

holdings, such as the potter Josiah Wedgwood's 1783 pamphlet urging his skilled workforce not to be attempted abroad by French manufacturers. I have also had the privilege of access to the library of the Reform Club where Simon Blundell, the librarian, was helpful as always.

On the subject of early railways, and the life of William James the railway promoter, I am indebted to Miles Macnair who corrected my chapter and put me right on a number of significant points. His biography of James is to be published in late 2007 by the Railway & Canal Historical Society. In search of information on John Holker, the greatest industrial spy of the eighteenth century, I had the help of Michael Hindley who scoured the libraries of Lancashire for the scant details there are of this Jacobite rebel, who was branded a traitor in England and a hero in France. Brian Stewart in Canada made some helpful suggestions on the Postscript.

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From: The Industrial Revolutionaries  
by Gavin Weightman

## INTRODUCTION

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In a photograph taken at University College London, in 1863, the five young men look like a modern pop group with their dark suits and oddly cropped hair – a Japanese imitation of the Beatles perhaps. They were, in fact, young revolutionaries, brave-hearted stowaways to London, who were to become powerful and famous in their own country a few years later. In Japan they became known as the Choshu Five, after the clan to which they all belonged, and were celebrated for the part they played in modernizing their country and transforming it into an industrial power.

The Choshu Five had left Japan illegally and risked their lives to discover the secrets of the success of Western nations. Their rulers, the Shogunate, had effectively sealed Japan off from foreign influences for more than two centuries, tolerating only a few trading posts such as that at Nagasaki in the south. Though in its art and culture Japan was highly sophisticated, the country had remained almost medieval in its economy and industry. In effect, its rulers had abdicated from the modern world and had been able to ignore it until ships were sighted off its coast belching black smoke and moving without sails. When engaged in battle, these dragon-like invaders possessed a firepower that no Japanese battery could match, and when their crews were finally allowed to land, they displayed strange engines which could pull entire carriages of people along a sort of track, and also a device which produced

astonishing, almost instant portraits. So the five young samurai had set out to discover how the sort of society which produced such technological marvels might be established in Japan.

It was in the late 1860s that reformers such as the Choshu Five overthrew the old order, reinstated the fifteen-year-old Emperor and ushered in the Meiji (Enlightened Rule) era which began with a crash course in industrialism. This was so spectacularly successful that Japan was able to inflict a humiliating defeat on Russia in 1904, destroying a large part of the Tsar's navy. As the lines of battle were drawn up in Europe in the summer of 1914, Japan took the side of the British, whose English and Scots engineers and merchants had taught them in a few years the technological and administrative skills that had been forged over the previous century during the most remarkable period of practical inventiveness in world history.

The first 'Industrial Revolution' had taken shape in Britain a mere hundred years before the Japanese were confronted with its consequences. Nobody had planned this revolution: the rise of the machine age and the mill in a new kind of town – one in which the smoking factory chimney dwarfed the church steeple – had come about in an explosion of innovation, the origins of which remain a matter of historical dispute. What it meant in Britain, however, was the rapid rise of towns such as Liverpool and Manchester, whose populations soared from the 1760s onwards. There was simultaneously a nationwide population explosion as birth rates rose and death rates gradually fell. Britain became reliant on coal for its heating and to fuel its steam engines. In the countryside, if there was coal underground, mining was much more profitable than farming. Digging coal and iron ore and other metals for industry employed a rising proportion of the nation's workforce. The nation became less rural and more urban as the number of jobs rose in factories and workshops, taking families away from the land. Steam-powered mechanization produced unprecedented wealth as well as new kinds of hardship. But there was no stopping the advance of industrialism once it had begun.

It took some half a century for the new industrial forces to change the fabric of British society significantly, and for that reason there are those who

still argue that the use of the term 'revolution' is misleading, if not downright wrong. It seems a Frenchman first coined the sobriquet 'industrial revolution' in the 1820s as a kind of counterpart to the earlier, political and non-industrial French Revolution. The term gained currency in the nineteenth century but it was not until 1884 that it became widely used, inspired by the publication, after his death at the age of thirty, of Arnold Toynbee's *Lectures on the Industrial Revolution*.

For Toynbee, the success of Britain in pioneering industrial change and ushering in a new era in world history was not the result of mere mechanical inventiveness. The essential ingredient was a political culture which was receptive to change and – to borrow the eighteenth-century term – 'improvement'. Old working practices had to be abandoned, old rights had to be torn up, new forms of financing had to be devised, and the whole social and economic fabric of a country had to be loosened up if innovation were to take effect. It was one thing to learn how to build a steam railway – and you could buy the thing lock, stock and barrel with driver and guard by the 1830s – but it was quite another to know where the money was to come from to pay for it, or to decide whose land was going to be annexed for the line and what the fares would be. These were issues the Japanese had to deal with in the 1870s and which other nations, notably France, Germany and Russia, grappled with when they sought to emulate Britain's industrial successes. For the newly emergent United States, which gained independence at precisely that historical turning point when a new industrial society was taking shape, the impulse to innovate and make use of new technologies was much less inhibited than it was in tradition-bound Europe.

*The Industrial Revolutionaries*, therefore, is not just about inventors, nor is it a catalogue of the kind of machines that drove the novelist Charles Dickens to distraction at the time of the Great Exhibition in London's Hyde Park in 1851. Lay readers of this book, whose minds numb at the mention of pistons and air pressure, will sympathize with Dickens, who escaped London for most of the Exhibition summer, renting out his house in Tavistock Square and hiding away at Broadstairs on the Kent coast. From there he wrote:

I find I am 'used up' by the Exhibition. I don't say 'there is nothing in it' – there's too much. I have only been twice; so many things bewildered me. I have a natural horror of sights, and the fusion of so many sights in one has not decreased it. I am not sure that I have seen anything but the fountain and perhaps the Amazon. It is a dreadful thing to be obliged to be false, but when anyone says, 'Have you seen?' I say, 'Yes,' because if I don't, I know he'll explain it, and I can't bear that.<sup>1</sup>

A certain amount of technical explanation is necessary in this book, but it is not intended as a guide to the functioning of any kind of 'engine' and it is written in the firm belief that you do not have to know how to build a motor car to be able to say something interesting about the uses to which it has been put and its impact on society at large. In fact, it is argued here that the over-emphasis on the mechanical inventiveness of the British in forging the first Industrial Revolution is extremely misleading. Promoters of railways such as the land surveyor William James were, for example, just as important to their establishment as the men – the Stephensons, say, or the Hackworths – who built them. Plagiarism was, in any case, rife in the early years of industrialism and it is almost invariably impossible to say with any certainty who first invented what. It is much easier, in fact, to knock a few tenacious myths on the head, such as the still-repeated nonsense that the dour and sickly Scot James Watt 'invented' the steam engine after watching the lid rise on a boiling kettle.

Many of the characters whose lives and achievements are recalled in this study of the spread of industrialism after the mid-eighteenth century are not well known at all today, though some enjoyed celebrity in their own lifetime. John Holker, the Catholic rebel from Lancashire, who escaped both London's Newgate prison and almost certain execution, was much better known in France, where he made a career of stealing the secrets of English textile machinery and enticing workmen to his factory in Rouen. Industrial espionage was common in the eighteenth century and was partly responsible for planting the seeds of British industrialism in Europe and North America.

Some industrialists, however, were so confident of the superiority of their workmanship that they had no qualms about setting up factories abroad, as did John 'Iron Mad' Wilkinson, replicating his cannon- and pipe-making manufactory in the Loire.

The United States, in particular, benefited from the time of its eventual independence in 1783 from an influx of skilled artisans, mostly from Britain but some also from France and Germany, who founded the earliest industries there. American industrialization was the more remarkable in its first fifty years because the country had virtually no coal-mining industry and relied for fuel on the abundance of timber in its forests. Its canals and early railways were all laid out with the help and advice of British engineers and its first locomotives were shipped across the Atlantic. Like pilgrims visiting an industrial Mecca, ambitious young Americans then embarked for Britain to school themselves in the arts of surveying and engineering: men such as Horatio Allen, who was the first man in the United States to drive a steam locomotive on native soil. However, it was not always a one-way traffic. The adventurous American Robert Fulton, who visited Europe first as a painter, was bitten by the inventive bug and, having failed to convince either Napoleon or the British Admiralty of the effectiveness of his torpedoes and submarines, returned home to inaugurate the world's first passenger steamboat service in 1807. His first steamers, with British engines, ran on the Hudson but the riverboat was soon the symbol of America's first industrial boom, carrying bales of cotton on the Mississippi and the other rivers of the southern 'slave' states.

Another very prolific American inventor was Jacob Perkins, an engraver and steam enthusiast who packed up his tools, gathered a few workmen around him and in 1818 sailed for London in the hope of winning the competition to print forge-proof banknotes for the Bank of England. He failed in that ambition but stayed on in London for the rest of his life: his firm printed the very first Penny Black postage stamps, which were issued in 1840, and on one occasion Perkins himself demonstrated what was in effect a steam-powered machine-gun to the astonished Duke of Wellington.

The nation which seemed destined to under-achieve in the first century or so of the spread of industrialism was Britain's most formidable rival, France. It would be wrong to blame the backwardness of French technology entirely on the Revolution and the guillotine, but that gruesome machine was certainly used to behead many leading scientists and intellectuals. It also drove into exile one of the most brilliant engineers and inventors of his generation, Marc Isambard Brunel, who fled to America before settling in Britain with his English wife Sophia Kingdom. It was their son, Isambard Kingdom Brunel, who became an engineering superstar of the Victorian era, but it is his father who features in this book as he was more the true innovator. The Du Pont family also fled the guillotine and founded in the United States a gunpowder factory with know-how brought from France, much of it in fact developed by the great chemist Antoine Lavoisier, who was beheaded in the Terror. Today, Dupont (this is the Americanized spelling of the name) is one of the world's giant chemical companies.

What post-Revolutionary France was good at was theoretical science and its famous chemists such as Gay-Lussac taught many aspiring Germans and some Americans the rudiments of chemical experimentation and analysis. British engineers, however, remained much superior in the practical application of technology and were so far in advance of the French that, in the 1840s, they built that country's first significant railway line between Paris and Rouen, one which was extended to Le Havre. In fact, the British built railways all around the world in the mid-nineteenth century, with contractors such as Thomas Brassey and William Mackenzie often taking with them a veritable army of 'navvies' who excavated the cuttings and raised the embankments for thousands of miles of line.

Indeed, it is quite remarkable in retrospect the degree to which British expertise was called upon around the world by any individual or any nation which coveted the wealth and power that industrial production generated. Almost everyone of any significance spent some time in Britain, if only to soak up the atmosphere of the first industrial nation or in an effort to sell some innovation. The German chemist Justus Liebig was lionized in England, and his star pupil August-Wilhelm von Hofmann was the first teacher of

modern chemistry in London. Though gas and petrol engines were first devised in France and Germany, brilliant engineers such as Gottlieb Daimler spent time in England to observe how factories were run.

Yet the most extraordinary example of the wholesale adoption of British expertise is undoubtedly that of the rapid industrialization of Japan. Once the old Shogunate was overthrown, with some British assistance, engineers were invited into the country to teach everything from road- and bridge-building to the laying down of railway lines and the building of lighthouses. Whereas the Russians, who had for more than a century relied on the importation of foreign expertise, failed to learn much from it, the Japanese were intent on creating their own manufacturing industry from the start. There are Scottish heroes in Japan who are barely known in their own homeland, men such as John Blake Glover, the merchant who helped the Choshu Five escape to Britain, or Richard Brunton, who built Japan's first lighthouses. The Japanese also recognized the importance of education, bringing in the many academics and teachers who founded their universities. The inevitable result, when the rival imperial ambitions of Russia and Japan brought them into conflict, was the near-total annihilation of the Russian fleet at the battle of Tsushima in 1905. As early as 1863, when they were bombarded by British gunboats, the Japanese had learned the lesson that industrialism equals military might and that, if they refused to modernize, they ran the risk of becoming a mere colony of a great power.

Choosing the cast for a book such as this has inevitably involved some arbitrary selection: tens of thousands of significant individuals were involved in the creation and spread of industrial societies in eighteenth-century Britain up to the outbreak of the First World War. The narrative stops in 1914, for to take it any further into the twentieth century would be too cumbersome and, anyway, all the essentials are by then in place: petrol as well as steam engines, electronic communications including wireless, electric light and electric motors, iron ships and heavier-than-air flying machines. As the first industrial nation, Britain had by then already lost ground to the United States and Germany, and a familiar pattern had emerged as the built-in obsolescence of all technologies was revealed.

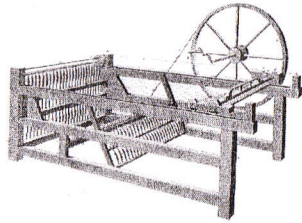
At one time there was an assumption that the forces of industrialism were such that all nations were bound in the end to succumb, and that the whole world would live in great cities, its workforce nailed to production lines, while farming and food production would everywhere become highly mechanized, requiring only a handful of workers in a depopulated countryside. In the 1960s, economists imagined that by studying the rise of industrial society in Britain and Europe they could predict where it would move next. There was a belief that many countries, in particular the newly independent African nations, were on the verge of 'industrial take-off'. All nations moving towards an industrial form of society would go through 'stages of growth' which were themselves predictable. The reality has turned out to be very different: technological innovation and the creation of a new kind of global economy have confounded the crystal-gazing of the economists.

The study of industrial change is full of paradoxes. There was a time when the wealthiest countries were the leading manufacturers, but now the most prosperous nations do not present an industrial image at all: most of their factories have been closed down and the work farmed out to much poorer countries where the wages are lower. There are countries which never developed any industries and have no factories to speak of yet are immensely wealthy because they own oil reserves. And then there is the enduring paradox of a machine such as the primitive cotton gin – a labour-saving device which vastly increased the demand for labour and helped perpetuate slavery in the American South.

There is no easy answer to the question of why industrialism has become established in some countries and not in others, or why, for example, in Europe it is more associated with the northern regions than with the southern. In the past, it was a popular notion that the countries which seemed to lag behind did so because of some failing of national character, a criticism often made of Italy and Spain. Certainly, even today, there are serious and knowledgeable commentators who regard certain cultures as resistant to industrialism and modernism, or lacking in some 'essential' component such as free speech or widespread education: they ask, for example, whether an orthodox Muslim nation could embrace industrialism. It is not the purpose

of this book to try to answer such questions, although some explanations are touched upon in accounts of the industrial development of Europe. *The Industrial Revolutionaries* tells a different story – that of the extraordinary spread of industrialism from the middle of the eighteenth century up until the beginning of the twentieth.

## CHAPTER ONE



### SPIES

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There were spies everywhere in eighteenth-century Britain. Though they disguised themselves in a variety of ways, they all had one ambition – to unearth the secrets of Britain’s industrial success. They came from many different European countries, from Russia, Denmark, Sweden and Prussia, but the most eager of the spies were from Britain’s greatest rival, France. Many were very erudite men who posed as disinterested tourists, compiling reports which they presented as purely academic treaties. Others posed as workmen in the hope of getting close to some fiendishly clever piece of machinery. And wherever the spies failed to gain entry, they were often reduced to lurking around local inns, hoping to engage knowledgeable workmen in conversation and induce them to cross the Channel for some splendid reward.

It was already evident to the French and other Europeans that Britain was gaining an industrial lead in the first half of the eighteenth century. There was, for example, the newly acquired technique of smelting iron with purified coal or ‘coke’ instead of charcoal, a fuel which was becoming prohibitively expensive. There were processes for the preparation of raw wool which were trade secrets and much sought after, as were some of the arcane skills of watchmakers. In the absence of any really reliable textbooks or journals which might disseminate information on how things were done, the most effective

way to steal an innovation was simply to bribe a skilled workman to leave his employer. Indeed, in 1719 the British government had passed a law forbidding craftsmen to emigrate to France or any other rival country and put a penalty on attempted enticement. At that time the chief concern was the loss of iron founders and watchmakers. But after the mid-century it was the astonishing developments in textiles which were the chief target of foreign spies and the subject of protectionist legislation outlawing the export of tools and machinery as well as skilled men. It was in this trade that the English turncoat, John Holker, the master of all French spies, began an extraordinary career which spanned half a century of rapid innovation.

The invention of machines for preparing and spinning raw cotton into a strong, even yarn was exclusive to a few pioneers in England, some of whom grew rich in just a few years. They built the first spinning mills which were worked night and day by children and women on thirteen-hour shifts. Much of the cotton thread was turned by hand-loom weavers into cheap and colourful cotton cloth which was sold around the world. Millions of miles of thread was exported to countries that had not learned the secrets of how to make machinery that would produce yarn of such quality so cheaply. The first of the revolutionary cotton-spinning mills was built in 1771 in the Derbyshire countryside on the River Derwent, the flow of which provided its power: it was not until a few years later that steam engines were devised which could drive spinning or other machinery.

Cromford Mill, as it was named, was the work of two men: Richard Arkwright, a former barber-surgeon and wig-maker, and Jedediah Strutt, a Nottingham manufacturer of stockings and inventor of an ingenious ‘frame’ for the machine-knitting of ribbed stockings. The novelty of Cromford Mill and the great secret the stone building kept hidden was the ‘water frame’, a complex piece of mostly wooden machinery, a confusing mass of cogs and pulleys and subtle devices which could turn ninety-one spindles at a go – the equivalent of nearly a hundred cottagers sitting on their porches with a single-bobbin spinning wheel. Cotton thread produced on spinning wheels or spinning jennies was not generally strong enough to be used as the warp as well as the weft of cloth, which meant that it had to be interwoven with linen

or wool yarn. However, the spindles of the Arkwright water frame turned out a high-quality yarn which could be used for both warp and weft so that cloth could be woven which was 100 per cent cotton.

In the last quarter of the eighteenth century, and for long after, the spinning of thread and the making of cloth was the single most important industry in Britain and much of Europe. By tradition, home-grown sheep's wool was the basic raw material, along with linen, which is made from the pounded stalks of blue-flowered flax. The very finest cloth was made of silk which came from China or was produced in some regions of Italy and France where the planting of mulberry trees, on which silk worms feed, was successful. Cotton, grown in Egypt or India, could not be raised in the temperate climate of northern Europe and was, until the 1770s, relatively unimportant. A speciality of one part of Lancashire, cotton yarn was generally woven with wool or linen thread to produce a variety of cloths.

For hundreds of years, colourful, lightweight and washable pure cotton cloth had been produced in India and was sold on a world market into which Europeans entered in the sixteenth and seventeenth centuries. The British East India Company, founded in 1600, for many years picked up Indian cotton cloth at the Malabar coastal town of Calicut and traded it in Indonesia for spices. Towards the end of the seventeenth century, the Company, seeking new ways of making money, brought back to England some cargoes of colourful Indian cotton cloth. It was a sensation, not only in England but throughout Europe. When it was washed, the dyes did not run, though how this was achieved nobody outside India knew. As the East Indiamen returned from the Thames to the Malabar coast, they carried instructions as to which kinds of pattern might be popular in England.

But the East India Company was soon in trouble, accused of unpatriotic profiteering. In the woollen-weaving and silk-producing districts of England, cotton became a dirty word. In France and other European countries too, the threat that these wonderful Indian goods presented to the established textile industries brought a swift reaction. Women seen wearing cotton gowns were attacked in the Spitalfields district of London in what became known as the 'calico riots' – calico being the term for all cotton goods derived from the

entrepot of Calicut. The selling and wearing of pure cotton goods was outlawed to protect indigenous industries. In Britain the ban lasted from 1721 until 1776, though many ingenious ways were found to get around it. Similar bans were imposed in Europe.

The popularity of cotton was established, however, and while British dyers puzzled over the secrets of the fast colours of Indian cottons, others set out to discover how the yarn could be produced in greater quantities and more cheaply. There were a number of false starts in the 1740s with machines that could spin cotton but for one reason or another were not successful. It was in the 1760s, although it is impossible to say exactly when, that the first 'spinning jennies' appeared. The invention is generally attributed to a Lancashire textile worker called James Hargreaves, who fashioned the first prototype with a penknife. It was a small machine which could revolve up to nine bobbins at a time with the turn of a single wheel which was worked by hand. There was a certain knack to it as a tension had to be kept in the threads, but it could be operated by a child and could fit into the rooms of a cottage. Revolutionary though it was, reproductions based on the original patent application show a piece of machinery that looks primitive, if not decidedly medieval.

Hargreaves was allegedly driven out of Lancashire and developed his jennies in Nottingham. The new machines were quickly copied and soon there were hundreds and then thousands at work. Not long after, Richard Arkwright arrived in Nottingham with his plans for a spinning machine that could be driven by 'gin' (an abbreviation of 'engine') horses or a waterwheel. Arkwright had no background in textiles and appears to have consulted a clock-maker about the mechanisms he needed, and he found a ready and skilled partner in Jedediah Strutt. Once their Cromford Mill began to whirr, it drew from other parts of the country, and from all over Europe, fascinated visitors, many of whom were quite obviously industrial spies.

If you glance at a diagram of the first of Arkwright's water frames, it is immediately apparent that copying it would be no easy task. There were those who bribed workmen to allow them a glimpse of spinning machines and other British technological novelties and attempted to fathom how they

worked. But with all this early equipment there was no substitute for finding someone who had spent time in the Mill and might be enticed abroad with the prospect of higher wages and a more comfortable life. Any workman who accepted such offers was taking a considerable risk, for under English law any possessions they left at home could be confiscated and they faced jail if they wanted to return.

The threats did not, however, do much to inhibit the efforts of John Holker, who was successful in enticing large numbers of English artisans to work in France. Holker was born in 1719 in Stretford near Manchester, the son of a blacksmith who died when John was in his infancy. When he was in his early twenties, Holker worked in the Manchester textile trade as an apprentice calenderer, a skilled job in which cloth was pressed between rollers to make it smooth. He went into partnership with a man called Peter Moss, who had money, and by 1745 they owned a thriving business. It was in that year that the forces supporting the claims of the 'Young Pretender' to the English throne, Bonnie Prince Charlie, reached Lancashire. Both Holker and Moss were Catholic and joined a rapidly assembled Manchester Regiment under Colonel Townley to fight for the Pretender in the uprising known for ever after as the '45. It was a mad venture which was quickly and brutally crushed, the decisive victory going to the Duke of Cumberland at Culloden. Moss and Holker were taken prisoner at Carlisle in Cumberland and, along with other officers and men involved in the rebellion, were sent to London's Newgate prison to await trial.

Newgate was a grim fortress in the mid-eighteenth century but run on commercial lines. Prisoners could pay for privileges and Peter Moss managed to bribe their jailer to sell them rope and tools to bore a hole in the prison wall. Holker was a big man and after Moss had eased through he became stuck and his friend had to go back to widen the gap. According to Holker, who would regale his French friends with the story many years later, they lowered themselves on knotted sheets to a roof which enabled them to leap across on to a merchant's house adjoining the prison. Holker missed a jump and landed in a barrel of water, but was still able to make his escape. One version of the story has Holker hidden for six weeks by a London woman with a

greengrocer's stall before he got away to Holland and on to Paris, which he reached in 1746.

In France, Holker joined a regiment of Scottish infantry fighting in Flanders and, by his own account, once again risked his neck by accompanying Bonnie Prince Charlie on a secret mission to England in 1750. The following year, he found himself a home in Rouen, Normandy, where there was an established homespun textile industry in which he took a professional interest. He went into partnership with two French associates, making velvet, but still in 1753 appears to have had a desire to return to England. Peter Moss's daughter had married into the prominent Gartside family and through them Holker asked if he might be pardoned for his treacherous Jacobite activities. Either he was refused this amnesty, or he received no reply, for in 1754 he accepted an offer to set up a textile works in Rouen. This was before the invention of the spinning jenny or the water frame, but in England at the time there were machines for preparing raw wool or cotton for spinning, and Holker persuaded the French Inspector of Cloths at Rouen that it would be worth importing some Lancastrian expertise. He was introduced to the head of the French Bureau of Commerce, Daniel Charles Trudaine, creator of the postal system and the bridges and roads department, who was convinced of Holker's abilities and knowledge.

Trudaine quickly found the money (about £350) to pay for Holker to return to England in disguise so that he could snoop around Manchester and other Lancashire towns. Holker's mother was still alive and helped him find samples of cloth and key workers with knowledge of particular processes. He worked frantically for three months, dispatching workers to be greeted by his wife at a temporary reception centre and then sent on to Rouen. In a short time a textile business with royal patronage was established in Saint-Sever on the outskirts of the town. Under Holker's direction, there was a team of English workmen including carpenters, joiners, calenderers and others. In October 1754, out of a total of eighty-six artisans at Saint-Sever, there were twenty English skilled workers and over the next few years they became influential in developing machinery for preparing and spinning cotton, not only there but in other parts of France as well.



Under Trudaine's patronage Holker flourished, earning a large salary and almost certainly prospering more than he might have done as a manufacturer back in Lancashire. That his main duty was as a spy is made clear in a letter in Trudaine's files: 'If one proposes to bring to France foreign skills, and principally those of England, where industry has made more progress than anywhere else, one can first use Sieur Holker to set up and maintain a secret correspondence with England to get thence surely and quickly all the models of machines and the samples and tools one needs.' Holker himself appears to have experienced little difficulty in bypassing the English customs officers, favouring the overcrowded port of London for transporting skilled artisans and machines to France. He chose ships sailing from the Thames to Rotterdam to allay any suspicion that cargoes were heading to Rouen. All the latest pieces of equipment – the spinning jennies from the 1760s onwards and the water frames and mules, which were hybrids of the jenny and water frame, from the 1770s – were shipped across to France illegally.

Some spies were caught. Charles Albert, a native of Strasburg, came to England in 1791 as the agent for a Toulouse firm which had cotton mills. While trying to recruit skilled workers, including a man called Geoffrey Scholes, he was arrested. He was tried in 1792 at Lancaster Assizes, where he was convicted, fined £500 and sentenced to one year in jail. Albert was unable to pay the fine and spent five years in Lancaster prison before returning to France where, undaunted, he set up his own spinning mill with the help of expatriate English artisans. He never looked back, establishing himself in Paris as a manufacturer of textile machines for which he was awarded a gold medal at the Paris Industrial Exhibition of 1806. Albert then moved into the manufacture of steam engines, for which he and his partner won more medals. Nevertheless, he ended his career simply buying in foreign inventions from England and America before his eventual retirement to Strasburg.

Holker was never caught, and in time he persuaded the French authorities that if he were given a high-ranking official position and were well paid, his conspicuous success would encourage more British artisans to follow. In April 1755 he was made one of just seven Inspectors General of Manufactures and attempted to encourage the best in British industrial practice in his adopted

country, not only in textile manufacture but other areas as well. Towards the end of his life Holker became a distinguished figure, elevated to the French aristocracy and honoured by the Academy of Sciences. He was visited by the American publisher, scholar and inventor, Benjamin Franklin, and was friendly with Thomas Jefferson, who took over from Franklin as ambassador to France in 1784. Holker was anxious to forge a closer relationship with the United States, but he died in 1786, just three years after America's victory in its War of Independence from Britain.

In the year before Holker died, a piece appeared in *The Daily Universal Register*, the forerunner of the London *Times*, which stated unequivocally that at one stage Holker (his name was spelt 'Haulker') had wanted to return to England and had asked for a pardon. Haulker was then already established in France but, so the piece claimed, offered to abandon his manufactory in Rouen if the Duke of Newcastle would allow him to establish a business again in England. According to the newspaper report, the Duke responded: 'It's all a mere trick to get a pardon, which he never shall obtain; and he may carry on what trade he pleases.' So Haulker 'reluctantly concluded with the Court of France and began to fabricate cotton cloth'.

The Duke of Newcastle then realized his mistake and offered Holker not only a pardon but a bribe of £400 if he would abandon his French factory. 'His answer,' says the *Universal Register*, 'was noble, and does him credit, though us an injury. "All I wanted [said he] was a pardon – this offer is now too late, as several gentlemen have embarked their property with me, depending on my honour to fulfil my agreement." From this cause was the cotton manufacture introduced into Normandy, and from that period, the French have done all in their power to encourage it. Spies have been repeatedly detected at Manchester and other places with models of the machinery.' In the opinion of the *Universal Register*, Holker had 'entailed more ruin and mischief on this kingdom than perhaps even the loss of America'.<sup>1</sup>

Holker was a spy, pure and simple. But there were many other visitors from France who did not travel cloak and dagger but were, on the face of it, honoured guests. Travellers such as Faujas de Saint-Fond and Monsieur Le Turc, and indeed carriageloads of distinguished Frenchmen, wrote up their

observations on the wonders of English industrialism in all apparent innocence. On their tours they were bound to take in Cromford Mill and might observe it at night with the spindles whirring under candlelight or the fiery hell of Coalbrookdale's iron foundries in the steep-sided gorge of the River Severn. Here, indeed, was the world's very first iron bridge, opened to traffic in 1781. Then there were the works at Soho just outside Birmingham where Matthew Boulton made what were known in the eighteenth century as 'toys' – buttons and buckles and all manner of metal trinkets. From the 1770s Boulton's factory also manufactured the most celebrated stationary steam engines of the day designed by the Scot, James Watt. And any serious tourist was bound to visit Etruria, where Josiah Wedgwood had his world-famous pottery which made splendid crockery and tea sets always with an eye to the latest fashions.

There was a dilemma for the leading industrialists of the day when confronted with a visitor from abroad. Men like Boulton and Wedgwood sold their wares all over Europe and they did not want to upset potential customers. It was always possible, too, that a visitor might want to order some of their wares or one of their machines and they were not necessarily averse to selling. And on occasion a foreigner might let slip some really useful piece of technical information, as happened from time to time. Matthew Boulton, for example, used his French contacts to discover the secret of *or moulu* (literally, 'ground gold') for gilding and employed at his Soho works some celebrated engravers, including the Frenchman Jean-Pierre Droz and Conrad Heinrich Kuchler from Flanders. On the other hand, they could never be quite sure if their guest had an eye to steal their trade secrets, and a decision had to be taken about how much to show them, or whether to let them in at all. Quite a few distinguished visitors were disappointed by their arm's-length treatment.

Josiah Wedgwood was one who felt seriously threatened by attempts to lure his skilled workmen away to France. In 1783 he published a little pamphlet he titled *An Address to the Workmen in the Pottery on the subject of Entering into Service of Foreign Manufacturers*, signing it 'Josiah Wedgwood FRS, Potter to her Majesty'. Prefacing his pamphlet with the proverb 'A rolling stone gathers no

moss', Wedgwood put forward a telling argument to the effect that any of his workmen who were enticed abroad by the offer of higher wages were bound to end up poorer than when they left his employ. Why could French property masters, for instance, afford to pay them at a rate six times higher than the local wage rates? 'Now they certainly cannot be gainers, so long as we are able to send among them a better and cheaper commodity than they can make themselves: and surely we shall not find it difficult to do this whilst they give double the wages that we do.'<sup>2</sup>

Inevitably, therefore, the foreign potter would seek to use the Englishmen to train up French apprentices and, once they had learned the trade, the English instructors would no longer be necessary and would certainly not command very high wages. In fact, in the long run they would probably be offered *less* than the locals. 'And such low wages would afford but miserable subsistence to Englishmen brought up from their infancy to better and more substantial fare than frogs, hedgehogs and the wild herbs of the field.'

It was not necessarily inventiveness that was stolen when a skilled worker went abroad but his knowledge of industrial technique. And that, in the eighteenth century, was what the British were thought to be especially good at: turning novel ideas into successful commercial ventures. Daniel Defoe, in his *A Plan of the English Commerce*, had written in 1728: 'It is a kind of Proverb attending the Character of English Men, that they are *better to improve than to invent*, better to advance upon the Designs and Plans which other People have laid down than to form Schemes and Designs of their Own; and which is still more, the Thing seems to be really true in Fact and the Observation very just ...'<sup>3</sup> As another proverb had it, 'For a thing to be perfect it must be invented in France and worked out in England.'

Within Britain, the theft of techniques and the enticing away of workmen from one firm to another was widespread. And it is quite probable that the celebrated inventors of textile machinery, James Hargreaves and Richard Arkwright, were really plagiarists. Conclusive evidence of who invented what does not exist. Either way, claiming an invention did not guarantee success. Hargreaves was, in the end, a failure, while Arkwright became a very rich man. It is extremely unlikely that Arkwright had the know-how or technical

ability to invent any complex machinery. He was more in the way of a fixer, who said what he wanted and got others to solve the problem. In the case of the water frame, the inventive genius was quite likely a watchmaker called John Kay whom Arkwright had met in his days as a travelling peruke- or wig-maker. Kay challenged the validity of Arkwright's patent for the water frame and won the legal battle, but only long after Arkwright had already become wealthy and been honoured with a knighthood.

The laws against the export of men and machines, which were extended throughout the eighteenth century and into the nineteenth, were the subject of a parliamentary review in 1824. Though the Select Committee, which took evidence from a wide range of manufacturers, found that espionage and the enticement of workmen abroad was still rife, the new enthusiasm for 'free trade' put an end to attempts to stem the flow of native know-how out of the country. The committee wondered if it was still true that finding workmen with special skills was so important in an age where the nature of inventions had become much more complex, the patent laws more rigorously applied and more information was available in technical publications. Skilled workers were now free to go abroad without fear of having their luggage searched for specialist tools. But the ban on the export of key machinery – the steam engine was a puzzling exception – remained until the 1840s.

In any case, as the French were to discover, transferring industrialism in bits and pieces across the Channel was never just a simple matter of enticing workmen away from home. In the age of the steam engine, an abundant and relatively cheap supply of coal was needed. Either industry had to be established on the coalfields or there had to be reasonably priced transport, which meant by boat before the coming of the railways. Britain had the huge advantage of rich coalfields lying along tidal rivers linked to each other by coastline. Most of France's coalfields were in the north while much of its textile industry was on the Rhone in the region of Lyons. That was just one fundamental difference between the two countries. There were many others to do with government's attitude to industry – which, for instance, was much more controlling in France than in Britain – as well as the attitude to manufacturing of the moneyed classes. As Arnold Toynbee was to argue in his

1888 *Lectures on the Industrial Revolution*, the key to 'take off' was a loosening of old guild restrictions and other cultural inhibitors of industrial growth.

The key figure, then, was perhaps not so much the skilled artisan as the talented entrepreneur or businessman. Men such as Matthew Boulton and Josiah Wedgwood combined both skills. In a later period they might well have considered moving their factories abroad to tap cheaper land and labour or to expand their business. As it was, they were content to sell to foreign buyers. However, there was a contemporary of theirs who seemed to suffer no fear at all of foreign competition, especially from the French. So assured was he of his superiority that he had no compunction in planting his industry on French soil, and it was not without reason that he became known as 'Iron Mad' Wilkinson.