completely washed out or the fish would quickly decay. The availability of freshwater, indeed, was an important consideration in the siting of a curing station. Both sides of the fish were then rubbed in salt, after which it was laid in a barrel and covered with a pickle consisting of salt and water. The fish was also sold locally in markets in Kinsale and Cork City.

Two-storey fish box factory of c. 1820 at Scilly Point, Kinsale. In the foreground the graving dock with its stepped stone sides can clearly be seen.

Did you know? In the mid nineteenth century the Irish fishing industry saw a revolution in the trading of fish based on the introduction of steam which provided rapid land and sea travel, refrigeration and powered trawlers to catch fish; underpinned by population growth and the expansion of towns.[2]

[1] D. Power et al. 1992 *Archaeological inventory of county Cork. Vol. 1 West Cork*. (Dublin), p. 314. J. Thuiller, 2017, *Kinsale Harbour a history*. Cork

[2] Connolly, S. J. (Ed.) 1998 *The Oxford companion to Irish History*. Oxford University Press.

Exemplar 15

Inchinagotagh Corn and Tuck mill

The Tuck and Corn mill at Inchinagotagh. The two-storey building in the foreground is the Corn mill; the single storey Tuck mill is in the background. The mill race ran in between.

The small rural corn and tucking mill at Inchinagotagh is some 7km northwest of Skibbereen, and is located immediately behind Dereeny National School. They represent the many small rural Corn and Tuck mills that occurred across the county in the nineteenth century, serving the local community by grinding corn for human/animal feed and tucking wool for clothing.

The Tuck mill predates the first edition of the OS Map in 1842 and the Corn mill was built soon after. The small vernacular corn mill is two-storeys in height, with a loft under a half-hipped roof, however, this no longer survives. The mill probably housed one or two pairs of millstones on the first floor powered by a waterwheel along the northern side. The small single-storey gabled building is the Tuck mill. The mill wheels faced each other and shared the same head race, suggesting the mills operated alternatively to requirements.

In 1849 the Valuation Office surveyed the property and noted that the Tuck and Corn mill site was owned by John Tobin; each mill having 14ft diameter, with low breastshot, waterwheels. It

is likely the corn mill was regularly used and the tuck mill operated intermittently for only a few months of the year.

The term 'Tuck mill' is the one most frequently used for such mills in Ireland and are shown as such on the OS maps unlike in England where the term was dropped in the eighteenth century, in favour of Fulling. People brought their woven woollen cloth to Tuck mills to be 'finished'. This entailed a preliminary scouring in an alkaline solution (either fullers' earth or urine), which was pounded in water-powered fulling stocks. This absorbed any grease, oil, or dirt which had lodged in the cloth when it was woven, whilst simultaneously thickening the fabric. The cloth was then *fulled* by continually pounding the material in a soapy solution by wooden fulling

Fulling stocks at work in a nineteenth century woollen mill agitating the wool in the wooden trough. The power line is visible entering the mill, each turn of the power line turned the cam wheel and tripped the stock.

Tuck and Corn Mill in 1985 from Cork Archaeological Survey archive.

The corn and tucking mill complex at Inchinagotagh, showing millrace shared by both.

stocks, which imparted a felted finish. Little is known about the internal arrangements of these mills as very few survive, with only one example of a fulling stock, surviving in County Galway. In most cases an undershot or a low breastshot waterwheel, as is the case here at Inchinagotagh, would have driven a driveshaft terminating in a series of iron-shod cams. The rotating cam wheels would have pushed down the outer faces of a single pair of fulling stocks (which swung on a pendulum motion); each stock falling into the wooden trough containing a web of cloth immersed in an alkaline or soapy solution. After fulling the woollen cloth was then *tentered*, a process during which the fabric was stretched under tension in the open air, on wooden racks, and then dried and ready for sale or use. In some cases, the fulling machinery was housed in the same building as a corn mill, powered by a separate waterwheel or occasionally sharing the same waterwheel as the grinding machinery.

The Irish tuck mill was already in decline by the 1840s and with the advent of larger spinning mills in the early 1850s it almost completely disappeared, surviving only in isolated rural areas. The scouring and fulling processes were now incorporated into a factory complex, where rotary scouring and milling (i.e. fulling) machinery replaced the traditional fulling stocks.

By the 1880s ready -to- wear clothes were both cheap and readily available, so there would not have been a demand for homespun cloth any longer, or for the traditional technologies required to finish it and so ended a long tradition which led to the demise of the Tuck mill.

Did you know? *Tuck* mills were in use in Ireland from the Anglo-Norman period onwards, but the vast majority of the surviving sites date to the eighteenth and early nineteenth centuries.[1]

[1] A.T. Lucas, 1968 'Cloth finishing in Ireland', *Folk Life* 6, 18-67.

Exemplar 16
Morrogh Bros. Woollen Mills, Donnybrook

Morrogh Brothers Woollen and Worsted Mill at Donnybrook, Douglas. The main building was originally built as a flax-spinning mill in 1866.

Morrogh Bros. Woollen Mills, at Donnybrook near Douglas, was one the largest wool spinning and weaving mills in the south of Ireland in 1914. It is one of the few mills in the county that epitomizes the large scale industrial enterprises that emerged as a result of the Industrial Revolution. The large mill, which now could be considered a factory, contained industrial quantities of mechanically powered machinery, operated by a large workforce.

The five-storey mill building was originally built as a flax- spinning mill owned by Wallis and Pollock. It was designed by the Cork architect and noted antiquarian Richard R. Brash (1817-88), and completed in 1866. The essential design is clearly based on contemporary Belfast flax spinning mills. Brash had been the contractor for the chimney of the Cork Spinning and Weaving Company's spinning mill at Millfield, where he is very likely to have come into contact with their Belfast architects. Indeed, he is also known to have travelled to Belfast to examine some of its more recently constructed spinning mills, sometime before work on the Donnybrook mill commenced.

In 1883, the Wallis and Pollock flax spinning mill had converted to woollen manufacture when the mill was apparently producing Cork tweeds. By 1885 it was entirely refitted with new machinery and given over to the manufacture of woollen cloth. In 1889, the mill was bought by John and Patrick Morrogh and R.A. Atkins, the High Sheriff of Cork. John Morrogh (1849-1901) had worked in the Kimberly diamond mines in South Africa, and later became M.P. for South East Cork.

The Morrogh brothers engaged the Cork architect W.H. Hill to make the necessary modifications to the existing structures for their own customised mill, which involved the creation of a 170ft long weaving shed, which housed mechanized or *power looms*, for weaving cloth. Raw, merino wool was imported from England, and by this period all of the various operations involved in the manufacture of worsted cloth: carding, spinning and weaving had become fully mechanized. The existing 250hp steam engine on the premises, formerly used to power flax spinning machinery, was used to run all of the machinery used for woollen manufacture, along with an electric generator set. The original steam engines were replaced before 1917 by two 130hp gas engines, which powered everything from milling (i.e. a process used to replace fulling) to tentering machines, on which the woven cloth was pre-stretched. By 1903 the mill was employing 300 people, many of whom were housed in the 100 company-owned cottages in Douglas. The original owners, Wallis and Pollock had also built some 50 worker's housing within the immediate vicinity of the mills, examples of which can still be seen on the Grange road.

Advertisement for Morrogh Brothers Woollen and Worsted Mills at Donnybrook, of 1919.

An advertising poster from 1919, states that the Douglas woollen and worsted mills manufactured, amongst other things; friezes, saxonies, black and blue serges and cheviot suitings. Irish frieze was essentially a form of strong tweed, highly resistant to most weather conditions, and was used for women's winter tweed skirts, country suits and sportmans'

Engine house and boiler house at Donnybrook mill, Douglas. The three arches on the boiler house suggests that it originally housed three boilers.

wear. Blue serges, a cheaper cloth, was used for military uniforms, while saxonies were a form of fine woollen cloth used for trousers, jackets and suits. Cheviot suiting was made with harder spun worsted yarn and was commonly used for sportswear.

The surviving building is almost an exact copy of a Belfast linen mill of the mid-nineteenth century, but which was easily adaptable to accommodate a different textile manufacturing process. Each of the internal floors of the mill consists of a matrix of brick segmental jack arches, which are supported on four tiers of cast-iron girders. Jack-arched floors were the principal means by which textile mills of this period were rendered fireproof, and the individual floor surfaces at the Donnybrook mill were also finished with fire-clay tiles. The girders, in nearly all multi-storied textile mills of this period, are connected by wrought-iron tie rods, and are supported along the central long axis of each floor on cast-iron columns. The cast-iron columns and the girders were supplied and installed by the Vulcan foundry in Cork. The main walls are built with Youghal brick and are externally faced with Ballinphellic brick, whilst the jack arches, window dressings and quoins are finished with patent facing bricks. The engine beds and most of the other cut stone work was supplied by a quarry in Foynes, county Limerick, although a certain amount of local limestone was quarried at Carrigacrump quarries near Cloyne. Before the mill was seriously damaged by fire in 1919 the roof was double-ridged and hipped all around. In its current state it has been appreciably lowered, and appears to have segmental trusses, whilst the original moulded eave cornice has also been removed.

Did you know? Factories like this provided much needed employment, however the working conditions were often miserable with low wages, long hours and dark, dusty and noisy conditions. People could work fourteen to sixteen hours a day for six days a week and women often received roughly half of the pay that men received.

Exemplar 17

Glanworth Woollen Mill

Glanworth Woollen Mill.

Glanworth Woollen Mill is situated in a picturesque location just above the old bridge over the River Funshion and overlooked by the ruins of Glanworth castle. It is an example of the late eighteenth century corn mill that was remodeled in the nineteenth century for a completely different industrial process.

The late eighteenth century Corn Mill was one of two flour mills at work in Glanworth village in 1848, when it was owned by Robert Gibbons; the second was situated about 100m to the south of Glanworth bridge but only its weir and part of the headrace channel survive. We know from a painting in the National Gallery by Francis Nicholson, c. 1805, that the Corn mill was four-storeys high. In 1849, the Corn Mill was powered by a 12ft diameter, 5ft wide, undershot waterwheel, which worked three sets of millstones. In 1837 Lewis states that there were two mills here owned by Messrs. Murphy and Killeher, producing 10,000 barrels annually. By the end of the nineteenth century it was converted to a woollen mills and at this stage it took on its present form of a two-storey, double pile structure to provide the more spacious

accommodation required for the woollen manufacturing process. For most of its working life it was run and managed by the Quinlan family. The Poncelet type undershot waterwheel dates to about 1860.

The scale of operations of the Glanworth Woollen Mill was much smaller than that of most Cork woollen mills, such as those at Blarney, Douglas, Drispey, or even that at Ballincurrig near Midleton. However, it managed to establish a niche market in Ireland for value for money woollen products; namely blankets, cot blankets made from lambs' wool, and rugs. It also appears to have produced worsted cloths such as tweed in its earlier years. It also used natural dyes well into the twentieth century. One of the more interesting and rare surviving features

Poncelet advanced undershot waterwheel of c. 1860, at Glanworth Woollen Mill.

Glanworth mills woollen blanket. Image courtesy of Pauline Dwyer and Paul Cotter.

Remains of woollen milling machinery abandoned in 1984 from Cork Archaeological Survey Archive

associated with the woollen mill is the circular wool washing trough, situated on the bank of the River Funshion.

Thomas O'Callaghan jnr. has left a fine description of how the woollen mills operated in the late 1950s which, with few modifications, was unchanged from nineteenth century practice.[1] In the preparatory processes for spinning, the mill employed carding machines on which the wool fibres were teased out by wire rollers to form a continuous web or *slivers* suitable for spinning. Spinning mules, some up to 100ft length, were then used to spin the warp (horizontal) and weft (vertical) threads used for weaving, which was done on power looms. After weaving, the cloth was washed in a tub set in the floor of the mill, where it was scoured, i.e. washed in detergent and then milled; a process which replaced traditional fulling, in which the cloth was felted. The cloth was then taken outside to a site across the road from the mill, to be stretched and dried on racks called *tenters*.

Did you know? The mill continued in operation up to 1971-2 when it was closed for the first time, but it appears to have ceased all operation by the late 1970s. In the 1980s most of the machinery was removed. The attractive location has led to interesting reuse of the building including a gallery, a restaurant and a shop - today it is a private residence bringing to an end a long and interesting industrial past.

[1] Thomas O'Callaghan jnr, 2000, *Glanworth Millenium* 2000.

Exemplar 18

Overton Cotton Mills

Overton cotton mills, 1802-1830.

Located in a narrow valley of the River Bridewell, c.1 km south of Oldchapel, are the substantial overgrown remains of Overton Cotton Mill. Its isolated location in a rural setting is unusual for such an imposing industrial building. It was built by the enterprising Bandon textile magnate, George Allman, who modelled it on the iconic large Manchester style cotton mills using the best and most up to date technology of the time. Allman employed Thomas Cheek Hewes, a Manchester millwright and the inventor of the suspension waterwheel, to build his modern mill. As a result, Overton Cotton Mills was powered by the world's first suspension waterwheel in 1802, making it one of the most important industrial buildings in the Country.

We have an account of Hewes' involvement at Overton through his deposition to the *Select Committee on Artizans and Machinery* in 1824:

"I built a mill at Bandon, fifteen miles from Cork [sic], in 1802; I added to that about eight years afterwards, and I filled it with machinery, and within these seven or eight months, Mr Allman the proprietor of it, wrote to me to say, that this machinery was going on very well, and he wished to extend it again; and he wrote an order for a quantity of parts of machinery, and I was obliged to decline that order; for those parts that we cannot procure ourselves; rollers and spindles, and some other work"

George Allman (1750-1827) was progressive and before his association with Hewes he had already established a reputation as a cotton manufacturer in Bandon. In fact his 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'***. 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 to Lancashire to learn about mule-spinning, sometime before 1804. Mule spinning allowed thousands of spindles to be in operation at the same time.

Mule spinning in a Lancashire cotton mill, around 1830.

Aqueduct for delivering water to suspension waterwheel at Overton Cotton Mills, c. 1802.

From Hewes' account, it is clear that he completed the Overton mill in 1802. It was a narrow five-storey building, 14 bays wide with a gabled roof. The deep wheel pit occurred along the southwest gable, where the mill race delivered water across an interesting three arched aqueduct. It was added to substantially and extended with the addition of ten bays onto the south west end in 1810.

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'.

The axle of the suspension waterwheel survives in the wheel pit, however, the outer rim and arms are now gone. Nonetheless, we are fortunate to have a good description of it by a progressive brewer from Fermoy. 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. Walker was excited by one innovation in George Allman's cotton mill, which prompted him to write to Rennie in May, 1811, describing Overton's suspension waterwheel as 40ft in diameter and which had 'no pit wheel but a set of cogs on the outer rim which work into a lying shaft'; in other words a wheel segment attached to the outer rim of the waterwheel. 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. Walker's description is partially confirmed by Townsend in the revised, 1815 version of his *Statistical Survey*:

[Allman's mill] is one hundred and thirty four feet long, thirty four feet wide and fifty feet high. There are five floors, all underlaid with sheet iron to diminish the risk of fire. It is capable of containing ten thousand spinning spindles, with all the machinery necessary for supplying them with prepared cotton, by which thirty hundred pounds of it may be spun per week ... The motion that sets them at work, is communicated by an iron wheel, of forty feet in diameter, so equally and admirably constructed as to be set going by a moderate stream of water.

The cotton for Overton mill was imported from America and was transported by boat up the Bandon River via Kinsale, and the bales of cotton then brought to the mill from Bandon town by cart. At its peak it could process 3,000 pounds of cotton every week and employed 500-600 workers. However, a severe decline in the demand for cotton led to its closure in 1830 and it remained largely derelict until the late 1840s when it was re-roofed as a storehouse.

Did you know? John Rennie (1761 –1821) was a Scottish civil engineer who designed many bridges, canals, docks and warehouses, and a pioneer in the use of structural cast-iron. He did a lot of work in Ireland including Dun Laoighaire Harbour and Custom House docks in Dublin, along with its locks and warehouses, including the CHQ Building, built to store cargos of tea, tobacco and spirits, where he pioneered the use of cast-iron in the early 19th century.

Exemplar 19
Ballinoroher Scutching Mill

The Ballinoroher Scutch Mill.

The Linen industry was probably one of the most important industries in the eighteenth, nineteenth and early twentieth centuries in Cork and was particularly suited to the cool wet climate of West Cork - an interesting fact that is almost forgotten today. The industry was promoted by developing landlords as a valuable economic enterprise. It was largely a rural based cottage industry where the spinning and weaving of linen was carried out at home. The Ballinoroher Scutching Mill was developed as a result of increased demand in the early nineteenth century.

It was a thriving industry in the late eighteenth and early nineteenth centuries, by the mid-nineteenth century it even expanded to areas of East Cork around Glanmire. By 1851 almost 6,000 acres of flax were being grown in Munster. However it experienced a slow decline throughout the remainder of the nineteenth century and by 1915, only 257 acres were under cultivation in Cork. The horrors of the First World War created a huge a demand for linen, however, and flax growing increased to 1,548 acres by 1917. Thereafter, the industry continued

to expand and received a further boost with increased demand for Irish linen during the Second World War. In 1945 the Clonakilty flax market generated upwards of £250,000 in sales. It continued to be grown and processed in West Cork up to the 1950s, with scutching mills at work at Ballinoroher, Reenascreena and Dunmanway.

Flax took approximately 100 days to grow. It was traditionally harvested by uprooting, rather than by sickle or scythe. It was then immersed and soaked in water for about two weeks in *retting dams* or *flax ponds*, a process which loosened the useful part of plant from the *shous*, the waste or non usable portion of the plant. A number of these flax ponds served Ballinoroher, but none are now extant, however, a few survive around the wider Clonakilty area. The woody fibre of the retted flax was then removed by hand by beating with a wooden blade, in a process generally called *scutching*. While most of the time it continued as a home base activity, a number of Scutching mills began to appear in the nineteenth century. Here the flax fibre was now mechanically separated from the shous by the action of rapidly rotating wooden scutching blades. Flax scutching was generally undertaken in the countryside, in order that the usable

Ulster scutch mill in early twentieth century.

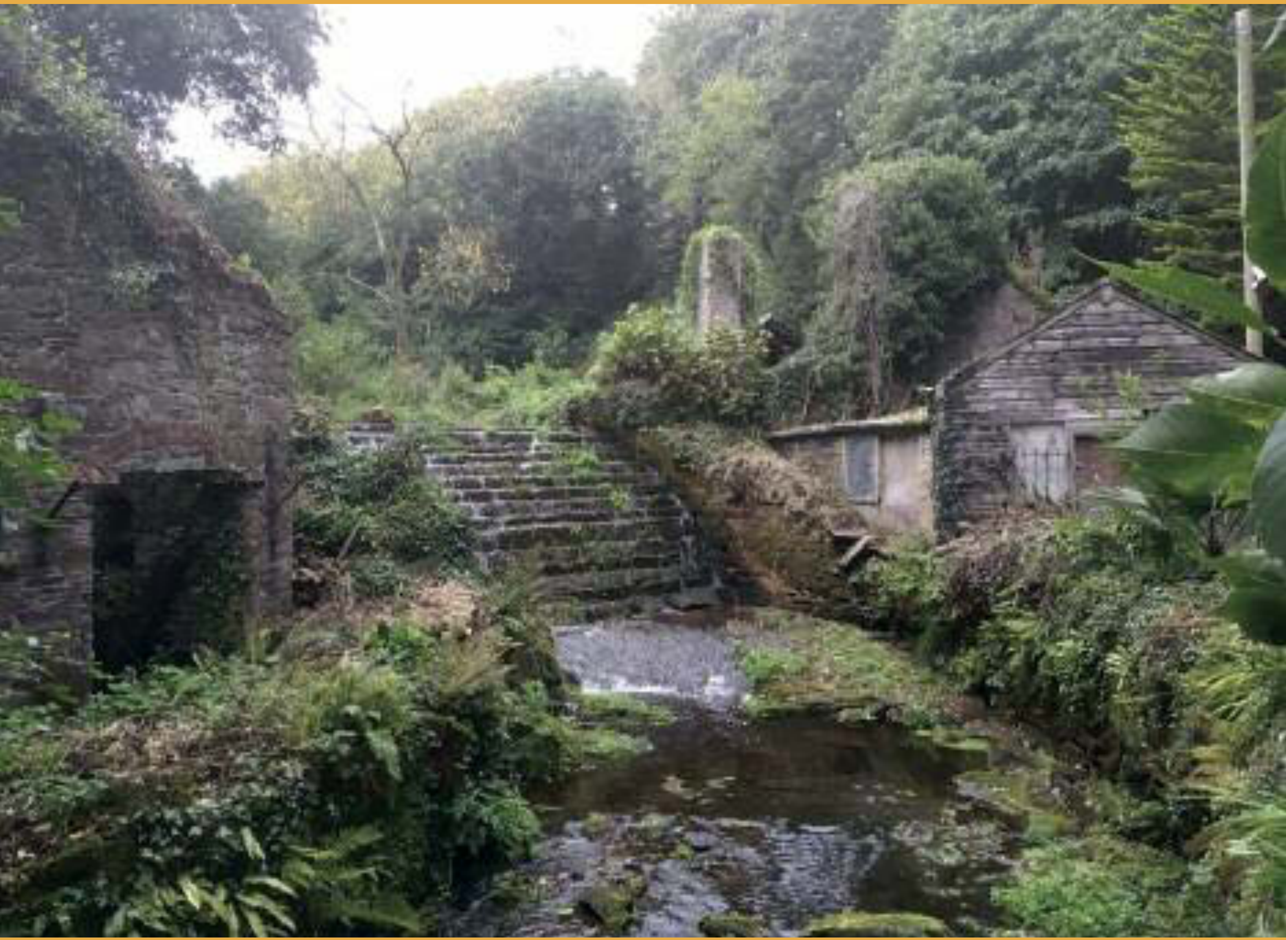
part of the flax (generally only some 10% of the entire plant) when divested of its waste, could be transported more economically to the large spinning mill. In a typical scutching mill, the outer skin of the plant was first broken in order that it could be stripped off in the scutching process. The area between each set of scutching blades was divided, by wooden partitions into *berths*, the number of which varied from four upwards. The fibres were then combed and straightened in preparation for spinning and weaving. The linen cloth was finished through the process of beetling and later by calendering to tighten the weave and give the cloth a smooth feel. For the more finer cloth it was bleached to produce the final finish.

The Ballinoroher Scutch Mill was built close to the Castleview Mills around 1915 in response to the increase in demand. It is a single-storey rubblestone building, which originally had a gabled, slated roof. The motive power for the scutching blades and the breaker rollers was provided by a small oil engine, housed in a shed with a sloping roof built up against the south gable of the mill. This powered the scutching blades via line shafting. In the early years, upwards of 15-20 men were employed as operatives. The mill was still at work in the 1950s and was recently converted to a blacksmith's forge by its current owner.

Did you know? During World War 1 Irish linen was in much demand for military aircraft as it was an ideal material to cover fighter planes. When flax from overseas became scarce, the government offered incentives to local farmers, urging them to grow flax again. The scheme succeeded and the area under flax cultivation in Ireland trebled. Thousands of planes were built during the war and could deliver bombs as far away as Berlin.

Exemplar 20

The Monard and Coolowen Ironworks



Coolowen Mill on left and stores to right, with stepped retaining wall, holding back the millpond water.

In the nineteenth century the preferred option for cultivation by small farmers was the spade. This was especially true in marginal land, and not just any kind of spade - each locality had their own speciality. In Ireland there is in excess of 1,000 varieties of one sided spades alone, in many different sizes. Most of these were made in the local forge, however, in the late eighteenth century the process was industrialised and the Spade Mills at Monard are a perfect example.

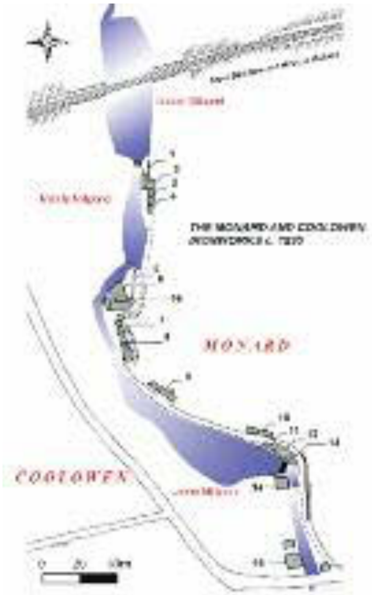
The Irish spade mill was essentially a water-powered forge which, in its most basic form, comprised a water-powered trip-hammer and forge; the forge itself often being serviced by a water-powered bellows. Cork has an exceptional number of Spade Mills, all in close proximity to

the city. There are at least nine documented examples of specialist spade and shovel mills within the greater Cork area operating, at various periods, between the closing decades of the eighteenth century and the early 1960s. By the 1830s, at least five spade mills were operating within the environs of the city, the largest of which - the Monard and Coolowen Ironworks - was also the longest continually operated.[1] In 1888, despite the ravages of the Irish famine and the decline in tillage, there were still four spade mills working near Cork, at Monard, Templemichael, Upper Glanmire and Curraheen.

The Monard works is the largest and best-preserved spade mill complex in Ireland. It occupies a small, picturesque glacial valley on the headwaters of the Blarney River, which discharges in torrents through a series of narrow, sandstone gorges. The choice of site was clearly governed by the availability of a good head of water which was utilised by a succession of mills with their own millpond. If you are quick you can see the mill complex from the Cork – Dublin train as you pass over the Monard Viaduct.

Operations on site began in 1790 when at least two water-powered mills containing mechanized forges were established on the upper reaches of the glen by a Cork Quaker merchant, Abraham Beale, along with a series of workers' dwellings and ancillary buildings. By 1844 the Monard works was being operated by Robert Scott and Co. who appears to be responsible for the construction of the Coolowen spade mill prior to 1863 on the east side of the Lower mill, directly opposite the Logwood mill. In evidence given to the *House of Commons Select Committee on Industries in Ireland* in the mid-1880s, Robert Scott and Co. claimed that there were four *trip hammers* at work at Monard which, based on the layout of the site, would suggest that one was operated in the upper mill; two in the middle mill and one in the Coolowen mill.

The water supply for the mills makes the best possible use of the difficult topography of the site, the principal feature of which is a series of narrow ravines which could not be canalised, in addition to a series of steep falls between each millpond. The construction of three of the mills; 'O'Hara's' (named after the family of smiths that worked there), the 'Middle' mill and the 'Coolowen' mill, required the preparation of rock-cut ledges, and in the case of the upper two mills, elaborate water delivery systems. The fall from the upper weir to the outfall of the 'Coolowen' and 'Logwood' mills is in excess of 12m,



General plan of Monard and Coolowen Irownworks, c. 1920. 1. Pipe delivering water to overshot waterwheel; 2 O'Hara's Mill; 3 and 4 Workshops; 5 Headrace; 6. Metal store; Workshop; 7, 8, 9, Workers' housing; 10 Forge (a traditional forge with no water power); 12 Logwood Mills; 13 Store; 14 Coolowen Mill; 15 Gatelodge.

Interior of Logwood Mill at Monard in late 1940s: a. Feeder cistern with shuttle; b. High breastshot water with clasp arms, c. Trip hammer; d, Hammer head.

Forge hearth in operation at the Coolowen mill in the late 1940s.

in which each of three millponds effectively divides into separate heads. Each of these was insufficient to ensure that each mill could be worked for an entire day, and when the water of the upper pond had been used up, work was transferred to the next mill in succession, and thereafter to the mill immediately below it. However, despite this ingenious arrangement, reduced water levels during the summer months meant that certain mills could only be worked intermittently.

The main product of the mills was spades and shovels of several different designs and sizes. These were made from pieces of heated metal that were folded over at the centre using the heavy blows of the *trip hammer* to weld their edges together. They used wrought iron and from 1870's on, mild steel. The smith held the piece with a large pliers and skillfully turned it under the hammer head to achieve the required shape. A lever allowed one to control the weight of the trip hammer by regulating the amount of water directed onto the waterwheel.

Cross-section through the Coolowen Mill showing: 1 Launder. 2 Wooden waterwheel. 3 Hammerhead. 4 Hammer beam. 5 Head bit. 6 Head stock. 7 Shuttle control. 8 Anvil. 9 Hammer fulcrum. 10 Cam wheel. 11 Cam. 12 Launder for bellows waterwheel. 13 External overshot metal framed waterwheel powering bellows.

The Monard and Coolowen works was closed in 1960 after the destruction of the Patrick's Quay warehouse of Robert Scott and Co. by fire. This led to Scotts going out of business and the Monard works, though closed for the last time, remained active and in working order as late as the early 1970s. A large amount of original machinery survives in situ.

Did you know? A fascinating documentary called the *'Kings of Spades'* was made by Ken Fitzgerald-Smith in the late 1930's which records the smiths at work in the Mills.

[1] Rynne 1999

Exemplar 21
Ballincollig Gunpowder Mills

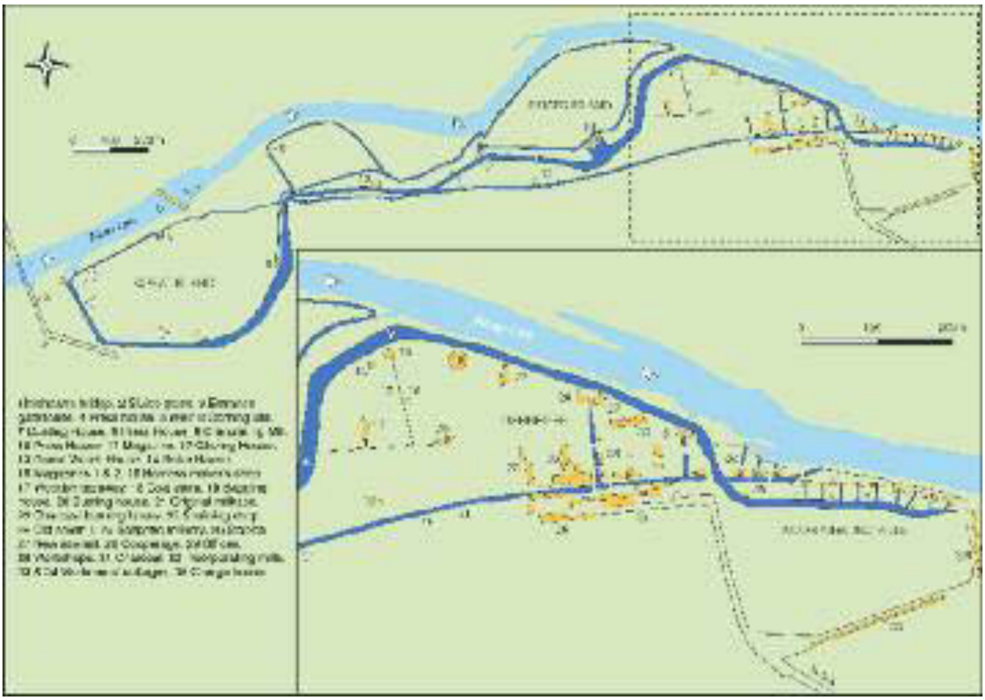
Restored incorporating mill (No. 1) c.1999 at Ballincollig Gunpowder mills with pair of edge runner stones adjacent to waterwheel and blast wall.

The Ballincollig Gunpowder Mills were established by Charles Henry Leslie, a Cork banker, and John Travers, in 1794. Gunpowder, which was originally used for artillery, became increasingly employed for blasting in mines and quarries from the late eighteenth century onwards. The Ballincollig works supplied large amounts of gunpowder to not only the British army and navy but also for numerous civil projects such as the railway companies for railway construction from the 1840s onwards and to mining companies in west Cork. The Gunpowder mills is Ireland's largest industrial archaeological site, occupying an area of just under 53 hectares (130 acres), and is of national and international importance.

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 British 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 nearly all of the processing was mechanized, access to a good water source was essential to provide the energy to drive the waterwheels. at the same time, in order to minimize the danger of chain-reaction type explosions, the buildings within the complex had to be well spaced out. 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 complex can be divided into three areas: (a) the refining area where the raw materials (saltpeter, sulphur and charcoal) were refined before milling and had a number of ancillary buildings including workshops, saw mill, weigh bridge, store, offices and stables; (b) Incorporating mills at eastern end where the refined material was incorporated or milled and (c) Finishing area, which took up the western half of the site with numerous isolated buildings associated with the finishing process. It also had two ranges of workers' houses called the Long Range and the Short range. These homes are still occupied today.



The Ballincollig Gunpowdermills complex in the later nineteenth century.

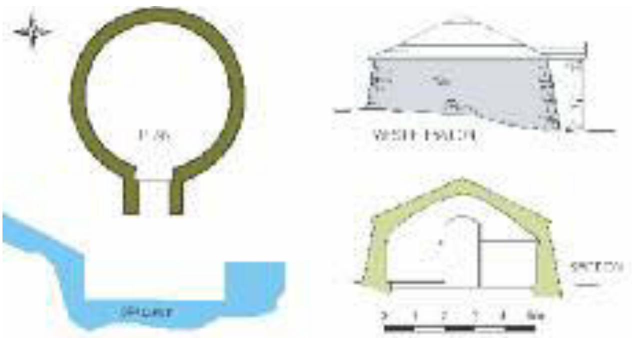
Aerial view of incorporating mills at Ballincollig Gunpowder Mills Complex, looking east.

The making of gun powder was a dangerous and arduous process. Black gunpowder has three principal ingredients - saltpetre (potassium nitrate), charcoal and sulphur, which were mixed in the proportions 75:15:10. Saltpetre was imported into Cork from India and the sulphur from Sicily. The only locally acquired ingredient was charcoal which was provided by plantations of the appropriate woods, such as willow and alder, within the complex. Most of the buildings within the mills are concentrated around the refineries; a necessary precaution as the ingredients were not yet mixed together and were thus, relatively speaking, less volatile. But in the finishing process of the powder after its initial mixing, the plant and buildings involved had to be widely spaced apart. After refining, the ingredients were taken to the mixing house where they were weighed and mixed in their various proportions called green charge, which was transported by canal to the charge house at the incorporating mills. Here the water wheels drove edge runner millstones, which rotated around a metal pan. The mills worked continuously grinding the green charge under the pressure of the edge runner millstones for two to six hours according to the grade of powder - the bigger the gun, the coarser the powder. In each mill, two pairs of edge runner stones were driven by a single breast-fed waterwheel. The incorporating mill buildings themselves were invariably of light wooden construction, which tended to reduce the risk of injury to millworkers in the event of an explosion and to enable the mill to be recommissioned as soon as possible. The double mill units were separated by substantial free-standing blast walls, which were supposed to deflect any flying debris resulting from an explosion away from the adjacent mill units. By the 1850s there were 24 individual incorporating mill units, which consisted of 12 double mills.

After incorporation, the mill cake, as it was then termed, was transferred by canal to the Press houses in the east of the complex where the density of the cake was increased by the action of a hydraulic press to remove excess moisture. The product resulting from this was called press cake, which was then broken up with a large mallet to produce fragments which could be safely introduced into the Corning house. In the corning house the press cake was mechanically forced through sieves, the action of which broke the powder fragments into finer pieces. However, the corning process produced dust, which tended to attract moisture to the powder if not removed. The powder was therefore, transported by canal to the Dusting house where the dust was removed by tumbling it in gauze-covered rollers.[1]

The powder was then transferred to the Glazing house, where it was tumbled in a slowly rotating reel or drum, the action that rounded the powder grains and imparted to them a slight gloss (hence 'glazing'). A small amount of graphite was also added to render the powder more resistant to moisture, and it was this, which gave the powder its distinctive black appearance. In the next process the powder was removed to the Stove house, which at Ballincollig, took the form of a distinctive oval boiler house with drying houses on either side. The powder was stored in wooden casks varying in size from 5 to 100lbs, and at least 50 coopers were employed on site to manufacture these. Two magazines to the east of the refinery buildings were used to store the powder before its collection by customers or its transportation to the docks at Cork. The government powder was stored in a Magazine on where Wellington square is today on Magazine road, hence the name, where 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. 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, which followed shortly after in 1903. In the period after 1850 up to 30 water-powered installations were at work within the Ballincollig complex, an arrangement that was unparalleled in Ireland during the nineteenth century. Over 90% of the original buildings within the complex survive, in various states of preservation.

Today gunpowder firearms are limited primarily to hunting, target shooting, and historical reenactments. In the early 1990's the Incorporating mill (No. 1) and adjacent charge house was restored by Cork County Council and is now part of the Cork Regional Park developed by Cork County Council with nature walks and tracks throughout.



Restored charge house at Ballincollig Gunpowder mills.

Did you know? The first recorded firearm using gun powder in Ireland occurs in 1487 and the first recorded use of the canon came the following year.

[1] Rynne 1999

Exemplar 22
The Cork-Tralee Turnpike

Aerial view of the Kerry turnpike near Rylane, looking east towards Cork.

The first turnpikes constructed in Munster in the early eighteenth century are generally a reflection of the importance of the port of Cork. The turnpike linking the city of Cork with Dublin via Kilworth Mountain; was constructed under a Turnpike Act of 1731. The road 'leading from the town of Newcastle in the County of Limerick to the City of Limerick and from thence to the City of Cork' also became the responsibility of a turnpike trust in the same year. A direct link with county Kerry was enabled under a Turnpike Act of 1747, which was to become the most important route for the Munster butter trade.

The Kerry turnpike; differed from the others in that the responsibilities normally delegated to turnpike trustees became vested in an undertaker. The undertaker, John Murphy, of Castleisland, was also the road's contractor. Murphy undertook to build 56 miles of road; nine large bridges, 15 smaller ones, along with toll houses and turnpike gates. The road was to be 30ft wide with parallel drainage ditches and was to have a gravelled surface 15ft wide. Murphy soon discovered the principal drawback of Irish turnpike roads was insufficient tolls.

The Irish Grand Jury system of road construction and repair saw to it that there was no shortage of good, toll-free roads in Ireland by the end of the eighteenth century. Road -users could use alternative routes and turnpikes, starved of income, rapidly went into decay. By the 1770s, poorly-maintained Irish turnpike roads were a key target for the criticism of English visitors to Ireland.

John Murphy's problems began early on. In January 1749 he petitioned the Irish Parliament to allow him to bring the turnpike of the Kerry road to the Mile house (today it is just beyond the junction of Dublin Hill and the old Mallow road) in the north liberties of Cork City and a mile out of city as the name suggests.

The subsequent parliamentary approval of this went against the wishes of Cork Corporation, who were indignant that their hitherto exclusive privilege to levy tolls on traffic moving within the county and city of Cork was now directly challenged. Nonetheless, the lack of tolls led Murphy to financial ruin and in 1768 he petitioned Parliament for assistance. He also faced

The Kerryman's table near Aubane.

competition from another turnpike when, in 1765, the road from Kanturk, County Cork to Fair Lane, in the north liberties of the Cork City, opened for traffic in 1768. Clearly, the transport in butter avoided the new turnpike wherever possible, and farmers preferred to use presentment roads or mountain tracks as they always had.

Although most surviving folklore concerns the Kerry butter roads, technically speaking, nearly all of the roads of County Cork were 'butter roads'. There were two main routes from County Kerry. The northern route followed the Kerry turnpike from Castleisland; and Killarney via Rathmore, Millstreet, Rylane and Tower, entering the city of Cork on the north side via Blarney Lane.

The Kerry turnpike road is a remarkable survival of early eighteenth-century road engineering, retaining, as it does, its original width and field boundaries for most of its course. Along certain stretches, indeed, the sunken remains of the original side drains are also in evidence. The straightness of the road also highlights its early eighteenth-century origins. From the 1770s onwards, turnpike roads were beginning to recognise the growing importance of wheeled traffic, by becoming contoured to avoid hills and steep inclines. This practice was also increasingly adapted by presentment roads. The most notable surviving landmark associated with this route is the Kerryman's Table, a table-like rock at Aubane; some five miles from Millstreet. The horses were often untackled and a local farmer provided some grazing and water while the drivers took well deserved nourishment and a few stories were no doubt told.[1] The site was believed to be roughly mid-way between Millstreet and Cork and became a traditional resting point for farmers and carmen making the journey to Cork. But more importantly, the Kerryman's Table assumed the role of a meeting place for suppliers, where business could be conducted and farmers could bring firkins for carriage to Cork by intermediaries. The second, or southern Kerry butter road, linked Glenfesk with Cork via Macroom and Dripsey, but also entered the city via Blarney Lane.

Aerial view of the Kerry turnpike near Tower, looking westwards. The Boggeragh Mountain can be seen in the background.

Did you know? In the nineteenth century butter was made all over Munster in farmhouses and sent to Cork to the Butter market in Shandon where it was distributed all around the world. Cork became the largest butter market in the world, making many merchants rich.

[1] Pers. Com. Donie O'Sullivan, 29/04/19

Exemplar 23

The Cork-Mallow Turnpike

The Cork Limerick turnpike section between Cork and Mallow, from George Taylor and Andrew Skinner, *Maps of the Roads of Ireland* (1777).

One of the systems for road construction in Ireland involved the turnpike trust, which was not introduced until 1729. A turnpike road was built and maintained by a turnpike trust, usually run by local landowners who could raise the finance necessary to obtain an act of parliament. The turnpike act invested powers in named trustees to erect gates and toll houses with which to collect tolls, but most importantly of all advanced a loan with which to build the road. These tolls were collected from most road users, save pedestrians and local farmers who had to use the road on a daily basis, and these were used for the upkeep of the road and to repay the parliamentary loan.

In 1731, a turnpike road was commenced to link Limerick and Cork, via Kilmallock. By the 1770s, turnpike roads, such as the Cork-Mallow section of the Cork-Limerick turnpike, brought about improved engineering standards, particularly where gradients were concerned. This is surprising as many Irish turnpike trusts did not engage the services of civil engineers. There can be little doubt that professional advice would also have been necessary for the widening of bridge carriageways, which was already occurring on many turnpike roads by the early years of the nineteenth century.

The increased use of cutting and filling, in which roads were cut directly through obstacles to maintain a gradient, and where the waste material resulting from this process was used to build an embanked section of road in a low lying area would, indeed, have required engineering expertise. However, engineering expertise aside, by the 1770s, Irish turnpike roads, even though they were being widened during this period, were a key target for the criticism of English visitors to Ireland. As in the case of the Cork Mallow road, the increased number of sharp bends to avoid hillocks and other steep gradients was becoming noticeable on Irish roads. This was to

accommodate the use of wheeled traffic, which had become more common, particularly around the turn of the eighteenth century. However, the fortunes of many Irish turnpikes improved substantially in the first half of the nineteenth century when the condition of many of them began to compare favourably to that of the presentment roads. By 1837 it was evidenced that many were accommodating high traffic densities. By law the Turnpike Trust had to erect toll gates, toll houses and mile-stones along the route.

As the hub of Munster's trade in provisions, all roads, whether turnpikes or Grand Jury controlled, led to Cork. The Cork to Limerick via Mallow turnpike road was administered by a conventional turnpike trust, which had 31 trustees, and was generally in good condition by the early 1830s. Some £2,157 was expended on its upkeep in 1830, and although all of the tolls collected on it were spent on the road, this was said to 'have hardly been adequate to keep the road in repair'.

The greatest threat to this road from Mallow to Kilmallock came from a new Grand Jury road built to Charleville which opened in 1837. This proved particularly difficult for Kilmallock, which was now bypassed with the preferred new route passing through Charleville. And, as a direct result, Charleville thrived while Kilmallock did not. However, with the existence of so many good toll-free roads and the advent of the railways in the 1840s, there was to be seen a terminal decline in the fortunes of the Irish turnpike roads, so much so that the mileage of turnpike roads declined from approximately 1,500 miles in 1820 to 300 in 1856. In 1858 all Irish turnpikes were abolished, and the roads themselves were transferred to the authority of local Grand Juries.

The original route of the Cork Mallow turnpike road has now been bypassed by the N20 since the early 1990s and is now relegated to a minor road status. The arrival of the Great Southern and Western Railway in the early 1840s, which cut across it at several points, introduced a series of bridges over with sharp, almost right-angle, bends adding to the already twisted nature of the road. These were easily negotiated by horse-drawn traffic but proved increasingly troublesome for motorised travel by the beginning of the 1950s. The original stone mileposts that had been laid along the road from Cork to Mallow in the 1730s, which was one of the longest surviving sections of eighteenth-century mileposts in Ireland, were removed to adorn the new road.

Original milepost from Cork-Mallow turnpike, now on the N20.

Did you know? The 'Old Mallow road' is known locally as the road with one hundred and one bends.

Exemplar 24

Fermoy Railway Station

Fermoy railway station (1860), terminus of the Mallow-Fermoy railway.

From 1860 up to 1967, the north Cork town of Fermoy became and played an important part in Ireland's extensive standard gauge railway system. The first important link was with Mallow, to the west linking it to the Great Southern and Western national network, and from 1872 it was linked to Lismore and subsequently to the ferries at Rosslare. In 1891 and up to 1947, it was also connected to Mitchelstown via an interesting network of smaller stations such as Glanworth and Ballindangan. Never, indeed, has northern County Cork been so closely linked by rail and it opened the area up to national and international markets. The loss of these links, beginning in the late 1940s was keenly felt, however, much of the infrastructure survives to remind us of this era - an important part of the industrial heritage of the County.

The site for the Fermoy terminus was chosen to the north of the large British military barracks at Fermoy primarily, it would appear, for strategic reasons. The Mitchelstown line would become very useful during the Boer War (1899-1900) when it provided a link for the new army barracks at Kilworth, near Mitchelstown. During the First World War the Fishguard and Rosslare link, to the east, also proved crucial for the dispatch of troops to the Western Front.

The surviving station buildings are remarkably well preserved and testimony to the designers and craftsmen who built them. The main central building is a two-storey, relatively modest terminus building, of cut limestone. The long single storey recessed wings on either side accommodated the rail dispatch office and waiting rooms. The main buildings usually included offices for the station master, for ticket purchases and parcels, along with waiting rooms for both sexes. A section of the platform immediately in front of the passenger buildings, was generally covered by an awning, as at Fermoy. A two-storey signal box forms the western end of this complex. The original platforms are parallel with these buildings at the north. There is also a long goods shed to the north of the passenger platforms. The original railway line to Mallow has been built over by an adjacent industrial estate. Across the main road are the well-preserved remains of the former goods store for the Lismore /Rosslare line. This line, known as the 'Duke's line' as the construction costs were almost completely covered by the Duke of Lismore, was made possible with the construction of the Carrigabrick Viaduct over the River Blackwater. This is a wrought iron lattice structure, built on five masonry piers faced with typical rusticated ashlar stones giving a sense of weight and strength to the structure. It was designed by James Otway, and completed in 1872 and is an amazing feat of engineering; so typical of railway design that had to overcome many obstacles like this.

The Fermoy station differs from most provincial terminus type railway buildings where the main buildings and platform are parallel to the line. Here the station was built at right angles to the line and the passengers enter a concourse, similar to Heuston Station in Dublin.

The high quality of the architectural design and craftsmanship of the station is effective creating a pleasant and attractive entrance to the passenger. Here the classical design and proportions work well with the cut limestone façade, articulated with raised quoins and a dressed sill course that give it an imposing and confident appearance.

The Carrigabrick viaduct (1872) which carried the Fermoy-Lismore line over the River Blackwater near Fermoy.

Did you know? Carrigabrick featured in the 1966 World War 1 film 'The Blue Max' where a German plane flew under the bridge's main span.

Exemplar 25

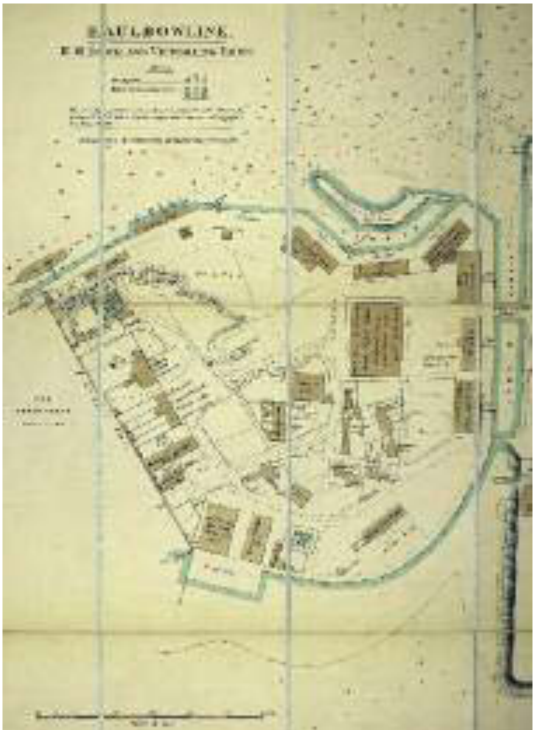
Haulbowline Island Naval Storehouses

The central storehouse of the northern section of the former British Navy warehouses on Haulbowline Island c.1818, with campanile.

Cork 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 in the harbour. At the end of the eighteenth century the port of Cork had become the most important single supplier of 'wet' provisions of butter, pork and beef for both the British army and navy. Up to 1782 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 British Admiralty decided to revamp its facilities for victualling early in the nineteenth century.

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. These new facilities were now designed to accommodate the entire needs of the British South Atlantic fleet, which operated in the areas between the west coast of Africa and the east coast of south America, as far south as the Falkland Islands. 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.

An Admiralty plan of 1807 shows the original extent of the island along with the proposed modifications to its shoreline to accommodate the storehouses and wharfage. From the outset, the island was physically divided between the Admiralty and the Board of Ordnance, by a substantial boundary wall running north-south. The Board of Ordnance lands comprised around ten acres at the west of the island. By 1811 over £10,000 had been spent on the Haulbowline complex yet it was still unfinished, although by this period substantial ground works for the storehouse, quaysides and housing for naval personnel had been completed. This was followed, in 1816, with the commencement of the construction of the naval storehouses.



Plan of Haulbowline victualling yards in 1897. The naval six storehouses can be seen in the top right hand corner of the plan facing the waterside.

All six of the original naval storehouses survive and are similar in size and design: three-storey with attic under a mansard roof, hidden behind a parapet wall, retaining their original sash windows. The buildings are clearly functional yet externally they present an imposing classical facade of rubble stone walls with cut limestone detail such as quoins, window and door surrounds and cornice. Two of the three aligned storehouses at the east have two sets of loading doors (one at each storey) and have external cast iron rotating cranes. The central warehouse in this alignment facing north has an elaborate campanile with a four-faced clock, which is quite a common feature of late eighteenth/early nineteenth-century British industrial buildings. Given their storage function it is interesting to note that the Haulbowline warehouses have a much wider roof span that other multi-storey industrial buildings of the same period; invariably they are about 20ft. The floors of these buildings were designed to accommodate heavy loads, which would have included thousands of barrels of salted butter, beef and pork, shipped from markets in the city of Cork. Originally, the warehouses were provided with wharfage along their eastern elevations, which was subsequently filled in when the adjacent section of open dock was removed to accommodate Irish Steel's mill, during the late 1930s.

The victualling yard at Haulbowline, in its heyday, was in full operation between 1816 and 1832, during which time it was responsible for the provisioning of the entire British South Atlantic fleet. Its virtual abandonment was largely a consequence of the end of the Napoleonic wars and in the 'downsizing' of the British armed forces.

West-facing elevation of former British Navy storehouse on Haulbowline Island, c.1818.

Did you know? The construction of the Haulbowline complex was the only overseas naval buildings to be overseen by a female building contractor. Mrs Elizabeth Deane, the mother of Sir Thomas Deane of the famous Victorian architect, had taken over her husband's building firm after his premature death. 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, an achievement that was commemorated in a contemporary song:

But not forgetting Haulbowline Island,
That was constructed by Mrs Deane:
Herself's the lady that has stowed the water,
To supply the vessels upon the main.

The song refers to the water tanks, to the west of the east-facing storehouses, whichwere designed to hold up to one million gallons of water.

Exemplar 26

Ballycotton Harbour and Lighthouse

Ballycotton lighthouse, first lit in 1851 and automated in 1992.

From the late 1820s to the early 1840s, mariners and merchants from Youghal and Cork had expressed concern about safety of the seas around Ballycotton and lobbied for the construction of a lighthouse on Ballycotton Island, against the wishes of authorities at the time. The small two-storey dwelling in Ballycotton village, built in the early 1820s for the newly established Coast Guard, was really the only look out service available. The running aground and wrecking of the paddle steamer *Sirius*, which had completed the first full steamship crossing of the Atlantic Ocean in 1838, on a reef off Ballycotton in 1847, clearly backed up their cause for lighthouse provision at Ballycotton.

The lighthouse was built on the larger of the two Ballycotton Islands, about 2 miles from Ballycotton village, and was first lit in 1851. Ballycotton lighthouse is 15m high, with its light visible to ships at a distance of about 29km. It is typically a circular-plan, three-stage tower, with a projecting cut stone platform supported by corbels encircling the faceted metal-framed glazed lantern on top. It has its original sash windows decorated with block-and-start surrounds. Inside it retains its original stone spiral staircase and lighthouse machinery. Attached to the

Aerial view of pier and breakwater at Ballycotton.

lighthouse is the original lighthouse keeper's house. In the early years the lighthouse keepers' families lived on the island, with their children actually rowing to school in Ballycotton village on daily business. This practice was only discontinued in 1896, when the families were then housed on the mainland.

The solid pier at Ballycotton is a typical mid nineteenth century pier built to serve the needs of the local fishermen and lighthouse keepers. The solid stone walls were built with large well cut stone. A stone staircase gives access to the sea on the west side and the exposed east wall is made of course rock-faced ashlar. A narrow concrete breakwater was added early on in the twentieth century to create a small refuge harbour for smaller fishing vessels.

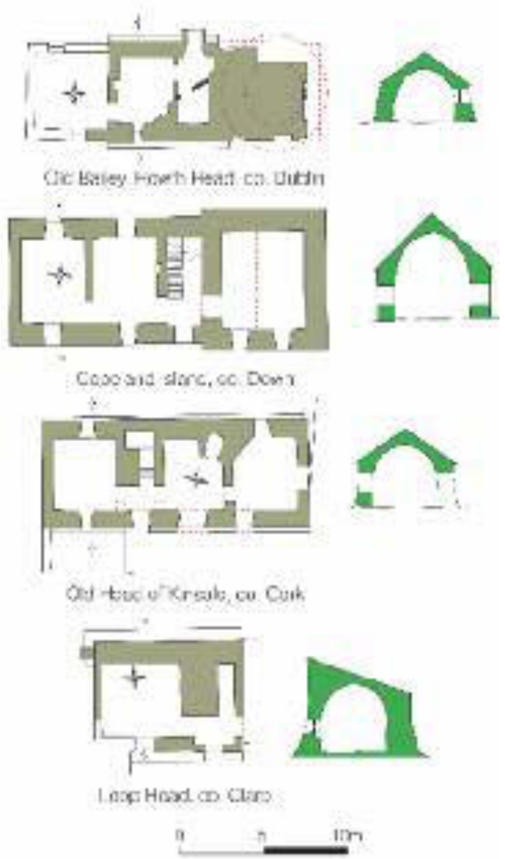
Did you know? The captain of the *Sirius*, the first steam ship to cross the Atlantic - Irish Royal Navy Captain Richard Roberts - was from Passage West.

Exemplar 27
Old Head of Kinsale Lighthouses

The seventeenth century brazier lighthouse on the Old Head of Kinsale and its replacement of 1814.

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 farmed out to private enterprise. Under this system, well connected private individuals held letters patent from the crown, which empowered them to collect tolls from shipping. In 1665, Sir Thomas Reading acquired patents to erect lighthouses in Ireland, which included the brazier light on the Hill of Howth, and that on the Old Head of Kinsale. The brazier usually sat on the fire-proofed roof of a cottage and were known as 'cottage light houses'. The method of lighting, which involved lighting a fire in an iron brazier was notoriously inefficient and very much at the mercy of the weather.

A number of early eighteenth century Irish cottage lighthouses survive in Ireland; here at the Old Head of Kinsale is one of the best examples. From these lighthouses it is clear 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 was clearly intended as a fire-prevention measure. However, unlike British examples, where the brazier was positioned in a tower, in Ireland such accommodation was provided in what was essentially a modified form of vernacular cottage. For the most part 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 a 70ft 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.



The seventeenth century brazier lighthouse on the Old Head of Kinsale, compared with other Irish examples.

In 1814 a new tower lighthouse was built near the brazier light, which was originally 12.8m high. This was equipped with a curious concentric building around its base which housed the light keepers. At some 89.6 metres above sea level the white light emanating from this tower could be seen at distance of around 37 kilometres. All told the position of this light was not without its problems, and in particular its tendency to obscured by fog. This led to the decision to build the present Kinsale lighthouse at the very tip of the Old Head itself, which was designed by the Inspector of Irish Lights, George Halpin, and completed in 1853. This was 72 metres above the high water mark and had an original range of 20 nautical miles. The Old Head of Kinsale lighthouse became fully automated in 1987.

The present Old Head of Kinsale lighthouse, completed in 1853.

Did you know? The Old head of Kinsale is made of hard sandstone rock which was lodged between two layers of shale. The shale is softer and eroded faster (in geological terms) than the sandstone forming the headland.

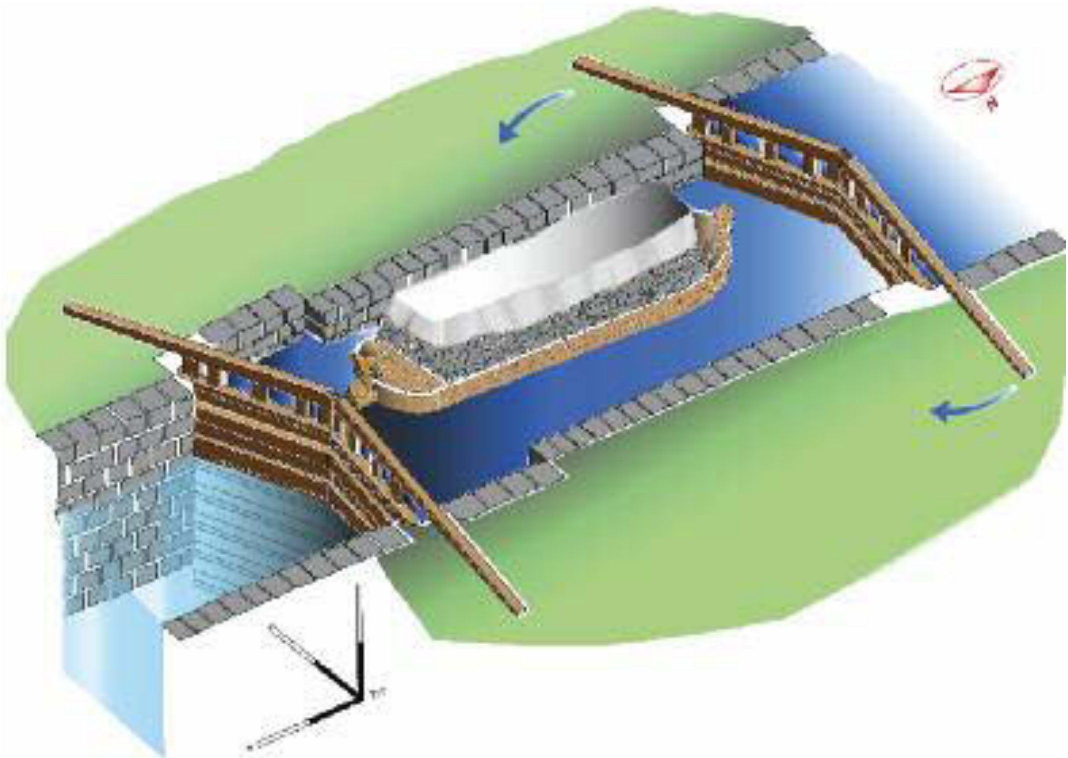
Exemplar 28

The Mallow-Lombardstown Canal

Eighteenth-century lock on Grand Canal, near Rathnangan, county Kildare.

Up to the early eighteenth century, transportation of bulky goods inland was difficult and slow. This was overcome by a major feat of engineering - the construction of new water highways. Canals began with the passing of an Act in 1715 but little funding was available at this stage. A second Act was passed in 1729, setting up the Commission of Inland Navigation for each province and allowing for the provision of public funding. Ireland's first canal was the Newry canal, completed in 1742. The eighteen and a half-mile canal linked Newry with the area around Lough Neagh to exploit the coal deposits in County Tyrone. It was the first summit level canal in Britain and Ireland.

The Mallow-Lombardstown canal was the second Irish colliery canal to be constructed in Ireland, and was originally intended to carry coal from the Dromagh coal mines to the navigable section of River Blackwater at Lismore and onwards to the port of Youghal. Construction work began in 1755 under the supervision of William Ockenden. However, only a short three and half mile stretch of the canal was built between Mallow and Pallas, near Lombardstown, completed in 1761. The canal received its water supply from the River Blackwater at Pallas with the direction of flow towards the town of Mallow.



Reconstruction of the surviving lock at Longueville on the Mallow-Lombardstown Canal, completed in 1759.

As mechanical excavators were not used until the nineteenth century, a considerable amount of human muscle power was required to build canals. When the lie of the land was uneven, the level of the canal was maintained either by cutting directly through an obstacle or by raising it up on an artificial embankment, but as the canal moved away from its summit, sudden changes in slope were negotiated by means of locks, by means of which canal boats negotiated the rises and falls in slope. Essentially the canal lock is a rectangular chamber, the sides of which were formed by massive ashlar masonry walls and finished on top by flat coping stones. The chamber was provided with heavy wooden gates at each end, balanced by wooden beams, which were used to lever the gates open. A boat descending to a lower level, entered the lock from the higher level, and the upper lock gates were closed behind it. Each lock gate generally had two sluice gates (or paddles), which could be lifted upwards by rack and pinion gears (paddle gears), and by opening the paddles on the lower gates the lock chamber could be emptied into the lower level. As the chamber emptied the boat descended, and when the reduced water level in the lock equalled that of the lower level, the lower gates were opened.

The Mallow-Lombardstown Canal had a lock at Loungerville near the middle of the run. The side walls of the lock were built with massive cut stone blocks of limestone. Considerable effort was also expended in rendering the lock chamber as watertight as possible. To this end, the sides and base of the chamber were packed with *puddle* clay, that is, clay which has been carefully chopped up, trampled underfoot and all stones removed from it. The Longueville lock was built very early on in the development of Irish canals, and so its basic design was copied largely from contemporary European practice. It was completed in 1759 and was 1541/2 feet long and 21ft 8in wide (47.1 x 66.6m): over twice the length and considerably wider than the typical Grand Canal lock of the 1770s. Later canal locks in Ireland were much smaller, as the need for larger locks was considered unnecessary given the lower volume of boat traffic than had initially been expected on Irish canals. The lock at Longueville also has the remains of a dwelling which would have been occupied by a lock-keeper. The lock-keeper's job was to operate the lock gates and to conserve water by preventing people sneaking through in boats at night. The Irish Parliament, which funded the construction of the canal, ceased to do so in 1763, after expending a whopping £11,000. This left only a short 3.5-mile section completed, which considerably reduced its usefulness. Competition from improved roads in the area led to its closure in 1786. The lock survives and is visible along the N72 between Mallow and Lombardstown and is a unique example of Irelands industrial heritage.

Did you know? The main Killarney road out of Mallow (N72) is called the Navigation road and illustrated information boards regarding the canal are provided at either end.

Exemplar 29

Cast-Iron Pump, Ballincurrig, Lisgoold

Typical public cast iron water pump provided by County Council with characteristic 'cow's tail' handle, at Ballincurrig.

In rural Ireland up to the middle of the twentieth century, many people would have little access to running water. Most people would have taken water from a nearby well, while rainwater barrels would have been an important source for washing. For many people in Ireland and particularly in rural areas even up to the 1960's, the fetching of water in iron pails was often a twice daily chore. So the provision of public water pumps in the late nineteenth century was a welcome development and their general availability facilitated cleaner and safer water.

During this period cast-iron water pumps with the distinctive 'cow's tail' handles, like this example in Ballincurrig near Lisgoold, began to appear across the County of Cork, both in rural and urban settings. The well pit was dug by hand to depths of about 30ft and lined with stone and capped at the top with a large slab of stone, later concrete, to seal it and to provide a base

for the pump mechanism. The cast iron pump enclosed a double action 'Lift Pump'. By pushing the pump handle downwards, a disc inside the pump chamber with leather seals, sucked water upwards to the spout, which generally took no more than a few upward and downward movements of the handle. Once this movement forced water out of the spout, the actual flow was often slow; one upwards and downwards movement of the handle would eject about a glass of water. In their heyday they were not just a utility but a good meeting place for neighbours to chat and catch up with the local news.

Early in the twentieth century another public water supply appears in small towns and villages with adjacent reservoirs. These were water pillars or fountains. They were not pumps in the technical sense as no mechanical effort was required to lift the water as the water discharged was led by gravity from an adjacent reservoir. These pillar fountains have a distinctive lion's head casting on their spout, and were operated by turning a decorated handle on the side. A tin drinking cup tied by a chain to a pillar was commonly provided and sometimes a moulded platform for a bucket. They bear the name of where they were cast, which was the Glenfield & Kennedy foundry in Kilmarnock, Scotland. This company had patented the design and the pillars/fountains were freeze proof.

These pillars/fountains were in use until rural electrification and the introduction of public and private waters schemes, which in some cases was as late as the 1960s. Electrification enabled the use of electric pumps. Many survive across the county and their service to the community and historical interest is acknowledged and highlighted by many local communities, such as these fine examples in Ballincurrig and Glanworth.

Typical water pillar or fountain at Glanworth.

Did you know? The weight of a pail of water containing 3 gallons is approximately 10kg.

Exemplar 30

Skibbereen Gas Works

The Skibbereen Gasworks 1867-1922.

The Old Gasworks Building in Skibbereen is situated on the banks of the River Ilen and is all that remains of a complex that also once contained two gas retorts and a manager's house. In many county towns in Ireland gasworks were established as early as the 1840s, mostly for street lighting, which soon became an index of modernization - something to aspire to. Gas came to Skibbereen in 1867 with the opening of a new gasworks, courtesy of the Skibbereen Gas Light and Coke Company - an organisation created by a group of local businessmen in December 1866 where local people bought shares to fund the Company. They originally supplied gas for 40 street-lamps on a market day evening in August 1868. As *The Skibbereen Eagle* newspaper reported: "The effect was magical and the change from darkness into light was warmly welcomed by an intense and admiring multitude."[1] It must have been an extraordinary experience for local townspeople to see their streets lit by gaslight for the first time.

The Skibbereen Gas & Electric Light Company, Ltd.

DIRECTORS' REPORT.

BEST COAL TAR
AT
SKIBBEREEN GAS WORKS,
IN ANY QUANTITY,
AT
CORK PRICES.

Ephemera relating to the Gas Works, provided courtesy of Terri Kearney.

Coal for gas manufacture was imported from Britain to the port of Baltimore on boats called coasters.[2] It was then transferred to Lighter boats (flat bottomed) to the Skibbereen quaysides. At the gasworks the coal was made into gas through the process called 'carbonisation'. The coal was heated in the 'retorts' at temperatures in excess of 1000 degrees centigrade which drove off the gas and other substances, some of which were later collected and sold. The gas given off was cleaned in a series of processes, called 'purification' that extracted important by-products such as tar and ammonia and hydrogen sulphide. The gas was ready to be sent to the gasholder for distribution. At the Skibbereen works the gas was stored in two gasholders.

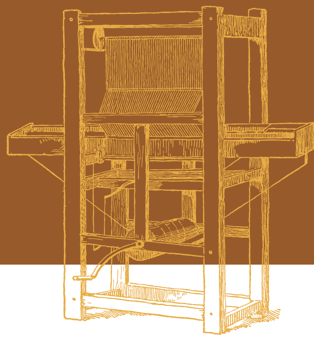
The gas works was converted to electricity supply in 1922, and became part of the ESB amalgamation of private electricity plant in 1929 with the opening of the electricity generation station at Ardnacrusha on the River Shannon in County Clare. By the 1990s, the Old Gasworks Building was in ruins but it was restored by Cork County Council and repurposed to accommodate the Skibbereen Heritage Centre, which opened in 2000.

Did you know? The Old Gasworks Building now houses Skibbereen Heritage Centre's 'Famine Story' exhibition and its genealogy services – a wonderful heritage attraction that garners praise and admiration from the thousands of people who visit every year.[3]

[1] Skibbereen Eagle Newspaper 1868 [2] Pers. Com. Terri Kearney, 13/04/19 [3] *Ibid*

Chapter 8

Protecting Our Industrial Heritage



Some of the industrial sites mentioned in this publication are *Recorded Monuments*, and, as such, are subject to statutory protection. This protection comes principally from the National Monuments Acts 1930- 2004, which define and protect Ireland's archaeological heritage, and the protection of our archaeological heritage is also covered under the Planning and Development Act, 2000-2010, as amended.

Archaeological sites and monuments are listed in the Record of Monuments and Places (RMP), established under Section 12 of the National Monuments Acts (1930-1994). Under this legislation, two months' written notice must be given to the Minister for Culture, Heritage and the Gaeltacht for any works on or near a site listed on the RMP. In addition, the Cork County Development Plan has an objective to protect all known archaeological monuments, and the County Archaeologist should be consulted prior to proceeding with any works at or near any archaeological monuments. Further information in relation to archaeological monuments in the county is available in the published series of Archaeological Inventories for County Cork (consisting of four volumes and an appendix volume); the details of which, can also be found online at **www.archaeology.ie** or indeed **www.heritagemaps.ie**. These online resources include interactive maps where a viewer can inspect any area for the presence of archaeological monuments.

Cork County Council acknowledges the importance of industrial heritage with a policy to protect it in the current County Development Plan, which also encourages the refurbishment of same. The County Development Plan 2014 Objective HE 3-4 - Industrial and Post Medieval Archaeology sets out to ***'Protect and preserve the archaeological value of industrial and post medieval archaeology such as mills, limekilns, bridges, piers, harbours, penal chapels and dwellings. Proposals for refurbishment, works to or redevelopment/conversion of these sites should be subject to careful assessment'***.

Many of the intact Industrial buildings are considered part of the architectural heritage and selected for protection through the creation of a Record of Protected Structures. Under the Planning and Development Act, 2000-2010, as amended, a Local Authority must maintain a Record of Protected Structures (RPS). Structures that are considered to be of architectural, archaeological, artistic, cultural, scientific, social or technical interest can be considered for inclusion in the RPS. The protection applied to a building on the RPS extends, for the very most part, to all parts of the structure, inside and out, and to any features in the curtilage of the building.

Under the provisions of the Planning and Development Act, 2000-2010, as amended, planning permission is required if any works are proposed that would materially alter the character of the structure. Works that involve routine maintenance and repair and which are carried out in accordance with best conservation practice and employing appropriate materials and technologies do not necessarily require planning permission. Nevertheless, clarification should always be sought from the Local Authority Architectural Conservation Officer.

Many of our towns and villages as well as our designed landscapes and streetscapes are designated as Architectural Conservation Areas (ACAs), also under the Provisions of the Planning and Development Act. These ACAs can contain a whole range of different structures including mills, bridges and railway infrastructure. Within these Architectural Conservation Areas, any works which are deemed to materially alter the exterior character of the area, even where such works are otherwise considered to be exempted development, will require planning permission. Cork County Council has produced a most useful publication entitled 'Guidelines on the Management and Development of Architectural Conservation Areas' which is available online at www.corkcoco.ie/arts-heritage. The publication is also available, free of charge, from the Heritage Unit of Cork County Council.

The Heritage Unit of Cork County Council is at hand to provide advice and information in respect of any proposed works to our industrial heritage, be they recorded monuments or protected structures. It also regularly works with community groups seeking advice on the protection and promotion of their local heritage. **For further information, visit www.corkcoco.ie/arts-heritage and to contact the Heritage Unit, send an email to cork.heritage@corkcoco.ie or phone 021 4276891.**

Chapter 9

Conclusion

Though there is a general perception that the Industrial Revolution of the eighteenth and nineteenth centuries largely bypassed Ireland because of its isolated position and lack of natural resources (notably coal), this idea masks the fact that there was industrial development in the country at this time, some of it innovative and progressive. Much of the development was generated by agricultural production, mostly corn and textiles like wool and linen. Throughout County Cork all the major river systems were dotted with water-powered mills, the larger ones concentrated at the major urban centres and the environs of Cork City with some exceptions such as the large cotton mill at Overton near Bandon. There was copper mining on the peninsulas; an active fishing industry along the coast, and all the main urban centres experienced a boom in trade and exports, notably from about the middle of the eighteenth century through to the opening decades of the nineteenth century. The recession in the 1820s that followed the end of the Napoleonic Wars and the Great Famine of the mid-century stunted this development but did not halt it completely.

The driving forces behind this industrial development were both private and State led. The State's contribution and that of the Local Authorities, concentrated mainly on services and infrastructure. But these services had a close relationship with private enterprise, either reacting to pressing needs or providing the opportunity for business development. The railroads are a good example of this, expanding into areas like West Cork due to local needs, but once there, encouraging new industries to develop around the service.

Industrialisation had profound effects on the county's landscape as land was reclaimed, roads were built, rivers were diverted, canals were created, quaysides were populated, workers cottages were constructed, and many other masonry structures and building complexes appeared, altering the vistas of urban and rural landscapes alike.

Though a percentage of our industrial heritage is now redundant and in a ruinous condition, as much again is still part of everyday life. For example, our basic network of public roads is essentially that created in the eighteenth and nineteenth centuries and retains features from that period, notably bridges.

An industrial building that can find suitable reuse is another positive development in principle. For example, the distillery in Midleton, and the Skibbereen Heritage Centre, retain and reuse historic buildings in an appropriate manner.

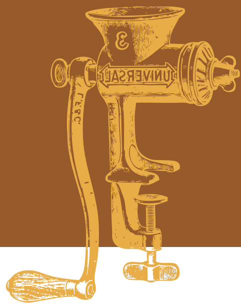
The archaeological survey of the county undertaken by the State in the 1980s and 1990s, and published as a series of Inventories (Power et al.,1992, 1994, 1997, 2000, 2009), showed an extraordinary number of industrial buildings and structures, unfortunately in varying states of repair. These are in themselves a fitting monument to the remarkable building industry of that time. Of course these are rarely massive in scale but rather, often humble in scale, like a single lime kiln or mill that served its local community.

Also included under this heading are transport services like roads and railroads. The building of an extensive road and rail system in the county in the eighteenth and nineteenth centuries has left a rich legacy of stone and brick bridges, tunnels, stations and other railway utilities. Utilities serving the river systems and along the coast, like piers, slipways, lighthouses and coastguard stations also form part of our built industrial heritage.

Particular industries at particular locations are worthy of note, like the Spade Mills at Monard, the Copper Mines at Allihies, and the Gunpowder Mills at Ballincollig. Other buildings like the Butter Market at Shandon are reminders of how small-scale cottage production fed into an international trade from the Port of Cork. By studying these industrial remains, though often humble and commonplace in their form, a different appreciation of the past can be developed and appreciated.

In the past, demolition of historic fabric was the usual way of dealing with change. However, with a greater appreciation of, and legal protection for physical heritage now in place, a challenge is created as to how best to preserve and maintain our industrial archaeology. The first part of this challenge is to identify, record and evaluate what has survived. This book aims to assist in this process by outlining this heritage and by bringing its appreciation to a wider public audience.

Appendix



The following pages contain a wealth of further information with regard to the industrial heritage of County Cork. In keeping with the Heritage of County Cork Publication Series, a poetry corner is included, in addition to a wonderful selection of photographs conveying just how vast the county's industrial heritage is. Many of these photos and accompanying texts are with thanks to dozens of people and community groups from throughout the County who chose to engage in the publication and for that, Cork County Council's Heritage Unit is most grateful. At the end of this appendix is a references section for further reading and a glossary as well as an index is also provided to make this publication as user-friendly as possible.








Glossary Of Terms

A-FRAMED ENGINE – An early form of vertical steam engine, supported on a A-shaped framework.

BALLAST – A bed of broken stones and gravel on which rail track was laid.

BEAM ENGINE – The earliest form of steam engine, which used a pivoted beam to activate pump rods and later, using a crank, to transmit the motion of the beam to drive machinery.

BEETLING – A finishing process for linen cloth, in which wooden hammers, were used to impart a sheen to the cloth.

BELL-PIT – A shallow mine pit with a distinctive bell-shaped cross-section, used for coal extraction.

BELT DRIVE – Endless leather belts used to drive machinery from an overhead lineshaft

BEVEL GEAR – Toothed gearwheel designed to transmit power from one drive shaft to another, usually at right angles to each other

BLAST FURNACE – A vertical furnace for smelting metallic ores, using an air blast to attain high temperatures.

BOB-WALL – The exterior wall of a Cornish Engine facing the mineshaft. This wall has a rectangular notch which allowed the beam or bob of the engine to extend outwards over the mineshaft and to operate the pump rods extending into the depths of the mine.

BOLTER – A cylindrical sieve, used for dressing flour.

BOLTING MILL – A flour mill which employs mechanical sieves called bolters.

BREASTSHOT WATERWHEEL – A vertical waterwheel which received water into the buckets on its periphery about mid-way up its circumference. Other forms include high breastshot, where the water is delivered at a point midway between the highest point on the wheel's circumference and the axle. In low breastshot wheels the water is received near the lower part of the wheel's circumference.

BULL NUT – See PINION.

CALENDERING - A finishing process for linen cloth, in which the cloth is rolled between rotating cylinders to produce a sheen.

CALICO – A plain woven cloth, either grey (unbleached) or white (bleached), in its undyed or printed state and made of cotton.

CAM – A raised portion of a shaft, which when rotated, causes a particular motion to a machine component.

CARDING – Preparing raw wool or cotton for spinning by separating and paralleling fibres of a tangled mass to form a sliver (like a rope)

CARBONIFEROUS PERIOD – A geological period 299-359 million years ago.

CAST IRON – The material obtained direct from the iron ore in a Blast Furnace.

CARBONISATION – The process of turning coal to gas.

CESS – Tax.

CLAMP KILN – A method used for firing brick, in which bricks are stacked in alternating courses, with arches built at the base, into which the fuel for firing the brick could be inserted and lit.

CLAPPER BRIDGE – A bridge built of narrow rough masonry piers or large boulders topped by stone slabs that form a walkway.

CLASP ARM – A method of affixing the frame of a waterwheel to the axle, using a series of beams laid at right angles to each other, which wedged the frame to the waterwheel's axle

COG – A wooden tooth on a composite gearwheel, made from hard wood such as apple tree or hornbeam.

COG AND RUNG GEARING – The earliest form of all-wooden gearing used to transmit the motion of a waterwheel to work millstones.

COMPASS ARM - A method of affixing the frame of a waterwheel to the axle, using radial arms or spokes that were morticed into the axle.

CONDENSER – In distilling a water-filled vat used to condense vapours emanating from the still.

CONTINUOUS STILL – See PATENT STILL.

COPPER-BED MINERALIZATION – The geological process in which copper ore were laid down in sedimentary rocks.

CORLISS ENGINE – A steam engine which employs the patent steam valve, invented by George Corliss in 1849, which substantially improved the efficiency of steam engines.

CORNISH BOILER - An improved boiler invented by Richard Trevithick, which enabled high pressure steam to be used in steam engines.

CORNISH ENGINE - A beam engine commonly used in 19th century mining operations, which employed high pressure steam created in a Cornish Boiler.

CRAFT – Any manufacturing activity performed with the skill of human hands.

CRANK – An arm attached at right angles to a shaft, which may be used to rotate the shaft or convert a circular motion into a reciprocating one.

DEVONIAN – A geological period 345-400 million years ago.

DIRECT ACTING ENGINE – An engine which acted upon machinery without the use of a pivoted beam as in a BEAM ENGINE.

DIMENSION QUARRY – See FREESTONE QUARRY.

DOUBLE PILE – The practice of doubling the size of a building by erecting a building of the same proportions alongside it.

DUNDRY STONE – A light yellow limestone quarried at Dundry, near Bristol.

ENGINE – A term commonly used for a machine producing power.

FEINTS RECEIVER – In distilling a vessel which receives the distillate from the second distillation.

FELT – A non-woven cloth made from wool, hair or fur

FIRKIN – A 56 pound butter barrel.

FLANNEL – A soft, loosely woven woollen fabric, and used for warm undergarments.

FLAX POND – A pond in which flax is submerged for a number of weeks to loosen the plant's outer skin.

FLUX - An ingredient such as quicklime used to separate waste material from the molten metal formed inside a furnace.

FORGE – A workshop where hot metal is shaped by hammering.

FOUNDARY – A workshop where metal articles are made by casting molten material into moulds.

FREESTONE QUARRY – A quarry yielding good quality stone that could be freely cut in any direction and to any size.

FULLING MILL – See TUCK MILL.

FULLERS EARTH – A non-plastic soft clay of fine texture containing alumina, found principally in chalky areas.

GEARING – Transmitting rotation and power by intermeshing toothed wheels.

GEAR PIT – In a watermill, a stone-lined chamber in which the PIT WHEEL rotates

GUAGE – The distance between the inner faces of each rail track.

HEADRACE – An artificial channel that leads water to either a waterwheel or water turbine.

HIGH BREASTSHOT WATERWHEEL – See BREASTSHOT WATERWHEEL

HORIZONTAL STEAM ENGINE – Engine in which the steam cylinder and piston are laid horizontally.

HORIZONTAL WHEELED MILL – A watermill where the waterwheel is set in the horizontal plane and turned the upper rotating millstone directly, without intermediate gearing, via a vertical axle or driveshaft.

HORSE ENGINE – A horse driven, cast-iron gear drive, which powered both pumps and agricultural machines via a driveshaft.

HORSE GINS – A wooden drum with rope coiled around it, which is turned by a horse, and which was commonly used in mining operations as a winding mechanism to lift ore out of a mineshaft.

HORSE WHEELS – A large wooden gearwheel, which engages a smaller gear wheel to drive machinery, turned by a horse walking in a circle

HOUSE-BUILT ENGINES – A beam engine which uses the building housing to enable it to be freestanding.

INDEPENDENT BEAM ENGINE – A beam engine supported on cast-iron columns and which does not require the support of the building housing it.

IMPULSE TURBINE - A water turbine set in motion by a powerful jet of water.

JACK ARCH - A segmental brick arch used in conjunction with a cast-iron frame as a form of fire-proofing in late nineteenth-century textile mills.

LANTERN PINION - A wooden gear wheel made from two wooden disks formed into a cylinder with a series of wooden staves. In a watermill, the cogs of the PITWHEEL engage the gaps between the staves to set it in motion.

LAUNDER – A wooden or cast-iron trough.

LAY OR LINESHAFTING - A means of power transmission in which a rotating metal driveshaft is set in motion by a either a water wheel or a steam engine. Belt pulley wheels were set along this shaft, and turned machinery using fan belts.

LEAT – See MILLRACE.

LIGHTER BOAT - A type of flat-bottomed barge used to transfer goods and passengers to and from moored ships.

LIME PUTTY – Lime that is slaked by adding water. Sand can then be mixed to make lime mortar for bonding masonry.

LITHARGE – Lead monoxide, an extremely toxic substance.

LOW BREASTSHOT WATERWHEEL – See BREASTSHOT WATERWHEEL.

LOW WINES – In whiskey distilling, the alcohol rich product of the first distillation.

LOW WINES STILL - In whiskey distilling, the still in which the low wines, or product of the first distillation, is re-distilled.

LUCAMB – A wooden awning.

MILLPOND – An artificial reservoir in which water is stored for the operation a mill.

MILLRACE - An artificial channel for leading water to, see HEADRACE, or away from see TAILRACE, from a watermill or water turbine

MULTURA – A toll, usually about one sixteenth to one eighteenth of flour ground in a mill, which the miller receives as payment.

NON-CONDENSING LOCOMOTIVE ENGINE – An engine which uses the force of high pressure steam.

OVERSHOT WATERWHEEL – A vertical waterwheel which receives water into its buckets near the highest point on its circumference.

PACKHORSE BRIDGE – A bridge across a river or stream in upland areas that enabled the transportation of goods by packhorse prior to road improvements in the eighteenth century.

PATENT STILL – A continuous whiskey still.

PENSTOCK - A conduit or pipe.

PIG IRON - The end product of an iron blast furnace

PINION – On a suspension waterwheel, the drive wheel that engages with the segment gear wheel attached to the waterwheel's circumference.

PISTON – The cylinder metal disc that slides to and fro inside the cylinder of an engine or in a pump, etc.

PIT WHEEL – The internal vertical gear wheel attached to the axle of a waterwheel, which engages the WALLOWER.

POT STILL – A still heated by a furnace used to distil alcoholic sprits.

PRIME MOVER – A machine, such as an engine, which is supplied with energy from a natural source and converts it into mechanical power.

QUICKLIME – Calcium oxide, formed by subjecting the calcium carbonate in limestone to high temperatures in a kiln.

QUOIN – A large dressed rectangular stone laid at the corner of a building.

REACTION TURBINE – A type of water turbine set in motion by the pressure of water flowing through it.

RETORT - A vessel used in the production of gas from coal, or indeed, the chamber in which coal is heated externally to make town gas.

RETTING DAM – See FLAX POND.

ROLLER MILL – A mill grinding cereals where the meal is ground to flour between revolving chilled iron or steel rollers instead of millstones.

ROTATIVE STEAM ENGINE – A steam engine, which can turn machinery.

RUBBLESTONE QUARRY - A quarry yielding rubblestone used for walling and roadbuilding.

RULING GRADIENT – The steepest climb that steam locomotives were permitted on a route.

RUNNER – The rotating section of a water turbine

SCUTCHING MILL – An installation for scutching flax, which used rapidly rotating blades to separate the outer skin of the flax plant.

SEGMENT - The principal driving wheel on a Suspension Waterwheel.

SEPARATE CONDENSER – In a steam engine, a separate chamber in which steam could be cooled and would create the vacuum necessary to complete the engine's stroke.

SHOUS – The waste or non-usable part of the flax plant.

SKEW ARCH – An arch, such as a part of a bridge, which has its axis at a oblique angle to its face, such as an arch that carries a railway across a road not at 90° to the road.

SLAKED LIME - Hydrated lime.

SMELTING – The process by which metal is obtained from its ores by the combination of action of heat and fluxes.

SPINNING – The combined drawing out and twisting together of short fibres to form yarn or threads.

SPUR GEARING - A large diameter, horizontal gear wheel which engaged any number of smaller gear wheels to turn the driveshafts of millstones.

STANDARD GUAGE – The Irish standard or broad gauge for rail tracks was set at 5 feet, 3 inches, in 1846.

STATIONARY STEAM ENGINE - A steam engine, which operates at a fixed location.

STEAM ENGINE – An external combustion heat engine which converts the pressure energy in steam into useful mechanical work.

STEAM TURBINE – A turbine activated by the pressure of steam.

STONE NUT – The toothed pinion which takes the drive from the spur wheel in a corn mil to rotate the millstones

SUIT TO THE MILL – A feudal custom under which a lord's tenants were legally required to bring their grain to his mill to be ground and pay a toll for this. See also MULTURA.

SUSPENSION WATERWHEEL – A waterwheel in which the motion of the waterwheel is transmitted by a SEGMENT wheel attached to its outer rim.

TAIL RACE – An artificial channel which directs water away from a waterwheel.

TAIL-POLE – A device for turning the cap of a tower mill to face the wind sails into the prevailing wind.

TENTERING – A process during which fabric was stretched under tension on wooden racks and dried.

TRIP HAMMER (or TILT HAMMER) - A large power-driven forging hammer, used for beating out impurities from hot wrought iron blooms and for shaping metal in forges. They were also used for stamping ores.

TOWER MILL – A windmill in which the cap section can be rotated to face the prevailing wind.

TUCK MILL – A mill in which fulling stocks are used to pound woollen cloth in either urine and detergent, both to degrease the cloth and to felt it.

TURNPIKE – A gate across a road where a toll was levied.

TURNPIKE TRUST – A trust, usually run by local landowners, set up to build and maintain a turnpike road.

UNDERSHOT WATERWHEEL – A waterwheel in which wooden floats attached to the rim of wheel are set in motion by the force of water.

VERTICAL WATERMILL - In this type of watermill the axle is set horizontally and requires the use of intermediate gearing, via a vertical axle or driveshaft.

VERTICAL WATERWHEEL – A waterwheel set on a horizontal axle. See also BREASTSHOT WATERWHEEL, SUSPENSION WATERWHEEL, UNDERSHOT WATERWHEEL.

VICTUALS – Ships' provisions such as salted butter, pork, beef and biscuits.

WEAVING – The manufacturing of a cloth from threads, which are inserted at right angles to each other in a loom.

WALLOWER – See PIT WHEEL.

WINDLASS - A type of drum around which rope was coiled.

WHIMS - See HORSE GINS.

WOOLLEN CLOTH – Cloth made with yarns made of short staple wool, such as that used in blankets.

WORM – A spiral copper tube used in distilling.

WORM TUB – The wooden vat in which the worm is in immersed to condense the spirit vapours.

WORSTED CLOTH - Cloth made with yarns made of long staple wool, which had to be separated from the short staple wool in a process called combing, such as that used in tailored garments such as suits.

YARN – A general term for a filament of twisted fibres of various materials such as wool or cotton which has been spun.

Poem:

In. Dust. Trees.

by Conor Nelligan

Cast the mind back to when iron first was cast.
Choose Bronze, Gold or Silver – can all of this last?
We had coal for the furnace, in turn had a blast,
But our talks by the fire will belong to the past.

We had the craft to mechanise, to mass produce for all,
But process went against the grain and now some sense the Fall.
Others say Winter is coming or perhaps a silent Spring,
But the memories of Summer, oh let us garlands brings.

In a future Summer, nature might achieve her wildest dreams,
But human nature has to change and not rip from her seams.
The earth can teach us so much yet we're focused on a cloud,
For our information, when it rains there'll be some sound.

In this world we value timber more than we do the trees,
Expect the fruits of labour and yet care not for the bees.
It's great to learn of process, of advancement, goods to send,
But when everything runs out, it's too late to make amends.

Industry, through its gears, has now surely met our fears –
In just three hundred years our debt to earth is in arrears.
Maybe it's injustice or just too many mishaps?
In dust, we hope that trees can rise where buildings have collapsed.

They'll return to the soil, as do we, but first we toil.
We just hope to look back and say that all was worthwhile.
The buildings, they remind us of the ways of long ago,
When we never stopped to think about how industry could grow.

Back then times were hard, a struggle just to live;
We never had enough but still we'd find something to give.
But more and more now struggle, when will somebody come clean?
Who gave up the Ghost and left it trapped in the machine?

Old truths are being hammered, society reshaped,
Formulated moves to science, inherent thoughts replaced.
We're so focused on minutia that we fail to see the All -
If goalposts keep on moving – the fool's errand is the ball.

But are limited resources now depleting industry?
It's strange how many view this world, there's so much we don't see.
Left to our devices, what have we left of our rights?
So many work throughout the day, too many working nights.

Are our thoughts the new-found industry – extraction of the mind?
Traditional labour now replaced – production lines refined?
Most minds are working overtime in endless industry.
What happens if we lose our mines – can we turn to alchemy?

The blood of the earth that powers us, it runs black beneath our feet,
But beneath our cars it's in the red - a thought for our car seat.
The salt of the earth that keeps us, can preserve us, if we stay
Away from past mistakes – let the process start today.

Industry has shown us just what we can achieve,
When we work in unison and when we all believe.
Our industrialised past now presents us with a task:
Can redemption be our industry, it's surely worth the ask?

Poem:

Saving the Corn

by Diarmuid Kingston

The rhythmical rustling of gently swaying ears of corn
in the windward way of a mild south-western
sea-whispering in from famed Ciarán's Clear
sure sign the harvest day is drawing near.

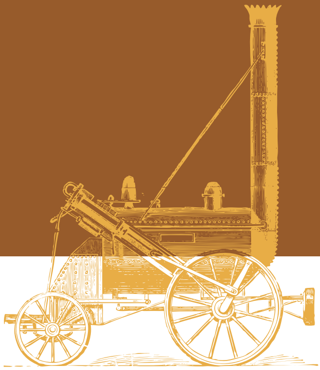
An illuminated night, a-glowed with parish lantern light
pre-charted course steered on elliptic curve over high hills
low-lying valleys lined with ash, sycamore and whitethorn
to the level, so imperious, that plain of golden corn.

Red harvest moon risen to join constellations and stars
intermingled with high hopes of pensive tillage farmers.
Wary watchful eyes transfixed on weather forecast
viability assured for year if prayers answered.

Sun-shining day, the replication of reaper and binder
with thresher, rumbles to harvest the golden spread.
The same since time began, the harvesting of wheat
for flour, the staff of life that is still called bread.

The corn threshed against a rock or a wooden spine
now by information technology driven combine.
Indelibly written in solid stone since history's dawn
homage must all still pay to the golden corn.

Pictorial of Additional Industrial Heritage in County Cork



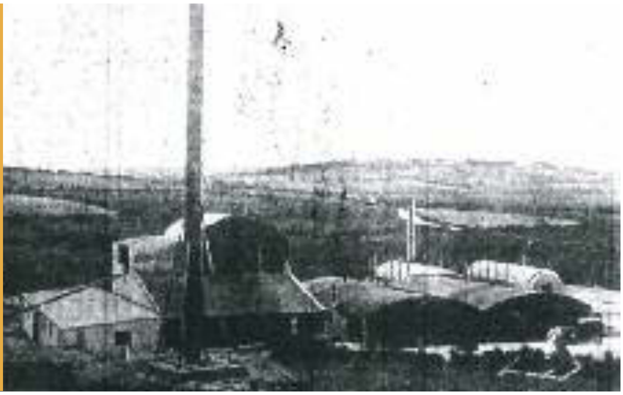
Allihies Copper Mine Museum with model of pump house (Theo Dalke).

Early nineteenth century workers' housing at Ballincollig Gunpowder Mills, known as the Long Range.

Ballinhassig Railway Station, closed 1961. (John L. O'Sullivan).

Ballingleanna Corn Mills, Glanmire, late eighteenth century.

Ballinphellic Brickworks, Ballygarvan (Cork Examiner 26th 1934) (John O'Sullivan).



Miller's house of c. 1855, Ballingleanna Mills, Glanmire.

Barleyfield Corn Mill. Image from Cork Archaeological Survey.

Blacksmith Tim Dineen outside his forge in Curaheen in the 1950s (Eamon Leonard and Gerard Dineen).

Nineteenth-century limekiln at Bridesbridge.

Chetwynd Viaduct (John L O'Sullivan).

Morrissey and Sons Flour Mill, Charleville.

'Leader's Aqueduct' - This aqueduct was built c.1860 by Henry Leader of Clonmoyle House, as a philanthropic irrigation project, providing much needed local employment. It consisted of seventeen pillars carrying water, sourced from the River Dripsey, across the valley from Clonmoyle to Knockanenagark (Henmount). The two highest pillars are 25.6 metres/84 feet in height. Thirteen pillars remain, some in ruinous condition. The aqueduct underwent many modifications, but fell into disuse during the late 19th century, when it became known as 'Leader's Folly'. Text and image provided by Doug Lucey (ACR Heritage).

Early oil engine (c. 1905), used to pump water to tower supplying boiler water for locomotives at Mallow railway station.

Coachford Creamery Sack. Image courtesy of Doug Lucey (ACR Heritage).

Early nineteenth-century malting house at Cloyne.

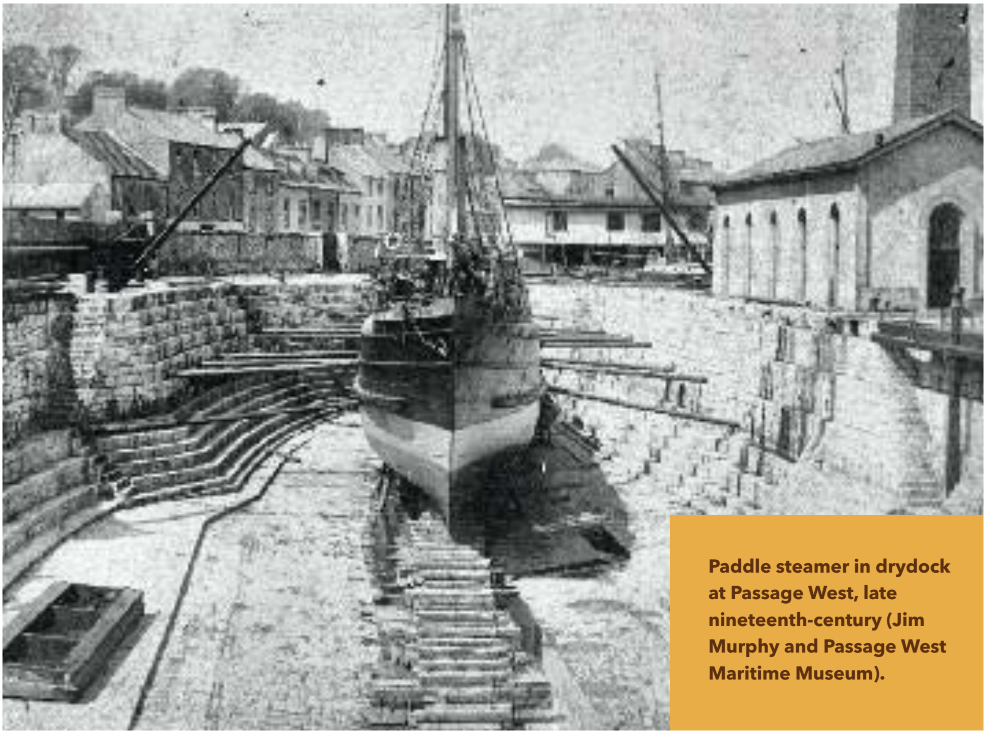
The harbour at Ring in the eighteenth and nineteenth century traded in slate, grain, potatoes and flour supplied by the adjacent Arundel mill, among others. This grain store and attached grain drying kiln are conveniently located at the water's edge. Image courtesy of Fr. Tom Hayes, and information courtesy of Diarmuid Kingston.

Farrangalway railway station today (Fergal Browne).

Bridge across the River Blackwater at Fermoy, c. 1865.

Railway bridge of c. 1846, carrying main Cork-Dublin line near Mallow station.

Watercolour of c. 1855, showing shipyards at Passage West. (Jim Murphy and Passage West Maritime Museum).

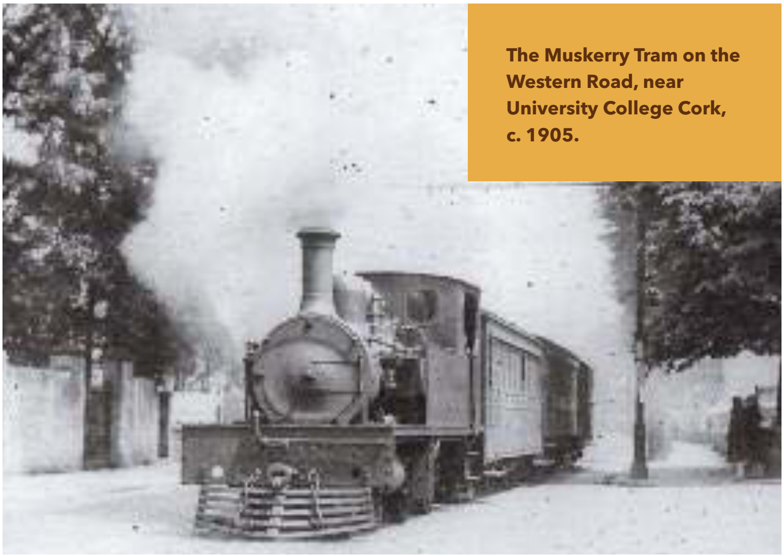


Paddle steamer in drydock at Passage West, late nineteenth-century (Jim Murphy and Passage West Maritime Museum).

Railway hotel built in 1864, beside railway station, now in use as offices by Cork County Council.

Gogginshill tunnel of the Cork and Bandon railway, completed in 1851.

Masonry viaduct of 1847, on Great Southern & Western Railway spanning Monard Glen.



The Muskerry Tram on the Western Road, near University College Cork, c. 1905.

Early twentieth-century creamery at Castletownroche.

Nineteenth-century lineshafting in saw mill at Glenville.

Surviving signal of Lismore and Fermoy Railway at Fermoy.

Banteer railway safety staff – a safety device – the train could not proceed without it (Donie O Sullivan).

Banteer Signal cabin (Donie O'Sullivan).

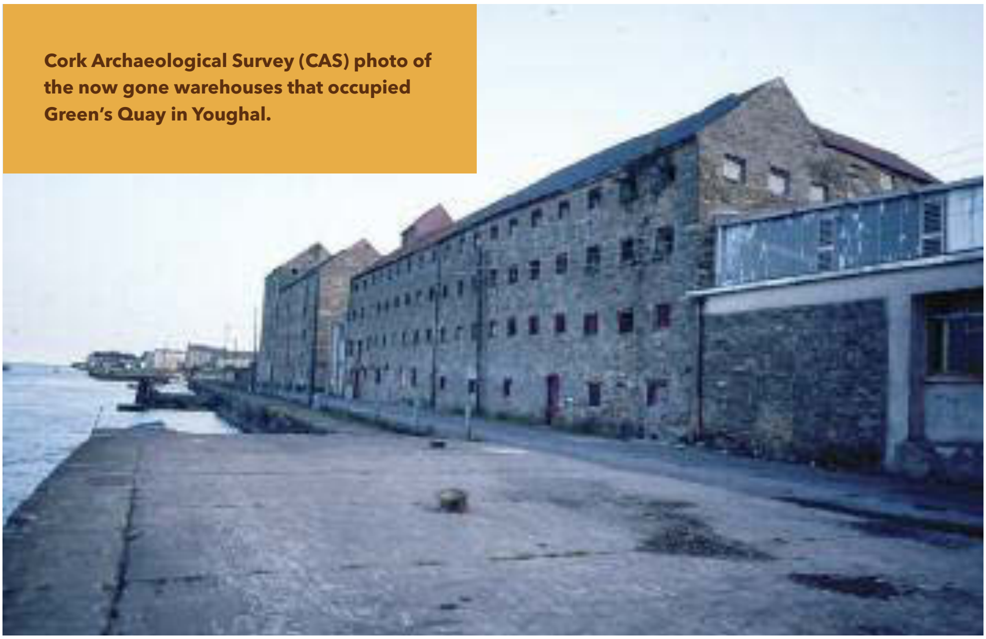
Nineteenth century railway station on Mallow-Killarney line at Banteer.

Youghal lighthouse of 1848, now owned by Cork County Council.

Butter firkin, early twentieth century, used to bring butter.

Cast-iron milepost at Sallybrook crossroads.

Cork Archaeological Survey (CAS) photo of the now gone warehouses that occupied Green's Quay in Youghal.



Killeagh station on Cork-Youghal line, c. 1862.

Former linen bleach works at Sallybrook.

Fragments of grain drying kiln tiles.

Mortar at Bleach mill near Dunmanway.

Grainstore adapted for modern use in Clonakilty.

Glenaknockane Lime Kiln, located near Nadd in North Cork, which used coal from the Duhallow Coal Fields (Donie O Sullivan).

Chareville has a huge reputation of industrial activity starting with Roger Boyle, who founded Chareville in 1661, shortly after, establishing industries of linen, woollen, milling and brewing. He brought weavers from England to teach the locals how to operate looms and provided housing for them in Weaver's Cottages at the Turrets. By the early nineteenth century there were three tan yards; small blanket and linen manufacturing, and two Corn Mills to name a few. A survey in 1846 listed the following industries: three chandlers (candle makers), five coopers, six blacksmiths, nine boot and shoemakers, thirteen bakers, thirteen butchers, three with their own premises , the others operating, "in the Market," three gun smiths, two carpenters, three stone masons, seven wheelwrights, three tailors, one hatter, two straw bonnet makers and one milliner, one watch maker and clockmaker, one confectioner, one slater, one painter and plumber and one feather merchant. Brickmaking was another old Charleville industry. The development of the cooperative creamery producing milk and cheese grew and in 1947, Golden Vale Food Products Limited in Charleville amalgamated with creameries in the surrounding area. At its peak Golden Vale employed 1,800 people in stainless steel engineering, cheese, butter and powder manufacture. Information provided by Michael McGrath. Image: www.flickr.com.

Home of seamstress Ellie (Nell) Dinan in Carrigadrohid. A lot of craft activities were carried out in houses like this (Aoife Nelligan).

Stone trough and edge runner stone from nearby, now on display at Bealick Mills, Macroom (Eoghan Nelligan).

Howard's Millworkers' Road Bowling Tournament Final 1980s. Howards Bellmount Corn Mills was built c.1810 by Thomas Herrick. (Bridget Goulding, Michael Goulding and Noel Howard).

Little Island Quarry (Patrick Twomey).

Millstones and gearing collapsed inside Clonmoyle Mill (Cork Archaeological Survey).

Overshot Suspension waterwheel at Dromore Mill near Dunmanway (Cork Archaeological Survey 1985).

Neily O'Regan dressing a millstone at Howards Mill c.1960 (Bridget and Michael Goulding).

Tall twentieth century silos adjacent to the Shannon Vale Mill (John Phair).

Plaque at Belgooly Distillery (Colm Gimblette).

Mossgrove Creamery farmers and workers in the 1960s (Bridget Goulding).

Rare example of West Cork Limekiln in Rineen Woods near Skibbereen (Cork Archaeological Survey).

Belgooly Distillery Mill (Colm Gimblette).

Restored double limekiln at Kilcrea (Bridget Goulding).

The Circular wool washing trough on the bank of the River Funshion at Glanworth Woollen Mills (Pauline O'Dwyer & Paul Cotter).

Road bridge over the Dublin - Cork railway line near Ballyhea.

Two sets of millstones enclosed in wooden casing at Russagh, near Skibbereen, before it was renovated. (Cork Archaeological Survey, 1986).

Water Pump, Ballinamona Cross, Shanballymore in North Cork.

Howard's One Way Flour Advert, Cork Examiner 26th October 1929 (Bridget Goulding).

Warehouse Clonakilty.

Ballinphellic Pottery: Kevin Fenton chairman of Ballygarvan History Society unveiling plaque with John L. O'Sullivan.

The Ballea mill, which was owned by Thomas Hewitt at the time of Griffith's Valuation 1852, was leased to Thomas Sullivan (Thomas Ryan and Derek Shears).

An anvil made of Coomhola iron, which was conserved for many years by the late Paddy O'Keeffe can now be seen in Bantry Museum on Wolfe Tone Square. At Coomhola there were two mills: one to smelt iron ('Mill Big') and the other ('Mill Little') to hammer the sows and pigs into "bar iron". The Bars were of one inch square by nine to thirteen feet long, though there are references to bars being produced as long as twenty feet. The first reference to the Coomhola Iron Works is in 'Regnum Corciagense', written by Sir Richard Cox in 1687 in which he notes about Bantry: "...not far hence there are iron works newly set up, which are in a thriving condition". In 1699 Dive Downs, the newly appointed Protestant Bishop of Cork, made a tour of his diocese and noted about Berehaven: "In our way to Kilnamanagh near Berehaven we saw iron mine on ye road, they use it at the iron works at Croomholla in Mr Walles's iron works". Information and image provided by Séamus Crowley, Mark Boyden and Áine Brosnan.

An assortment of labels relating to Glanworth Woollen Mills (Pauline O'Dwyer & Paul Cotter).

The Ballinhassig Railway Station West Cork Line closed in 1961 (John L O'Sullivan).

The Rostellan Mining company was established in 1926 in Cloyne. It produced many different types of clay, including china clay. It ceased operating in 1993. Information and image provided by Martina Williams.

Curraghbower Corn Mill. This corn mill was built in 1847/48 by George Bolster PC who owned Curraghbower estate. The extended Bolster family were noted millers throughout the 1800s in the North Cork area. The store attached to the mill was at one stage converted to a dwelling house and was occupied until the 1980s when the site was abandoned. (Donie O'Sullivan).

Jagoes Mills in the 1920s (Fergal Browne).

Ballincurig Woollen Mills was founded in 1840 by the well-known Cogan family from Midleton and operated up until 1972, mainly producing woollen blankets as well as "Coarse Woollen White Cloth" for the Habits of the Monks in Mount Melleray Abbey. The "Brands" and "Quality" of "Ballincurrig Blankets" and "Ballincurrig `Striped` Rugs" were renowned, not only in Ireland, but in the UK and in America. Many families of up to three generations worked at the Ballincurrig Woollen Mills and at its peak the Mill employed 50 Workers. Employees worked from 8 am to 6 pm and weavers did what was called 'Piece Work' where they got paid for the number of blankets woven by them in a given week. The machines in the mill were powered initially by a water wheel and a steam engine had been introduced by 1875; followed by a water turbine in the early 1900s. This mill was an important part of the community and provided a focus for many social events in the area. Information and image provided by Edmond J. Stack who expressed gratitude to John Potter Cogan ; Noreen Payne Fitzgerald ; Nicola Ahern and John Joe Regan in sourcing details.

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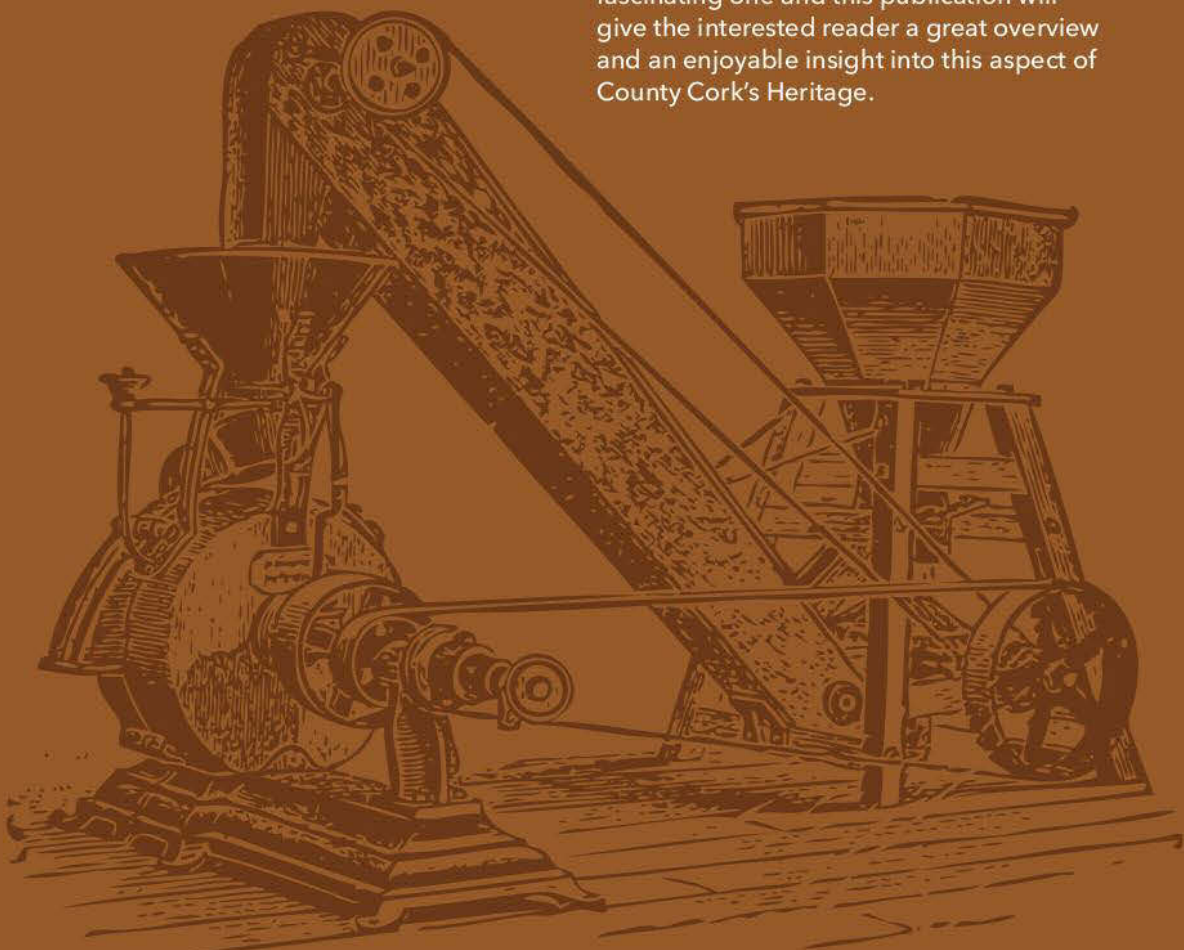
The Industrial Heritage of County Cork is the seventh in the Heritage of County Cork Publication Series; a series, which has been undertaken in association with the Heritage Council, and one that has been recognised nationally. County Cork's industrial past is a fascinating one and this publication will give the interested reader a great overview and an enjoyable insight into this aspect of County Cork's Heritage.



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