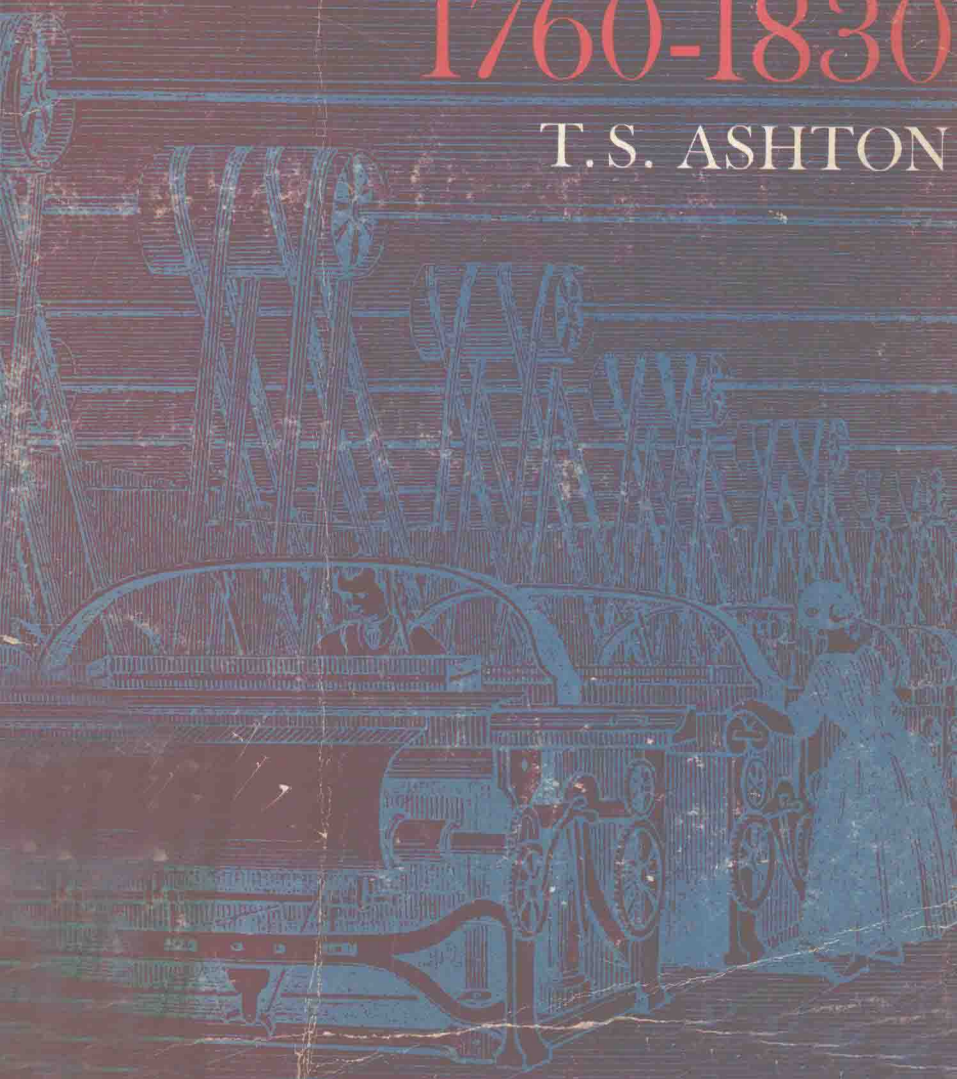


# THE INDUSTRIAL REVOLUTION

1760-1830

T.S. ASHTON



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OXFORD UNIVERSITY PRESS

LONDON    OXFORD    NEW YORK

First published by Oxford University Press, London, 1948  
Reprinted with revisions, 1962  
First issued as an Oxford University Press paperback, 1964  
This reprint, 1967  
Printed in the United States of America

## PREFACE

No one who teaches at the London School of Economics can ever be sure how much of what he writes is his own and how much belongs to his associates and pupils. This book is based on the work of many scholars (not all of whom will agree with the interpretation it offers). In particular, my colleagues H. L. Beales and F. J. Fisher have contributed perhaps more than they realize. The paragraphs on the cotton industry and on the standard of life of the workers are drawn from the researches of Miss Frances Collier of the University of Manchester, and those on the coal and iron industries have gained from the reading of an unpublished thesis by A. H. John. The statistical material, without which the book could hardly have been written, was assembled by a former student, W. Ashworth; and the final chapter owes something to brief conversations with Professor W. W. Rostow of Harvard. I thank them all.

LONDON

*May 1947*

T. S. A.

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## *Chapter I*

### INTRODUCTION

In the short span of years between the accession of George III and that of his son, William IV, the face of England changed. Areas that for centuries had been cultivated as open fields, or had lain untended as common pasture, were hedged or fenced; hamlets grew into populous towns; and chimney stacks rose to dwarf the ancient spires. Highroads were made—straighter, stronger, and wider than those evil communications that had corrupted the good manners of travellers in the days of Defoe. The North and Irish Seas, and the navigable reaches of the Mersey, Ouse, Trent, Severn, Thames, Forth, and Clyde were joined together by threads of still water. In the North the first iron rails were laid down for the new locomotives, and steam packets began to ply on the estuaries and the narrow seas.

Parallel changes took place in the structure of society. The number of people increased vastly, and the proportion of children and young people probably rose. The growth of new communities shifted the balance of population from the South and East to the North and Midlands; enterprising Scots headed a procession the end of which is not yet in sight; and a flood of unskilled, but vigorous, Irish poured in, not without effect on the health and ways of life of Englishmen. Men and women born and bred on the countryside came to live crowded together, earning their bread, no longer as families or groups of neighbours, but as units in the labour force of factories; work grew to be more specialized; new forms of skill were developed, and some old forms lost. Labour became more mobile, and higher standards of comfort were offered to those able and willing to move to centres of opportunity.



At the same time fresh sources of raw material were exploited, new markets were opened, and new methods of trade devised. Capital increased in volume and fluidity; the currency was set on a gold base; a banking system came into being. Many old privileges and monopolies were swept away, and legislative impediments to enterprise removed. The State came to play a less active, the individual and the voluntary association a more active, part in affairs. Ideas of innovation and progress undermined traditional sanctions: men began to look forward, rather than backward, and their thoughts as to the nature and purpose of social life were transformed.

Whether or not such a series of changes should be spoken of as 'The Industrial Revolution' might be debated at length. The changes were not merely 'industrial', but also social and intellectual. The word 'revolution' implies a suddenness of change that is not, in fact, characteristic of economic processes. The system of human relationships that is sometimes called capitalism had its origins long before 1760, and attained its full development long after 1830: there is a danger of overlooking the essential fact of continuity. But the phrase 'Industrial Revolution' has been used by a long line of historians and has become so firmly embedded in common speech that it would be pedantic to offer a substitute.

The outstanding feature of the social history of the period—the thing that above all others distinguishes the age from its predecessors—is the rapid growth of population. Careful estimates, based on figures of burials and christenings, put the number of people in England and Wales at about five and a half millions in 1700, and six and a half millions in 1750: when the first census was taken in 1801 it was a round nine millions, and by 1831 had reached fourteen millions. In the second half of the eighteenth century population had thus increased by 40 per cent., and in the first three decades of the nineteenth century by more than 50 per cent. For Great Britain the figures are approximately eleven millions in 1801, and sixteen and a half millions in 1831.

The growth of population was not the result of any marked change in the birth rate. During the first four decades of the eighteenth century, it is true, the number of births per thousand people seems to have risen a little. Farm labourers tended to set up households of their own instead of boarding with their employers, and a decline of the system of apprenticeship in industry also led to earlier marriage and larger families. But from 1740 to 1830 the birth rate appears to have fluctuated only very slightly: for no decade does the estimate rise

above 37.7, or fall below 36.6. Throughout the industrial revolution fertility was high but steady.

Nor can the increase of people be attributed to an influx from other countries. In every decade men and women took ship from Ireland to England and Scotland, and at times of dearth the trickle became a stream. But there was no such torrent of Irish immigration as was to come in the last five years of the eighteen-forties. On the other hand, during the eighteenth century perhaps a million people left Britain to seek a living overseas, mainly in the colonies. Among them were some 50,000 criminals transported to Maryland or Botany Bay, and a number of artisans who defied the law by carrying their technical knowledge and skill to Europe—not in the long run, it may be guessed, to the disadvantage of their native land. On balance, Britain was not a receiving centre but a breeding-ground for new communities across the seas.

It was a fall of mortality that led to the increase of numbers. In the first four decades of the eighteenth century excessive indulgence in cheap gin and intermittent periods of famine took a heavy toll of lives; but between 1740 and 1820 the death rate fell almost continuously—from an estimated 35.8 for the ten years ending in 1740 to one of 21.1 for those ending in 1821. Many influences were operating to reduce the incidence of death. The introduction of root crops made it possible to feed more cattle in the winter months, and so to supply fresh meat throughout the year. The substitution of wheat for inferior cereals, and an increased consumption of vegetables, strengthened resistance to disease. Higher standards of personal cleanliness, associated with more soap and cheaper cotton underwear, lessened the dangers of infection. The use of brick in place of timber in the walls, and of slate or stone instead of thatch in the roofs of cottages reduced the number of pests; and the removal of many noxious processes of manufacture from the homes of the workers brought greater domestic comfort. The larger towns were paved, drained, and supplied with running water; knowledge of medicine and surgery developed; hospitals and dispensaries increased; and more attention was paid to such things as the disposal of refuse and the proper burial of the dead.

Since there are no reliable statistics it is not possible to say which age groups of the population benefited most from these improvements. In a well-known passage of his *Autobiography* Edward Gibbon says:

‘The death of a new-born child before that of its parents may seem an unnatural, but it is strictly a probable event; since of any given number, the

greater part are extinguished before their ninth year, before they possess the faculties of mind or body. Without accusing the profuse waste or imperfect workmanship of Nature, I shall only observe that this unfavourable chance was multiplied against my infant existence. So feeble was my constitution, so precarious my life, that in the baptism of each of my brothers, my father's prudence repeated my Christian name of Edward, that in case of the departure of the eldest son, this patronymic appellation might be still perpetuated in the family.'

This was written in 1792-3. By that time it is probable that the profuse waste of infant life was a little less than at the date of Gibbon's birth, and, if so, there would be a higher percentage of children and young people in the population. It is a matter to be borne in mind in considering the constitution of the labour force of the early factories.

The increase of the population of Britain occurred at a time when the output of commodities was also increasing at a rapid rate, and this coincidence has led to hasty generalizations. Some writers have drawn the inference that it was the growth of industry that led to the growth of numbers. If this were true the growth of industry must have exerted its influence, not through the birth rate (which, as we have seen, remained steady), but through the death rate. Some of the improvements in the arts of living mentioned above certainly depended on a development of industry, but it would be rash to assign to this a major part in the reduction of mortality. For population was growing rapidly, not only in Britain, but also in most other countries of western and northern Europe, where nothing in the nature of an industrial revolution occurred.

Other writers, reversing the causal sequence, have declared that the growth of population, through its effect on the demand for commodities, stimulated the expansion of industry. An increase of people, however, does not necessarily mean either a greater effective demand for manufactured goods or an increased production of these in the country concerned. (If it did we should expect to find a rapid economic development of Ireland in the eighteenth, and of Egypt, India, and China in the nineteenth century.) It may just as well lead to a lower standard of life for all. The spectre of the pressure of population on the means of subsistence which oppressed the mind of Malthus in 1798 was no chimera. It is true that the immediate pressure was less than Malthus supposed. But if, after the middle of the nineteenth century, there had been no railways in America, no opening up of the prairies, and no steamships, Britain might have learnt from

bitter experience the fallacy of the view that, because with every pair of hands there is a mouth, therefore every expansion of numbers must lead to an increase of consumption and so of output. In Britain, in the eighteenth century and later, it so happened that, alongside the increase of population, there was taking place an increase of the other factors of production, and hence it was possible for the standard of life of the people—or of most of them—to rise.

There was an increase in the acreage of land under cultivation. Much attention was given to the draining of fens and marshes, to the breaking up and turning to arable of the old, rough, common pastures (which were usually spoken of as the waste), and to the hedging of land, so as to make it more productive of both crops and livestock. 'In this manner', wrote an observer of these developments, 'was more useful territory added to the empire, at the expence of individuals, than had been gained by every war since the Revolution.' Several new crops were introduced. The turnip made it possible to increase the size of the herds of cattle, and the potato, which was becoming a popular food in the North, brought substantial economies in the use of land. More will be said later about the agricultural and agrarian changes. It is sufficient here to make the point that land previously outside the system of economic activities was being drawn in, and put to better use. The lines of the moving frontier can be discerned on the hillsides to-day by those with eyes to see.

At the same time there was taking place a rapid increase of capital. The number of people with incomes more than sufficient to cover the primary needs of life was growing: the power to save was increasing. Stable political and social conditions, following the settlement of 1688, encouraged men to look to more distant horizons: what economists call time-preference was favourable to accumulation. The class structure also was favourable to it. It is generally recognized that more saving takes place in communities in which the distribution of wealth is uneven than in those in which it approaches more closely to modern conceptions of what is just. Estimates of statisticians, from Gregory King in 1688 to Colquhoun in 1812, exhibit wide variations in the incomes of different social classes; and the rise of new institutions, including that of the National Debt, intensified the disparities that had been handed down from earlier generations.

The public debt, as we know it to-day, arose out of the exigencies of the wars of William III. It grew steadily—almost entirely as the result of successive wars—until, by 1815, it had reached a figure of £861 millions. Not all of it was held by the British people themselves:

in 1776, perhaps a quarter or more of it was in the hands of the Dutch. But, after 1781, when Holland became involved in war with Britain, the great bulk of the debt came to be held in this country—by noblemen, squires, lawyers, retired merchants, and widows and spinsters of the well-to-do classes. In 1815 perhaps about one-eleventh, and in 1827 (according to the estimate of Sir Henry Parnell) one-twelfth, of the money income of the people of the United Kingdom consisted of sums raised from the taxpayers, including the poor, and transferred to the relatively rich holders of government bonds. In this way, increasingly, wealth came into the hands of those whose propensity was to save, rather than to spend.

Accumulation does not of itself, however, lead to the creation of capital goods: it was not only a willingness to save, but also a willingness to employ savings productively, that increased at this time. In the early eighteenth century, landlords had used saved resources to improve their own estates, merchants to extend their markets, and manufacturers to engage more labour; and some of the savings of the retired and leisured classes had been lent on mortgage to local landowners, farmers or tradesmen, or invested in the shares of a turnpike trust. Gradually the market for capital widened, aided by the rise of country bankers (who existed long before they took the name). The offer by the State of a mass of gilt-edged stock accustomed men to the idea of impersonal investment, and so they came to put their savings into enterprises distant in space and speculative in character. That the results might not always be advantageous was made manifest when the South Sea Bubble burst in 1720 and brought ruin to thousands. But, in general, the increased mobility of capital was socially beneficial, leading as it did to a substantial fall in the rate of interest.

For centuries the attitude of the State to the taking of interest had been one of hostility or, at least, of suspicion. The State was an habitual debtor—and laws had been passed prohibiting the making of loans at more than a prescribed rate. In 1625 the legal rate had been lowered from 10 to 8 per cent.; in 1651 it was reduced to 6, and in 1714 to 5—in each case following upon a fall in the 'natural' rate. In the early eighteenth century the abundance of loanable funds made it possible for finance ministers to reduce the interest paid to the creditors of the State. During the wars, the Government of William III had been obliged to offer 7 or 8 per cent. (the Usury Laws did not apply to the State); but in 1717 the rate on the perpetual annuities was reduced to 5, and in 1727 to 4 per cent. Finally, in the 1750s, Pelham lowered it once more, and, by converting a number of issues

into a single one, brought into being, in 1757, the 3 per cent. Consolidated Stock which, for short, we call Consols. These conversions were not imposed on an unwilling public: they reflected, rather than initiated, a fall of the rate of interest in the community generally. There was, at this period, no single market rate to which reference can be made, but the process can be observed in the rising price of Bank of England stock; and the ledgers of merchants and manufacturers afford further evidence of what was taking place. Much economic activity at this time was controlled by small groups of partners, each of whom was entitled either to receive his share of the annual profits or to leave it, wholly or in part, to earn interest in the concern. During the early part of the eighteenth century the rate allowed on money reinvested in this way was falling steadily. A firm of ironmasters of Worcestershire, Edward Knight and Company, for example, credited each partner with 5 per cent. on the undistributed profit during the 'twenties and early 'thirties, but in 1735 the rate was reduced to 4, and in 1756 to as little as 3 per cent. If a group of men were considering the investment of their savings in some new, large capital enterprise, such as a turnpike, they would first make an estimate of the number of years it would take for their capital to be restored to them in full. If the current rate of interest were 5 per cent. it would be worth while embarking on an undertaking that would return the capital in twenty years; at 4 per cent. investment might be extended to one that would take twenty-five years, and at 3 per cent. to one that would take up to thirty-three and a third years, to reimburse the initial outlay. The lower the rate at which capital could be obtained—the smaller the advantage foregone in locking it up in a fixed form—the further would capital works be extended.

As early as 1668 Sir Josiah Child remarked that 'all countries are at this day richer or poorer in an exact proportion to what they pay, and have usually paid, for the Interest of Money'. He went on to observe that 'the bringing down of Interest from 6 to 4, or 3 per cent. will necessarily . . . double the Capital Stock of the Nation' and added that 'the Nobility and Gentry, whose estates lie mostly in Land, may presently upon all they have, instead of fifty write one hundred'. In spite of this early exposition of the relation between interest, capital, and well-being, the importance of the lowering of the rate of interest in the half-century before the industrial revolution has never been properly stressed by historians. If we seek—it would be wrong to do so—for a single reason why the pace of economic development quickened about the middle of the eighteenth century, it is to this we

must look. The deep mines, solidly built factories, well-constructed canals, and substantial houses of the industrial revolution were the products of relatively cheap capital.

One thing more was necessary: the increasing supplies of labour, land, and capital had to be co-ordinated. The eighteenth and early nineteenth centuries were rich in entrepreneurs, quick to devise new combinations of productive factors, eager to find new markets, receptive to new ideas. 'The age is running mad after innovation', said Dr. Johnson; 'all the business of the world is to be done in a new way; men are to be hanged in a new way; Tyburn itself is not safe from the fury of innovation.' The sentiments and attitudes of mind of the period were propitious. The religious and political differences that had torn society apart in the two preceding centuries had been composed; and if the eighteenth century was not markedly an age of faith, at least it practised the Christian virtue of tolerance. The regulation of industry by guilds, municipalities, and the central government had broken down or had been allowed to sleep, and the field was open for the exercise of initiative and enterprise. It was perhaps no accident that it was in Lancashire and the West Riding, which had been exempted from some of the more restrictive provisions of the Elizabethan code of industrial legislation, that the development was most marked. It was certainly no accident that it was the villages and unincorporated towns—places like Manchester and Birmingham—that grew most rapidly, for industry and trade had long been moving away from the areas where some remnants of public control were still in operation.

During the seventeenth century the attitude of the Law had changed: from the time of Coke judgements in the courts of Common Law had become tender indeed to the rights of property, but hostile to privilege. In 1624 the Statute of Monopolies had swept away many vested interests, and a century and a half later Adam Smith was able to say of Englishmen that they were 'to their great honour of all peoples, the least subject to the wretched spirit of monopoly'. Whether or not the patent system, the lines of which had been laid down by that same Statute, was stimulating to innovation in industrial practice is not easy to determine. It gave security to the inventor, but it allowed some privileged positions to be maintained for an undue length of time, and it was sometimes used to block the way to new contrivance: for nearly a quarter of a century, for example, James Watt was able to prevent other engineers from constructing new types of steam engine, even under licence from himself. Many

manufacturers—not all from disinterested motives—opposed the application of the law and encouraged piracy. Associations were brought into being in Manchester and other centres of industry to contest the legality of rights claimed by patentees. The Society for the Encouragement of Arts, Manufactures and Commerce, founded in 1754, offered premiums to inventors who were willing to put their devices at the free disposal of all. And Parliament itself made awards (for example, £14,000 to Thomas Lombe when his patent for silk-throwing expired, £30,000 to Jenner for the discovery of vaccine inoculation, £10,000 to Edmund Cartwright for various contrivances, and £5,000 to Samuel Crompton for his invention of the ‘mule’) in addition to the substantial annual grants it voted for the use of the Board of Agriculture and the Veterinary College. Without any such monetary incentive, one of the outstanding industrialists, Josiah Wedgwood, resolved ‘to be released from these degrading slavish chains, these mean, selfish fears of other people copying my works’; and, at a later stage, the inventors of the safety lamps, Sir Humphry Davy, Dr. Clanny, and George Stephenson, all refused, in the interest of the miners, to take out patents for their devices. It is at least possible that without the apparatus of the patent system discovery might have developed quite as rapidly as it did.

Some accounts of the technological revolution begin with the story of a dreamy boy watching the steam raise the lid of the kettle on the domestic hearth, or with that of a poor weaver gazing with stupefaction at his wife’s spinning wheel, overturned on the floor but still revolving. These, needless to say, are nothing but romantic fiction. Other accounts leave the impression that the inventions were the work of obscure millwrights, carpenters, or clockmakers, untutored in principles, who stumbled by chance on some device that was destined to bring others to fame and fortune and themselves to penury. It is true that there were inventors—men like Brindley and Murdoch—who were endowed with little learning, but with much native wit. It is true that there were others, such as Crompton and Cort, whose discoveries transformed whole industries, but left them to end their days in relative poverty. It is true that a few new products came into being as the result of accident. But such accounts have done harm by obscuring the fact that systematic thought lay behind most of the innovations in industrial practice, by making it appear that the distribution of rewards and penalties in the economic system was wholly irrational, and, above all, by over-stressing the part played by chance in technical progress. ‘Chance’, as Pasteur said, ‘favours only the mind



which is prepared': most discoveries are achieved only after repeated trial and error. Many involve two or more previously independent ideas or processes, which, brought together in the mind of the inventor, issue in a more or less complex and efficient mechanism. In this way, for example, the principle of the jenny was united by Crompton with that of spinning by rollers to produce the mule; and the iron rail, which had long been in use in the coal mine, was joined to the locomotive to create the railway. In such cases of what has been called cross-mutation the part played by chance must have been very small indeed.

Yet other accounts of the industrial revolution are misleading because they present discovery as the achievement of individual genius, and not as a social process. 'Invention', as a distinguished modern scientist, Michael Polanyi, has remarked, 'is a drama enacted on a crowded stage.' The applause tends to be given to those who happen to be on the boards in the final act, but the success of the performance depends on the close co-operation of many players, and of those behind the scenes. The men who, together, whether as rivals or as associates, created the technique of the industrial revolution were plain Englishmen or Scots,

Being neither demigods nor heroes,  
But ingenious, hard-working descendants of *homo sapiens*,  
Who had the luck to plant their seedlings in fine weather,  
Not in the frost or storm, but when the slow ripening of time, the felicitous  
crossing of circumstance  
Presented unimagined opportunities,  
Which they seized. . . .

(The words are those of a master cotton-spinner, Godfrey Armitage, of our own day.)

Invention appears at every stage of human history, but it rarely thrives in a community of simple peasants or unskilled manual labourers: only when division of labour has developed, so that men devote themselves to a single product or process, does it come to harvest. Such division of labour already existed when the eighteenth century opened, and the industrial revolution was in part cause, and in part effect, of a heightening and extension of the principle of specialization.

Invention, again, is more likely to arise in a community that sets store by things of the mind than in one that seeks only material ends. The stream of English scientific thought, issuing from the teaching of