

Introduction: What this Book Is About

This book sets out the process by which a small group of islands off the Eurasian Continent catalysed a revolution in human welfare that has permitted the global population to increase by almost ten times while everybody became unimaginably richer. The Industrial Revolution was the most important transition for mankind since the development of agriculture, and much more unequivocally positive in its effects on living standards. It is a story of superior economic policies, political and scientific ideas, over a period of some 180 years, that enabled islands with only minor special advantages to develop in a unique way that turned out incalculably beneficial for humanity.

I shall begin by showing what preconditions, in terms of both resources and policies, were essential for the development of an industrial society from a mediaeval one. I have listed a total of sixteen such factors, all of which contributed significantly; one could argue that one or other such factor was unnecessary, but we have only a few 'control experiments' so can demonstrate only that societies without several such factors did not make this development. (I shall assume that the 'game' begins in the early seventeenth century, so that certain necessities such as printing, settled agriculture and ocean-going transportation already exist and are available throughout Europe.) I shall show why the preconditions are needed to create any industrial economy, regardless of where it is created. By applying this template to societies other than Britain, I shall show in what respects they were lacking. I shall then examine the development of British policies and society, to show how the necessary conditions for industrialization were developed and enhanced.

Factors Needed to Move from a Mediaeval Society to an Industrial One

Individual Freedom

British society at the time of the Industrial Revolution differed from all contemporary Continental societies except the Netherlands in one overwhelmingly important respect: almost all its people were fully free. That freedom derived from the period after a pandemic, the Black Death.

Before the Black Death the Norman Conquest of England had sharply compromised the living standards and embryonic freedoms of the then-indigenous Saxons. The Normans appropriated the large land-holdings and imposed serfdom, the more severe French version of feudalism. Most of the Saxon population existed in an unfree status for the following centuries, providing labour and possibly military service to their feudal lord, and receiving no cash compensation. As England became more settled and its wealth increased, more land was cleared and cultivated. However, population increase among the serfs kept them mired in serfdom, even though the non-rural sectors of the economy were developing a cash economy with free exchange.

Then the Black Death from 1348 wiped out at least a third of the population. The result was a severe labour shortage. In response, the ruling classes who controlled Parliament passed the Statute of Labourers 1351, prohibiting working people's wages from being increased. These restrictions were initially somewhat effective, but over generations, with people moving, new employers emerging and new job types appearing, they became a dead letter – the Peasants Revolt of 1381 showed the former serfs asserting their new autonomy. By the fifteenth century, wage restrictions had effectively disappeared – the descendants of the serfs freed themselves and worked for the much higher wages now available. This period was in retrospect known as 'Merrie England'. For many of the former serfs, if not for those embroiled with their former masters in the Wars of the Roses, it was indeed 'Merrie'!

This liberation happened across Europe for similar demographic reasons, but England and the future Netherlands saw workers liberated more fully than in France, Spain or the Holy Roman Empire. Thus, even though living standards declined again with increasing population after 1500, the greater freedom of English labour, maintained even through the impoverished early seventeenth century, was an important contributor to the Industrial Revolution.

English working men were free to move about the country, provided they could support themselves – only the 1601 Poor Law, which provided

a minimal subsistence for the indigent on a parish basis, forced those seeking relief to return to their home parish. They were also free to work in any occupation they chose and to make any arrangement they could negotiate with their employer.

These freedoms were essential to the genesis of the Industrial Revolution, and a leading reason why it happened first in Britain. The Holy Roman Empire, for example, full of industrious and well-schooled German engineers, was still bedevilled by serfdom and feudal obligations in the eighteenth century because the Thirty Years' War (1618-48) had re-immiserated much of its populace. Consequently, German industrialization was mostly delayed until after 1850.

Rule of Law

As well as individual freedom, the rule of law was necessary for industrialization. Laws should be clearly and unambiguously stated, equitably applied and universally applicable, and the arbitrary misuse of them by a king or bureaucrat should be prevented. In mediaeval societies, kings and other powerful nobles often acted above the law, subverting the lives, rights and property of ordinary people. In the eighteenth century, that was still the case in France and Spain, but not in the Holy Roman Empire, the Netherlands or Britain.

The development of English law reflected a perception that the power of the king had limits. Sir John Fortescue's¹ 1470 work, *The Difference between an Absolute and Limited Monarchy*, describes how the English monarchy was bound by law, rather than absolute like the French one. In practice, it was possible for an English King like Henry VIII² to flout the law.

The Civil War and the Interregnum, together with the legalism of the seventeenth century and the 1689 Bill of Rights, established the rule of law as a bedrock constitutional principle. Legal scholars and Members of Parliament played an important role in resurrecting shadowy mediaeval or Saxon liberties and establishing a solid legal structure that provided effective opposition to the early Stuart Kings.

1. Sir John Fortescue (1394-1479) Kt. MP for Tavistock, 1421-25, Totnes, 1426 and 1432, Plympton Erle, 1429, and Wiltshire, 1437. Chief Justice of the King's Bench, 1442-60. He held the nominal title of Chancellor of England during Henry VI's exile and redeption, 1463-71.

2. Henry VIII (1491-1547). King of England, 1509-47.

Sir William Blackstone's³ *Commentaries on the Laws of England* (1765-69) codified English common law and made it available to ordinary people. Eighteenth-century Britain was a highly, even excessively, legalistic society, and the courts were often abominably slow and expensive. However, the existence of a rock-solid legal system was universally accepted and an enormous protection for entrepreneurs whose success conflicted with existing vested interests.

Scientific Revolution

To design and produce the complex machinery necessary for an industrial society, the Scientific Method was essential. Without it, *ad hoc* advances might have occurred but the kind of sustained scientific advance over a prolonged period that produced James Watt's⁴ steam engine, Arthur Woolf's Cornish Engine and the first workable locomotives would have been impossible.

The Scientific Method, propounded by, amongst others, Francis Bacon⁵ in his *Novum Organum Scientiarum* (1620), showed the practical technologists of the seventeenth, eighteenth and nineteenth centuries how they could perfect their machines using an iterative method of practical experimentation refined by theoretical reasoning, leading to further practical experimentation. This powerful methodology produced more sustained advances than had previously been possible and provided an intellectual paradigm that would prove key to the Industrial Revolution.

The Scientific Method and the quickened pace of scientific advance to which it led explain well why the Industrial Revolution occurred in Western Europe in the eighteenth and nineteenth centuries. Western European countries other than Britain had equal access to Bacon's treatise (which was written in Latin and published in the Netherlands). They also had access to the research other great scientists of the time,

3. William Blackstone (1723-1780). Kt 1770. Tory MP for Hindon, 1761-68, and Westbury, 1768-70. Vinerian Professor of English Law, Oxford, 1759-66. Justice of King's Bench, 1770-80. *Commentaries on the Laws of England* (1765-69).

4. James Watt (1736-1819). Invented steam condenser, 1765. Partnership with Matthew Boulton, 1775, with whom he developed the first truly economically superior steam engines.

5. Francis Bacon (1561-1626). Kt 1603, Baron Verulam, 1618, Viscount St Alban, 1621. MP for Bossiney, 1581, Weymouth and Melcombe Regis, 1584, Taunton, 1586, Liverpool, 1589, Middlesex, 1593, Ipswich, 1601 and 1604, and Cambridge University, 1614. Attorney-General, 1613-17, Lord Chancellor, 1617-21.

only a minority of whom were British. Countries outside Europe, such as China, Japan, the Mughal and the Ottoman Empires, accessed Bacon's work only indirectly, and their intellectual climate was less well equipped to take advantage of its paradigm.

As well as the Scientific Method itself, it was also necessary for a society's business and professional class, within the overall Baconian paradigm, to be oriented towards practical experimentation and results rather than theoretical knowledge. N.A.M. Rodger, the naval historian, in discussing the progress of ship design in the eighteenth century,⁶ illustrates the difference between British approaches and those of its naval rival, France. Among others, no less a mathematician than Leonhard Euler⁷ advised the French navy on ship design, focussing on the fashionable subject of hydrodynamics, but omitting consideration of skin friction, which at sailing ship speeds contributed almost the entire resistance to motion. Thus, Euler's work was useless. Conversely, British shipwrights focussed on the practical problems faced by sailing ships under normally rough conditions over prolonged periods at sea, and came up with copper-bottoming, which after its adoption by the British navy gave Britain a decisive naval advantage.

Rodger's explanation of Britain's greater ability to make important practical advances in ship design applies equally to the practical advances in manufacturing technology and techniques that formed the Industrial Revolution. Then, as now, few industrial advances took place at the cutting edge of scientific knowledge; instead, they rested on the application of well-established scientific knowledge to practical problems and situations.

Rights and Security of Private Property

Building a business using a new technology requires the investment of much capital, with a high risk of failure and a relatively long pay-back. Its risks are not only unquantifiable but also un-assessable; it differs qualitatively from sending a trading ship on a long voyage.

6. N.A.M. Rodger, *The Command of the Ocean: A Naval History of Britain, 1649-1815* (New York: W.W. Norton, 2004), p. 410.

7. Leonhard Euler (1707-83). Swiss mathematician, physicist, astronomer, logician and engineer, the most eminent mathematician of the eighteenth century. Pioneered topology and analytic number theory; introduced the concept of a function and the modern notation for trigonometric functions, the base of natural logarithms e and the imaginary number i . Also discovered that $e^{i\pi} + 1 = 0$.

(An insurance company can provide insurance against shipwreck by insuring large numbers of similar voyages, but each new technological investment is unique; there is no way to find insurance against its possible failure.) To enter such a venture, generally absorbing most of his capital, an entrepreneur must have highly secure property rights, against expropriation by a government, a powerful noble, his workforce or a fellow citizen armed with a good lawyer and a friendly judge.

Rock-solid property rights are generally not possible in an absolutist regime, or in one with an uncertain legal code. They are the most important single requirement for industrial capitalism to come into existence, even more important than wholly free markets. A lengthy period of well-defined, well-enforced property rights, without the intervention of military, political or financial factors is essential for industrialization to occur.

When examining societies for their potential for industrialization, we should examine their potential for a long period of solid property rights, without externally imposed interruptions. Geography, making a society relatively immune from military incursions, is an additional important factor. Property must be secure against marauding armies and domestic agitators, who can destroy property and render long-term plans nugatory. Industrial investment requires a much greater physical security than farming, where the loss of a year's crop can be repaired in the following year.

Britain was lucky in this respect. Its Civil War was not especially destructive, and occurred early in the pre-industrialization process, before major investments were at stake. Then Britain enjoyed two centuries of domestic peace, protected by the Royal Navy, with only brief and unsuccessful Jacobite rebellions in 1715 and 1745 and a small abortive French attack in 1798. With stable governments firmly committed to maintaining order, violent unrest was also minor before the 1830s.

Contrast this with the experience of the other European competitors for industrialization. Spain had one major domestic incursion, the War of the Spanish Succession, before falling victim to Napoleon in 1808. France had a civil war (the Fronde) in 1648-53, then a lengthy period of domestic peace until both domestic and foreign military chaos after 1789. The Netherlands was invaded by France in 1672-78 but was then tranquil until modest domestic revolts in 1783-87 and the French Revolutionary invasion of 1795. The Holy Roman Empire fared worst of all, suffering the immensely damaging 'Thirty Years' War between 1618 and 1648, then being the scene of most of the conflicts over the following century, before succumbing to French invasion and domestic

chaos after 1792. Lack of domestic tranquillity was a significant obstacle to industrialization in most European countries, with the Holy Roman Empire worst off.

In Britain, it was also necessary for 'Luddism' to be resisted. The first major outbreak of machine-breaking occurred in 1779, in the early stages of the adoption of water-powered machinery in the textile sector, which threatened traditional 'cottage' textile operations. One Ned Ludd, a weaver from Anstey, Leicestershire, allegedly smashed two stocking frames, but this was only a small part of a substantial outbreak that included the destruction of one of Richard Arkwright's⁸ mills in Birkacre, Lancashire.

The authorities suppressed the disturbances on public order grounds, but there were further disturbances over the next four decades, particularly during the economically difficult decade of the 1790s. The most serious outbreaks came in 1812, after Napoleon's Milan Decree had cut off most of Britain's export markets, throwing many textile operators out of work, after an exceptionally poor harvest in 1811 had raised the price of grain to exceptional levels.

The government's answer to the riots was the Destruction of Stocking Frames etc. Act 1812, which made the destruction of industrial machinery a capital felony. The Second Earl of Liverpool,⁹ Leader of the House of Lords in Spencer Perceval's¹⁰ government, introduced the bill in the House of Lords (and Lord Byron used his maiden speech in the upper chamber to oppose it). Nobody was executed under the specific provisions of the Act (which expired automatically two years later) but it acted as an effective deterrent to machine-breaking activity, which died down thereafter.

Perceval, Liverpool and their colleagues knew that the labour-saving machinery of the Industrial Revolution was improving living standards rapidly, even though some traditional workers, such as framework knitters, handloom weavers and 'croppers' were being made redundant by the innovations. Since those groups contained over 100,000 workers, the social disruption and hardship was considerable.

8. Richard Arkwright (1732-92). Kt 1786. Invented the spinning frame, known as the 'father of the modern factory system'. High Sheriff of Derbyshire, 1787.

9. Robert Banks Jenkinson (1770-1828), 2nd Earl of Liverpool from 1808. MP for Rye, 1790-1803. Foreign Secretary, 1801-4, Leader of the House of Lords, 1803-6, 1807-27, Home Secretary, 1804-6, 1807-9, Secretary for War and the Colonies, 1809-12, Prime Minister, 1812-27.

10. Spencer Perceval (1762-1812). Attorney-General, 1802-6, Chancellor of the Exchequer 1807-12, Prime Minister 1809-12.