

Economia Marche

Lecture, 1990

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The industrial revolution revisited

THE INDUSTRIAL REVOLUTION REVISITED

of David S. Landes

Now without intending to depreciate in any manner the heroic efforts of the French Revolution and the immense gratitude the world owes the great men of the Republic, we think that the relative position of France and England with regard to cosmopolitanism is not at all justly delineated in the above sketch (by Louis Blanc).

We entirely deny the cosmopolitic character ascribed to France before the Revolution, and the times of Louis XI and Richelieu may serve as proofs. But what is it Mr. Blanc ascribes to France? That she could never make predominant any idea except it was to benefit the whole world. Well, we should think Mr. Louis Blanc could not show us any country in the world which could do otherwise than France is said to have done. Take England, for instance, which Mr. Blanc places in direct opposition to France. England invented the steam engine; England erected the railway — two things which we believe are worth a good many ideas. Well, did England invent them for herself or for the whole world? The French glory in spreading civilization everywhere, principally in Algiers. Well, who has spread civilization in America, in Asia, Africa and Australia, but England?

Friedrich Engels

The Northern Star, XI, N. 530 (18-12-1847)

What may well be the first use of the term “Industrial Revolution” dates from 1799, when a French envoy to Berlin with the German name of Otto wrote that his country had already entered upon

the industrial revolution¹. As the name came into wider use, especially among such political economists as N. Briavoinne, it was intended to convey the sense that a number of European nations had passed, were passing, or were about to pass through a profound and momentous economic change that would alter them forever². What is more, this was a change of universal import: no corner of the globe was immune to its effects, which were seen by many, including radical political dissenters, as intrinsically and "objectively" progressive. As the epigraph above shows, this was true even of Friedrich Engels, but also of Karl Marx, for all their denunciation of the abuses and suffering that accompanied the rise of "modern industry". (Engels 1845, Marx 1867).

In those days the Industrial Revolution was not yet a theme of scholarly analysis and debate, although the name itself was soon consecrated by use and the political-social-economic implications of these changes became matter for state policy and political polemic. Thus there is a substantial body of literature, going as far back as the late 18th century, dealing with the strategic, national implications of the new industrial technologies and the urgent necessity for other countries to follow Britain (Alexander Hamilton, J.-A. Chaptal, Friedrich List, Gustav Mevissen, et al.); and another literature from about the same period describing and debating the social and moral conditions and consequences of the new industrial system.

¹ "La revolution industrielle est commencée en France". Louis-Guillaume Otto (1754-1817) was a career diplomat whose highest post was that of ambassador to Vienna from 1809 to 1813. I owe the Otto reference, which is the earliest use of "industrial revolution" to come to my attention, to François Crouzet, who has it from Annick Pardailhe-Galabrun, Ingenieur of the Centre National de Recherche Scientifique and member of the Centre de Recherches sur la Civilisation de l'Europe moderne, Université de Paris-Sorbonne (Paris VI). My thanks to both. The document in question is from a Memoire attached to a letter of 18 Messidor An VII (6 July 1799), Archives des Affaires Etrangères, Memoires et Documents Angleterre 136, f. 352.

² "Revolution", as used in the text above, has the sense of "an instance of great change or alteration in affairs or some particular thing" — OED, s.v., III, 6, b) — a sense that well antedated, by a century and a half, the use of "revolution" to denote brusque or abrupt political change. The same anteriority is true in French, where the Littré cites among other examples the Abbe Raynal's prescient remark (*Historie philosophique et politique des etablissemments et du commerce des Europeens dans les Deux-Indes*, 1770-1773, XIV, 47) that "a great revolution is under way in the commerce of Europe, and it is already too far advanced not to be consummated". This was as close as pre-Revolutionary France could get to the term "industrial revolution", for the word "industrie" was then used primarily to denote diligence. It was banalized in its modern sense of a sector of the economy, particularly that sector concerned with manufacturing, only in the second quarter of the 19th century (See 1925; Hauser 1931). On the word "commerce" as subsuming industry in the 18th century, Viennet 1947, p. 3, n. 2.

1. It was not until the 1880s, about a century after the introduction of machines and factories into the manufacture of cotton textiles, that people whom we might describe as academic scholars began to look back on this development and assess its consequences. One dates the beginning of this new stage with Arnold Toynbee's *Lectures on the Industrial Revolution* (1884), which were intended for night students in Manchester (hence largely working men continuing their education after a day's labor) and took as their theme the unhappy consequences of the new mode of production for the condition of the working class. Toynbee's view of the Industrial Revolution was that it was sudden, rapid, and drastically unfavorable in its reorganization of labor and its larger social effects. This regretful point of view was sustained and continued by the work and writing of other social-activist scholars — the Webbs for example, partners in Fabian socialism, and the Hammonds — and it remained the dominant orthodoxy for almost half a century, into the 1920s. (Note that this discussion dealt exclusively with the British experience. There were, however, Continental students of economic change who were less negative in their judgment, at least in their comparisons of the European experience with the British [Schmoller, Weber, Mantoux]).

The first major breach in this pessimistic construction came from John H. Clapham, then Fellow of King's College and later professor of economic history at Cambridge University. In a comparative study of France and Germany (1921; 2d ed. 1923), to which he gave the still unaccustomed title of "Economic Development", he contrasted the swiftness of German industrialization to France's "leisurely movement" in that direction. Clapham presented this transformation as a natural and inferentially desirable aspect of modernity: the French, he implied, had paid in wealth and strength for the slowness and incompleteness of their development, retarded in his view by want of coal and the high cost of fuel (1923, pp. 56, 234-35). Not that they had stood still or wanted for "inventiveness, endurance, or organising capacity" (p. 232). They had changed, but it was more evolution than revolution. In the meantime, the people of both countries had benefited from "the solid economic gains" of the 19th century. This, he asserted, was "a purely historical conclusion, ...which involves no blessing and no cursing of the social system of Europe in the first decade of the twentieth century" (1923, p. 407).

Then, beginning in 1926, Clapham brought out a major study in three volumes of the *Economic History of Modern Britain* that made the point that the Industrial Revolution in Britain was less cataclysmic than had been maintained; that rather it was partial and

gradual. Basing himself on the census of 1851, he noted that even in the mid-19th century, at the time of Britain's triumphant Great Exhibition, the most numerous occupations were the old ones: agriculture and domestic service, and that even industry was still organized predominantly in small units using older methods and sources of power (1952, ch. ii).

Different but in the same tradition was T. S. Ashton, professor in the London School of Economics, who continued the emphasis on empirical data and argued explicitly that the Industrial Revolution had been a good thing, not only in its effects on the standard of living (hence directly contradicting the Hammonds) but even more in terms of what might have been. In a highly influential little handbook of 1948, *The Industrial Revolution 1760-1830*, much used as a school text, he contrasted the condition of Britain with that of the poor, overpopulated parts of the world and stated that there but for the grace of modern industry went we (p. 161):

"There are today on the plains of India and China men and women, plague-ridden and hungry, living lives little better, to outward appearance, than those of the cattle who toil with them by day and share their places of sleep by night. Such Asiatic standards, and such unmechanized horrors, are the lot of those who increase their numbers without passing through an Industrial Revolution".

The work of Clapham, Ashton, and others really turned around the debate on the social consequences of industrialization.

Instead of seeing modern industry through guilty eyes, people had to face the fact that the empirical data supported the optimists, that is, those who saw the bottom line as positive. The pessimists hung on by shifting ground and arguing on the basis of subjective appreciations: even if real wages rose, they said, the quality and security of life diminished. This was an ironic turn for Marxists and marxisants, who had always stressed the primacy of the material. In the long run, however, the judgment of the Revolution had to be favorable if only because there was no blinking the evidence: the British working classes did not live well, but they lived better and longer than their ancestors, and, as Ashton put it, they certainly lived better than they would have had their numbers increased without the gains in productivity made possible by mechanization, inanimate power, and factory manufacture.

That still left open the question whether there had not been a transitional phase of deterioration. This was what Eric Hobsbawm argued, for example, saying that things got worse until the 1840s and then improved. The rejoinder came that if things got worse temporarily, this decline was concentrated in the first two decades of the

19th century and was the result of war rather than industrialization; or that the picture was mixed, with some (most) sectors or branches improving while others (hand-loom weaving, for example) shrank and suffered. Whatever ...such arguments were a far cry from the unrelievedly bleak judgment of an earlier generation, or for that matter, from the absolute immiseration thesis (the condition of the working classes getting steadily worse) put forward by some Marxists. All of this, however, has not put an end to the controversy. The standard of living question is the stuff of eternal disagreement, not so much because the facts are or are not ascertainable — although they are complex enough to sustain a variety of interpretations; or because scholars will not rest so long as there is something to argue about — although that is also true. (The latest — but only the latest — refinement comes from John C. Brown [1990], who uses regression analysis to say that apparent gains in real wages before the 1840s have to be adjusted downward for the disamenities of urban life: the optimists no longer have a monopoly of the quantitative argument). No, what keeps it going in my opinion is that the two adversary interpretations are also seen as shibboleths, as clues to and tests of political stance (Landes, 1976).

2. Ashton's ode to industrialization announced a period of positive emphasis on the Industrial Revolution as a major break in the course of history, the opening of an era of sustained technological change and economic growth. It also continued and was reinforced by an older tradition, going back to writers of the nineteenth century and summed up by such students of the history of technology as A. P. Usher and Lewis Mumford, that stressed the material content and definition of the Industrial Revolution.

I count myself in that group. The Industrial Revolution, as I defined it in the *Cambridge Economic History of Europe* (the manuscript went back to the late 1950s but was not published until 1964), was a complex of technological advances: the substitution of machines for human skills and strength, the development of inanimate source of power (fossil fuels and the steam engine), the invention, production, and use of new materials (iron for wood, vegetable for animal matter, mineral for vegetable matter), and the introduction and spread of a new mode of production, known by contemporaries as the factory system. The emphasis was on the gains in productivity these changes made possible, their cumulative character, their ramification from a few leading branches into more and more of the industrial sector, and lastly the consequent gains in product and income per head.

What is more, the argument went, these changes could not and were not limited to the British Isles. Rather they changed the relative wealth and power of nations and so doing compelled those who pretended to commercial and political parity with Britain to follow suit ...which they did. The British example was not the model for the rest of the world: given its originality and particular circumstances, it could not be that. But it was both stimulus and a source of knowledge, ideas, and experience — positive and negative.

In short, by this thesis, the Industrial Revolution was seen as a major break of worldwide significance. In my own work, I described the transition from pre — to post — Industrial Revolution as the puberty of nations. Others argued along similar lines, in particular Walt Rostow, who invented the term “takeoff”, which he defined as simply another way of saying “industrial revolution”. This had the merit of being catchy — always an advantage in the contest for attention — and of figuratively emphasizing the notion of sustained growth (flight) as a result of passage from level motion to an upward trajectory. Unfortunately, it also conveyed a sense of rapidity, metaphorically telescoping the work of decades into the image of a fast-climbing aircraft.

For Rostow, the Industrial Revolution became a stage that all countries would pass through on their way to higher stages of development, and the European (British) example would show the way to less fortunate peoples. In this connection, Rostow described his influential essay *The Stages of Economic Growth* as a “non-communist manifesto” that would show how the West could bring growth to the world more efficiently than could the Soviet Union. At the time such partisan polemics helped sell books, but it was also a lightning rod that drew strong ideological opposition. One does not attack a religious icon like The Communist Manifesto with impunity. (In the light of subsequent and especially recent events, of course, much of this hostility now looks misinformed, archaic, or even benighted).

3. Yet it is not political adversaries, now largely discredited, who have given Rostow and indeed the whole discontinuity school (the Industrial Revolution as a major break or breakthrough) their hardest time. Criticism has come from the academic community as well, and it began and has rested with new techniques of quantitative, macroeconomic analysis. Just as numbers turned the standard of living controversy around, so it is numbers that have overturned (or pretended to overturn) the orthodoxy concerning the significance of the Industrial Revolution.

The first manifestation of the difficulty came with the perceived incompatibility of one of Rostow's key assertions with the empirical data, and this perception in turn was the consequence of the application of national income accounting to the distant past. Here the prime mover was Simon Kuznets, who with his colleagues in the National Bureau of Economic Research had shown what could be done by way of reconstructing past national accounts for the United States and who was mobilizing similar research projects in other countries. Among those laboring in this vineyard: Phyllis Deane, then a "lecturer" in Cambridge University, who brought out in the late 1950s a number of articles estimating British economic growth in the 18th century.

In 1961, the International Economic Association brought together a group of economic historians, historical economists, and straight economists in Konstanz (Switzerland) to assess and discuss Rostow's Stages. Such special attention was no small honor, and Rostow was justifiably delighted. What's more, he managed to maintain this happy, sweet demeanor throughout the meeting in the face of a barrage of heavy and not always sympathetic criticism (I couldn't have done so) and even edited the volume of proceedings, which was published two years later (Rostow 1963).

Well, to proceed from reminiscences to substance, among the papers presented was one by Phyllis Deane and H. J. Habakkuk on the takeoff in Britain that addressed itself to the effect, among other things, of the Industrial Revolution on the accumulation of capital. You will perhaps recall that Rostow, drawing on an observation (speculation) of Arthur Lewis, had asserted that one of the salient characteristics (manifestations) of industrialization was a sharp rise in the rate of saving and investment, a shift from under 5 per cent to 10 per cent or more of income, and that this was in fact what had happened in Britain. Now this was presumably a verifiable hypothesis; and Deane and Habakkuk questioned it, if they did not disprove it. Using reasoning as much as data, they argued that the accumulation of capital in Britain was slower than the Rostow thesis seemed to require (the Rostow model of the take-off requires that it should have been largely compressed within the space of two decades). Their language was cautious: "It does not seem reasonable to suppose[....] It is difficult to credit that a change of this order of magnitude could have occurred[....] The contemporary estimates are, of course, highly speculative, and we have little evidence against which to check them" (1963, pp. 74 - 76).

Nevertheless the sense conveyed was of slow increase covering decades. They did not address themselves to the later years (the se-

cond and third generations) of the Industrial Revolution); nor did they pretend to contradict the accepted orthodoxy that the crucial transformation occurred fairly rapidly — certainly within the century between 1750 and 1850, probably in a considerably shorter time (p. 63). But they did stretch and blur the chronology: In the end it seems that the most striking characteristic of the first take-off was its gradualness. Professor Nef has traced the process of industrialization back to the sixteenth century. The sustained rise in the rate of growth in total output probably dates back to the 1740s (p. 82). As for capital formation, the sense that emerged was that it was not until the building of the capital-hungry railways after 1830 that the rate rose close to the level asserted by Rostow.

That was then a little cloud, no bigger than a man's hand, but it became a tempest. In subsequent years, further research (Pollard, Feinstein, Crafts, Harley) seemed to show that, just like capital formation, all the macroeconomic variables grew slower than the "revolutionary" character of the Industrial Revolution might have led one to expect and slower even than the Phillis Deane series³. See, for example, the comparison of growth estimates offered by Crafts in a recent essay (1989, p. 66):

TABLE 1: *Great Britain: Growth Rates in Real Output, 1700 - 1860 (per cent per year):*

	Industrial Output		GDP	
	Crafts	Deane & Cole	Crafts	Deane & Cole
1700-60	0.7	1.0	0.7	0.7
1760-80	1.5	0.5	0.7	0.6
1780-1801	2.1	3.4	1.3	2.1
1801-31	3.0	4.4	2.0	3.1
1831-60	3.3	3.0	2.5	2.2

N.B.: Figures for 1700 - 1810 are for England and Wales; thereafter for Great Britain.

³ Feinstein's estimates of the investment ratio (domestic investment as a proportion of gross domestic product) and its course also differ considerably from those of Deane 1961, 1962, 1965 (and by implication Deane and Habakkuk 1963). Deane has capital formation growing at an average of no more than 3 per cent per year in the 17th and early 18th centuries; this rate begins to rise in the middle decades of the century, rising in the last quarter to "a sustained average of more than 5 per cent", may be a bit over 6 per cent; and then the rate goes up again in the 1830s with the coming of the railway, reaching about 10 per cent in the late 1850s. Feinstein's timing is the reverse: his is a picture of rapid increase in the last decades of the 18th century, from 8 per cent in the 1760s to a peak of 13 per cent in the 1790s, followed by a slight reduction and leveling off throughout the first sixty years of the next century. Feinstein 1978, pp. 30, 91.

Note moreover that these rates are not of growth per capita. These would show even slower increase: Jeffrey Williamson (1990, p. 1), apparently building on Crafts, reminds us that British national income, when deflated for population, works out to only about 0.3 per cent head per year in the last decades of the eighteenth century — “hardly impressive”⁴. To be sure, Great Britain was then experiencing a population miniexplosion (five to ten times the rate of increase of the first half of the century [Deane & Cole 1962, p. 8; Komlos 1989, p. 209]), and it could be argued that the very fact of being able so to multiply without incurring a Malthusian rupture — very different from earlier historical experience — was in itself evidence of the unprecedented power of the new technology (North 1981; Komlos 1989). Still, a rate of 0.3 per cent is very small. If one took into account margins of error, it could be something; but it also could be nothing.

Along with this diminution of the spurt, this reducing of a mountain to a hillock, went a renewed emphasis on the long and impressive preparation that made in Industrial Revolution possible. On the level of technology, this approach went back to J. U. Nef's tale (1933, 1934) of Britain's precocious recourse to fossil fuel, which he called a First Industrial Revolution. But there was also the early example of mechanized factory production afforded by the Lombe silk-throwing mill in Derbyshire (1719); Savary's and Newcomen's steam pumps (late 17th and early 18th century); Abraham Darby's successful use of coke to smelt iron (1709) — these and other innovations occurring well before the cluster that we commonly denote as the Industrial Revolution (1760s on). And on the level of growth, the argument has been made that pre-industrial Britain was not standing still, that growth was an old story.

⁴ Deane & Cole, 1962, p. 78, would work out to about 1.0 per cent from 1770 to 1800. But I would worry about this: they have a strange and, to me, unpersuasive dip in product and income in 1770:

TABLE 2: *Index Numbers of British Real Output, 1760 - 1800. (1700 = 100)*

	Total Real Output	Per Head	Without Government	Per Head
1760	147	130	137	121
1770	144	119	147	122
1780	167	129	151	117
1790	190	134	189	133
1800	251	160	231	147

The latest estimates in this area, by Graeme Snooks in a communication to the Tenth International Congress of Economic Historians at Leuven in August of 1990, build on Domesday Book (1086) and Gregory King's income figures (1688) — so, two end points and nothing in between — to suggest a rate of growth of national income at .49 per cent per year; of income per head, at .29 per cent; of productivity per head, at .23 per cent. This is high precision to the fourth decimal place on a tenuous base, to the point where Knut Borchardt was moved to remark in discussion that he found the paper “wonderful, in the sense that it is full of wondrous things”.

This macroeconomic reconstruction and diminution of the Industrial Revolution has been reinforced by a number of new studies of particular sectors. S. D. Chapman (1971), A. E. Musson (1976), Nicholas von Tunzelmann (1978), Dolores Greenberg (1982), and others have pointed out that steam power, for example, traditionally viewed as the technological heart of modern industry, was adopted slowly and piecemeal; that water power long accounted for the larger share of the inanimate energy employed in manufacture, to be passed by steam only in the second half of the 19th century; and that indeed use of animal (including human) power remained important (cf. Samuel 1977).

Along similar lines, G. R. Hawke (1970), following in the footsteps of Robert Fogel, has calculated that the railways, for all their importance, “only contributed about 10 per cent of [British] national income in 1865” (Cannadine 1984, p. 157)⁵.

And F. T. Evans (1982), denouncing the iron and steel propaganda of the Industrial Revolution, has pointed out that in the mid 19th century timber and wood were not scarce (some prices were even falling) and continued to be used widely for industrial purposes.

The apparent slowness of overall change has given rise to numerous efforts at explanation: the essence of a good social scientist is that, given the “facts”, he can account for them. (Turn them around, and he can still account for them). One argument, highly plausible on the face, is that the Industrial Revolution was an exercise in selective, unbalanced growth, so that changes in a few branches, however spectacular, took some time to work through to the rest of the economy. A stronger version would note that some of these changes were destructive as well as constructive, that is, they shriveled some branches while swelling others; and that aggregate

⁵ I cite Cannadine because my primary concern here is the impact of this kind of work on the consciousness of the scholarly community. Hawke's estimate of social saving in 1865 as a proportion of income in 1865 is 4.1 per cent. Hawke 1970, p. 196.

gains necessarily reflect this process of compensation. Some of the research into real wages would support this view: thus we have significant differences in wage trends and levels between the manufacturing districts of the North and the agricultural South; the former go up, the latter fall (Hunt 1986, Hunt and Botham 1987, Schwarz 1990); and that's as it should be in a process of uneven growth.

A second argument, advanced by Jeffrey Williamson (1984, 1987), who also agrees with the first (1987, p. 273), is that British - government financing, especially in wartime, crowded out investment in industry, which could not take advantage of its technological opportunities. Not everyone would agree with that, in part because the issue is complicated by earlier movements of capital into Britain and by the debt-melting effects of inflation, and obscured by the incompleteness and artificiality of the statistical data (Mokyr 1987). Still, one could make the argument that, other things equal, Britain would have grown faster had it been able to put resources into productive rather than destructive activities.

All of this has given rise to a reassessment of the nature and - significance of the Industrial Revolution.

Thus A. E. Musson (1978, p. 61): The older view of the Industrial Revolution - that was a sudden cataclysmic transformation, starting around 1760 - clearly is no longer tenable; and again (p. 149): British economic historians have generally tended to place too much emphasis on the Industrial Revolution of 1750-1850 by comparison with developments in the second half of the nineteenth century[...] Truly, much of the England of 1850 was not very strikingly different from that of 1750".

And N. L. Tranter (1981, p. 266): "The British Industrial Revolution was a very modest affair which emerged slowly from the past as part of a long, evolutionary process, not as a sharp, instantly recognizable break from traditional experience: its technology was small-scale and comparatively primitive; it needed relatively little additional investment capital; its capacity for introducing labour-saving technology was circumscribed; and its pace was gradual and uncoordinated".

And Harley, dismissing what he feels to be the conventional wisdom (1990, p. 22): "it seems impossible to sustain the view that British growth was revolutionized in a generation by cotton spinning innovation".

Well, if change was so "slow, gradual, and continuous" (Mokyr 1990), if the growth rate so modest, shouldn't we reconsider our terminology? Rondo Cameron (1982, 1985), once an active contributor to our awareness of the significance of the new industrial technology

and now seized with remorse, has been calling at every opportunity for the abandonment of the term "Industrial Revolution" on the grounds that it is inaccurate, unscholarly, and misleading — a misnomer. Misleading: here he joins forces with Donald McCloskey, who worries that myths about the Industrial Revolution are encouraging would-be developers in the wrong direction (1981, p. 104):

"Yet, for all that, the industrial revolution was the central event of modern history, British or other, more in memory than in happening. The British example of the early nineteenth century inspired frantic emulation in the late nineteenth century, and myths of how Britain did it influence economic policy to this day. The fascination in poor countries now with industrialisation on the British pattern, complete with exports of manufactures (in an age of ubiquitous skill in making them), puffing railways (in an age of cheap road transport), and centralised factories (in an age of electric power) would seem odd without the historical example in mind".

But McCloskey is obviously not ready to give up the term, "industrial revolution". He is even of two minds on the subject of its significance, concluding his essay on an ambivalent note: "[...]the explanation and evaluation of the industrial revolution is not the only task of British economic history for the period 1780-1860[...] much of Britain's economic life was only lightly touched by it. But it was, in more ways than one, the primary event" (1981, p. 124).

In the meantime, Cameron is in my opinion crying on the wind. And rightly so: the name Industrial Revolution is not only consecrated by clarity and convenience; it accords as we have seen with good and early English and French usage.

But what of the suggestion that we speak of evolution rather than revolution? This is the subject of Joel Mokyr's forthcoming essay, *Was There a British Industrial Evolution?*; also of the final chapter of his new book, *Lever of Riches*.

To be sure Mokyr's evolutionist model (Gould, Golschmidt, et al.) has room for macroevolutionary mutations and leaps, hence for evolutionary revolutions or revolutionary evolution. Yet Mokyr points out and criticizes the fact that economic historians, in using the evolutionist model or metaphor, have implicitly adopted the purely gradualist version; and it is not unreasonable to suppose that some readers may never get past his title.

This revisionist thesis has been reinforced by comparable quantitative work on the Continental countries, in particular - France, where Marczewski, Markovitch, Levy-Leboyer, Crouzet and others have produced data showing that French industry, long seen as slow and technologically laggard, grew quite respectably in

the 19th century. Some have gone so far as to suggest that French overall growth may well have been faster than British in the 18th century, a surprising result indeed (if true) considering the link between growth and technological change. Talking the opposite tack, that is, arguing from French slowness and using an argument derived from the Gerschenkron model (the later, the faster), Richard Roehl (1976) suggested that France, rather than Britain, was the first industrial nation. Nick Crafts (1977), picking up a hint from Tony Wrigley (1972-73), speculated that it was only a matter of change that Britain industrialized first; that France might easily have taken the lead instead⁶. And Patrick O'Brien and Caglar Keyder, in a particularly provocative monograph (1978) that is surely the only book ever published that has French coal cheaper than British, argued that mass production was not the only way to industrialize and that France, with her small craft and manufacturing units grew more or less as fast as Britain, and that when quality of life is taken into account, probably did better.

4. All of this left the old orthodoxy, going back to Clapham's classic comparison of France and Germany and including my own work on the technological sources and characteristics of the Industrial Revolution, in a shambles. (I should note that I have been largely spared in this general assault, and I don't know whether to feel grateful or neglected). Eric Jones, in what I find a dismayingly credulous chapter in his new book, *Growth Recurring* (he believes every revisionist word, and the newer the better) — a chapter fetchingly entitled "*A Know-all's Guide to the Industrial Revolution*" — dismisses what he calls the "technicist" interpretation⁷. Is this disparaging term his invention — a way of deriding all that fuss about new ways of doing things? In any event, he clearly has no patience with those who do not or will not see the light: he describes the "old interpretation" as "a dead horse that is not altogether willing to lie down" (p. 19). Why should it?

Let me reconsider here the reconsiderationists. I would first

⁶ Knick Harley echoes this in the following terms (1990, p. 40): "The technological breakthrough in industry occurred in Britain in part because of the dynamic character of the economy but Britain probably also benefitted from a lucky draw in the random process of invention". It does seem strange to me that economists (or economic historians trained as economists) should think that major differences in the direction and pattern of invention would be a random process.

⁷ Jones 1988, p. 19. Compare Robert Merton's fallacy of the latest word, cited in Gudmund Hernes 1989, which deals with the similar running debate concerning the merits of the Weber thesis.

note an important but easily overlooked point: that this love affair with numbers entails all the risks of instant passion. Or to cite another metaphor, is really no more than the make-believe of children: Joel Mokyr compares some of this quantitative casuistry to "a fight between two toddlers blowing smoke bubbles at each other. Their weapons are too dull to decide the issues at stake" (1987, p. 308). These macro — and microstatistical calculations are all of them bold constructs that make use of proxies, fill in gaps by interpolations and extrapolations, and build brave structures on shaky foundations. Perhaps the best of the quantifiers, Charles Feinstein, warns in a recent essay that his numbers for the key variables of British economic growth can be little more than "insecure guesses", that most estimates of output and income before the late 19th century are likewise "guesstimates", and that attempts to measure and date changes in the investments ratio or assess the contribution of capital to the growth of output and productivity will continue to be a hazardous undertaking (cited in Cole 1989).

Hazardous indeed. In its short history, cliometrics has already seen considerable revision and re-revision of findings that once seemed authoritative for their numerical character. Why assume that we have heard the last word?

But I shall assume just that and concede that the "guesstimates" of scholars like Feinstein and Crafts are smart, informed, and reasonably close to what actually happened⁸. Some people are better guesstimators than others because they are not merely guessing; they have some data to go on and they possess superior critical faculties. Indeed, for the purposes of this essay, I am prepared to believe them all, even when they differ. That still leaves the question of interpretation. What does all this mean?

The first thing to note in that regard is that this debate over continuity vs. discontinuity is an old business. Historians never tire of it, because it provides matter for endless retort and rejoinder. It is the stuff of controversy and debate, and controversy and debate are the stuff of Ph. D. theses and professional reputation. The Industrial Revolution is only one of a large number of topics that have generated such arguments: think only of Pirenne's *Mahomet et Charlemagne* (was the fall of the Roman empire a major break?); or the still hot

⁸ On the other hand, I would not go so far as Mokyr, who writes (1987, p. 294, n. 2) that "since Deane and Cole and Crafts agree that there was little or no growth during the 1760-1780 years", there was in fact little or no growth ("the macroeconomic performance of the British economy was indeed quite disappointing"). That may be so (although I doubt it), but the coincidence of agreement between two sources otherwise far apart proves nothing but coincidence.

debate on the consequences and character of the French Revolution (Tocqueville's continuity vs. Republican and socialist doctrine about the world transformed); or that favorite Japanese topos, how much credit to give to Tokugawa antecedents of Meiji growth.

On this level, there is more noise here than light. In the Industrial Revolution debate, as in most of these others, both sides are right: history, of its nature, is a constant interplay of continuity and change. Everything has its antecedents; but nothing remains the same, and some changes are more drastic and rapid than others.

None of this is new, then. It should be recognized that the older generations of historians of the Industrial Revolution, for all their emphasis on its revolutionary character and consequences, were explicitly aware of its gradual penetration of the larger economy and its protracted character. I have already cited Clapham in that regard: he did not have national income constructs, but he did have the census, and that told him volumes about the tenacity of older branches of economic activity. Nor were they unaware of the long preparation of these developments: history, like nature, abhors leaps and random walks, and generations of scholars worked to understand why England, and why England first. Let me quote Usher, who focused on technological aspects of the story and might be expected, more than anyone, to stress the revolutionary character of these innovations (1920, p. 271):

"The Industrial Revolution was thus a revolution in every sense of the word, except that of suddenness of transition. But the extraordinary character of the transformation must in itself be sufficient to convince one that such changes in the matters of daily life could not take place suddenly. Particular machines can be brought to public attention within a brief space of time; the form of industrial organization can be changed, though that would inevitably require a longer period. But the Industrial Revolution was more than any such formula could possibly imply. The "Great Inventions" were merely a stage in a long development of a new mechanical technique, neither the beginning of the new order nor its culmination.

The rise of the modern factory system was only one of the many results of mechanical change, industrial dislocation, and commercial development. The abandonment of the idea that the Industrial Revolution was sudden involves a considerable readjustment of chronology for the entire movement. The study must be carried farther back into the past and continued down nearer to the present time.

The establishment of even approximate limits is obviously difficult". This, in 1920.

Reading this and other warnings of the gradualism cum rapidity of these developments (I stress, as Ashton did, this combination)⁹, one wonders if some of the “new economic historians” of today have ever read this literature; or whether their preoccupation with numbers has impoverished their historical culture. (Eric Jones doesn’t even cite Usher or Clapham or Wadsworth & Mann in his bibliography). Its as though economic history were like physics: the older works fall into rapid desuetude and well-deserved oblivion because they no longer have story right. Where did we, their teachers, go wrong?

For surely, if they had been aware of this literature, they would not have been shocked to “rediscover America” – to find overall industrial growth of 3 per cent per years; or low rates of capital formation in an industrial revolution of low capital requirements; or water power playing an important role throughout; or small enterprise coexisting with large; or agriculture persisting alongside industry; or railways generating perhaps a tenth of British national income in the mid-19th century.

Instead they would have asked such questions as, what is slow? or what is fast? what is large? what is small? and what matters in assessing significance: level or trend? aggregates, or foci of change?

I am reminded of a dinner of the “Friends of Business History” at Harvard back in the 1960s when I had been asked to comment on the contribution and significance of the so-called New Economic History. In those days, this meant above all Robert Fogel, whose work on the contribution of the railroad to American economic growth was the sensation of the day. (It had everything: lots of numbers, a new technique of argument – counterfactuals –, and a surprise ending: the railway had marginally contributed less to U.S. economic growth than anyone would have guessed – maybe 4 per cent of national income in 1890, at most 6 or 7 per cent)¹⁰.

Anyway, I sat down at the head of the table, all prepared to say something measured, safe, and wise, like: The New Economic History is still small and poses serious problems of method and significance, but[...] it does use powerful techniques; it makes more, and more explicit, use of economic theory; and it will become more im-

⁹ “There is a danger of overlooking the essential fact of continuity...” Ashton 1948, p. 2.

¹⁰ By this I mean the contribution in the form of social saving, that is, the saving produced by the railroad as against other modes of transport. Such a calculation entails the estimate of a counterfactual: if there had been no railway, what would it have taken to produce equivalent facilities using older technologies? It goes without saying that such a calculation is suppositious, hardly testable, and hence subject to considerable error.

portant with time. But when I looked around, I saw facing me across the way none other than Fogel himself, in Cambridge on a short visit from Chicago. Well, I said my say, but as you can well imagine, my monologue became something of a dialogue with Fogel. And this was the livelier because also in the room was my own teacher, Abbott Payson Usher, long retired and into his 80s, but as sharp as ever. And he asked the big question of the evening, namely, how big is 5 per cent or 6 per cent? [Those were the percentages I recall our playing with that evening]. To that question, no one — not even Fogel — had an answer).

And so for the British Industrial Revolution. The rates of change were low by 20th-century standards; also clearly lower than these historical income accountants had expected.

But were they Low?

They were certainly not low by comparison with what had gone before. Not that there had not been growth before. There had to be, and that was part of the preparation for industrial revolution. That was one of the reasons Britain came first: thanks to the cost advantages of putting-out, its textile manufacture in particular was growing faster than those of other European countries in the decades preceding the invention of the new carding and spinning machinery and the development of new power sources.

But we know that from about the 1760s, growth took an upward turn and proceeded at a higher rate. There was in other words a discontinuity, a kink in the curve. How do we know that? By extrapolating backwards. It takes some 99 years for income decreasing at 0.7 per cent per year (Crafts's estimate of the rate of growth in the early 18th century) to halve; go back two centuries, and even at this slow pace, one arrives at impossibly low levels of income. Use Crafts's 1.3 per cent rate for the end of the century (after the early innovations of the Industrial Revolution), and it takes only 38 years for income to halve¹¹. So something had changed: What was that? Well I continue to believe that the substance of change was technological. In that regard, I am astonished by such assertions of Eric Jones as: "the nexus between technology and economic growth is not particularly

¹¹ The above-cited estimates of Graeme Snooks imply a sixfold increase in income per head of the six centuries from Domesday to Gregory King. Working backwards, that would imply a standard of living in the eleventh century too low to sustain life. Snooks argues that most of that growth took the form of increase of capital and social overhead, so that the standard of living at the earlier date was not so low as implied by the growth rate. But shouldn't these gains on the side of non consumables have affected the supply and price of consumables? My own sense is that one must look at the Snooks as a first, brave, very gross approximation. We'll have more and better estimates in years to come.

strong" [1988, p. 54], for such an assertion is simply wrong in fact and in logic. Although it helps to distinguish between growth (or what Jones prefers to call "intensive growth", that is, growth per head) and technical change, if only because one can conceive some gains in income per head that do not derive from gains in real productivity (for example windfalls from newly discovered resources, or favorable changes in relative prices and the terms of trade, or increases in trade and profits therefrom, or rents derived from growth itself), it is a mistake to think that such increase can be sustained if not initiated and supported by technological advances¹².

These may take the form of hardware or software: of new products or new ways of producing; or even of new and more efficient forms of organizing labor (Adam Smith's progressive division of labor would fall in this last category)¹³.

5. So when the British began to move ahead of their neighbors and inaugurated a new, more productive mode of production, they did so because, building on earlier gains, they found technological solutions to the stresses and opportunities of widening and deepening markets. They substituted machines for men; they used more and more inanimate power; they found new materials or made old materials better, bigger, and faster; and they organized this in larger units that brought labor together under supervision.

This did not mean that they had a monopoly of discovery and invention. On the contrary, their neighbors and rivals on the Continent were as advanced as they in science and created their own innovations to meet the needs and opportunities of their economies: one thinks for example of the French improvements in silk manufacture,

¹² That is the soft form of the proposition. I would argue the hard form: that although such technology may be imported, as is often the case with multinationals or joint-ventures, unless an economy possesses technological autonomy, that is, the ability to generate its own innovations, technical advances will not ramify and the modern sector will remain encapsulated, a kind of industrial plantation. Cf. Krikkiat and Yoshihara 1989.

¹³ On the implications of division of labor for technological innovation, one has only to consider the history of clock and watchmaking and the invention of special-purpose tools that later found application in the manufacture of machines. Mokyr 1990, 323, nn. 7-8, would cast doubt on this connection and asserts, "Before standardization and interchangeable parts, ...the simplification of work brought about by the division of labor as such was not significant". But of course, it was precisely this simplification, which grew out of specialization and made possible batch production, that suggested the utility and method of interchangeable parts. Mokyr refers to Brenner 1987, pp. 109-10, who cites Smith's own intellectual versatility as a kind of argument against the alleged advantages of work specialization. An example of misplaced analogy: intellectual curiosity is not the same thing as work efficiency.

or their production of sugar from beets once colonial supplies were cut off, or their manufacture of alkalis by the Leblanc process in response to a similar problem. But the British innovations had wider economic consequences because the demand for these products was potentially larger and supply more elastic (compare cotton and silk for supply and cheapness); and because they had wider ramifications within the larger economy (thus multiple uses of iron and the general applicability of advances in power technology). They were the stuff of an industrial revolution. *Pace* Dr. Crafts, the French changes were not¹⁴.

The nations of Continental Europe, of course, understood that. They also understood that such innovations enhanced enormously Britain's wealth and political strength; that in effect, they upset the European balance of power; and that if these nations did not follow suit, they were condemned to secondary, dependent status¹⁵. (This was the same judgment made by Japan almost a century later: modernize or become another China).

Fortunately for these Continental follower countries, they were not able to read the likes of Crafts, Roehl, O'Brien & Keyder, Jones, and the other representatives of the new, self-proclaimed orthodoxy. So they did not think they were doing just fine, maybe even better than Britain, and that haute cuisine and more picturesque landscapes are a compensation for lower wages and incomes. Nor for that matter did they listen to British injunctions about the

¹⁴ There is also good reason to believe that the level and diffusion of mechanical skills were more favorable in Britain. One may reasonably infer that from the difficulties the Continental countries had copying the British machines. Whence this superiority? I would lay heavy emphasis on the British advance in clock and watch manufacture (clock-makers constituted the preferred pool of skilled workers for the making and maintenance of textile machinery, and the wheelwork was commonly known as clockwork) and on the precocious recourse to water and steam power in mining and industry. (Landes 1969, 61-63; 1983, 219-27; also Mokyr 1990, 235-39.)

¹⁵ In a strange, even bizarre, excursion, which Donald McCloskey has chosen to repeat in a number of places (so one must presume he believes), he tries to decouple Britain's economic lead and the strategic interests of other countries, and by implication to devalue its significance, by arguing that the nations of Continental Europe should not have been concerned about British industrial gains for political reasons, that industrial power was (is?) not a vital ingredient of political and military power: "In an economy there are substitutes for blood and iron, even if there are not in chemistry" (1990a, p. 42; also 1988, p. 647; 1990b, p. 295). That argument from theory strikes me as dead wrong (as are such "factual" allegations as that which says that Napoleonic France was able to buy iron from Britain throughout those years of war), but even if it were right, it would not be relevant to the decisions of contemporaries of the Industrial Revolution, who thought otherwise. Carnot during the Revolution and Napoleon later both knew better. But then they had not had the benefit of courses in neoclassical economics. A little theory is a dangerous thing.

advantages of an international division of labor, in which Britain would be workshop of the world and they would supply food and raw materials. Instead they read the people named above: Hamilton, Chaptal, List, and the other advocates of strong and deliberate measures to promote industrial change. And they caught up with, in the case of Germany even passed, Britain — much to Britain's surprise ¹⁶.

6. But if such is the power of technology, why do we see these major, revolutionary innovations take so long to drive out older methods? Why do we see small units persist and even flourish alongside the factories of the new industrial order? Why do such older techniques as water power persist and even grow in efficiency and application?

These questions are not so difficult as they may seem, especially if one does not subscribe to simplistic views about the nature of technological change. Few innovations ever sweep the field. The electric lamp, for all its intrinsic superiority, did not put an end to gas lighting or, that matter, to kerosene lamps and candles. And in spite of the desk-top and lap-top, there are still people who type their manuscripts or even write them out by hand and then have secretaries, spouses, or friends transcribe.

For one thing, the early versions of innovations are always less than satisfactory, full of problems that have to be worked out, but also full of opportunity. As result, they may begin only marginally better, and they need a lot of work and attention. This was true, for example, of the new spinning machinery, perhaps the most immediately advantageous of the new equipment of the Industrial Revolution. It worked well at first only on the coarser yarns, for only they had the strength to withstand the still irregular motions of the working parts. It took two generations to devise machines smooth enough in their motions to make the higher counts, higher even than could be made by human hand, and it was not until after 1815,

¹⁶ As in France and Prussia, so in the British colonies of North America. Already in the 1760s, the growing resentment of the colonists against British protectionist trade policies and fiscal initiatives gave rise to an interest in promoting import substitution. And since the subservient colonial governments could not be expected to pursue their own protectionist policies, the leaders of this movement called for a voluntary boycott of British manufactures. Among the more active of these visionaries: Benjamin Rush, newly graduated in 1768 from Princeton and beginning his medical education at the University of Edinburgh. Cf. his letter of April 1768 to Thomas Bradford, publisher of the *Pennsylvania Journal* and *The Weekly Advertiser*: "Go on in encouraging American manufactures. I have many schemes in view with regard to these things. I have made those mechanical arts which are connected with chemistry the particular objects of my study.... Yes, we will be revenged of the mother country." Quoted in Brown 1989, p. 557.

for example, that British yarn was able to penetrate the Indian market and kill off the fine hand-spun yarn of the Indian peasant.

Secondly, older equipment does not ordinarily die and just abandon the field to its newer rivals. On the users of old equipment are moved by competition to imagine their own improvements, so that the greatest technological gains often take place in obsolescence. Sailing vessels, for example, reached their peak only after the introduction of steam. Water power was enormously improved in the late 18th and 19th centuries, the biggest advances perhaps being the adjustable breast wheel (cf. Mokyr 1990) and the use of the turbine in place of the wheel. And today mechanical watches are better than they ever were, even though the quartz watch is simply, flat-out, a superior timekeeper.

Thirdly, older technologies often have special, local advantages that ensure continued application. Water power, for example, was not available everywhere, but where it was abundant, it offered a cheaper alternative to steam; capital requirements were considerably lower. The same for wood fuel as against coal: in a timber-rich country like the United States, it paid to throw logs into the locomotive firebox. The same for the putting-out system and domestic manufacture, which offered real advantages over the factory in circumstances that made possible dependable performance. In the mid-19th century, for example, a number of the new power-loom enterprises worked along with domestic manufacturers, because this enabled them to handle the variance in demand without sinking unnecessarily large sums into fixed capital. There was, and continues to be, a symbiosis between newer, larger-scale modes of manufacture and older, smaller units. Why should we be surprised that the old did not disappear overnight?

Finally, older methods are often locked into social and institutional arrangements that are not easily altered. We know, for example, that in nineteenth-century France (and maybe elsewhere), the persistent use of wood joists and timbers in construction in preference to the stronger and more economical iron owed much to the influence of the carpenters, who constituted the aristocracy of the building trades, had the force of experience and craft knowledge behind them, and could intimidate architects and builders or make them pay dearly for unfriendly decisions (Guillermie 1988: 240-41).

Obsolete and obsolescent technologies may also be written into codes and official standards, which then become a focus of political resistance to technological advance.

It is not an accident, then, that some new techniques and materials make their breakthrough as a result of a spectacular episode,

the sort of event or achievement that seizes the imagination and consecrates an innovation: the Crystal Palace, the Eiffel Tower, electric light at the World's Fair of 1889.

Indeed, the propagandistic aim and value of industrial and trade fairs, going back to the first, modest efforts in Napoleonic France to inform the public and businessmen in particular of the progress of manufactures, is directly related to this psychological need to shake and break the cage of custom.

7. The question has been raised, why, if the historiographical record is so clearly on the side of a gradual revolution, of a prepared discontinuity, is this new orthodoxy so triumphant. Why are people so ready to argue that Industrial Revolution is a "misnomer", never happened, had little effect?

I shall hazard a number of reasons:

(1) This is one more example of the kind of cyclical revisionism that characterizes all the social sciences. The best way to attract attention, get a Ph. D., get a good job, get promoted is to stand things on their head. As a cynic once put it, we climb on the backs of our predecessors.

(2) David Cannadine, in a provocative historiographical article of 1984, argues on Crocean grounds ("all history is contemporary history") that this new turn in opinion reflects a larger change in public and political mood; that the slowing of economic growth in the 1970s (oil shock) and the growing doubts about its inevitability and even desirability led to a more negative assessment of the Industrial Revolution and turned the "dissenting views of the 1960s and even some of Clapham's dissenting views of the 1920s" into a new orthodoxy (1984, p. 162). Joel Mokyr strongly disagrees and feels that the moods, modes, and substance of economic history can be explained by endogenous considerations.

(3) Numbers have power to lull the skeptical mind. They seem somehow more authoritative, and today's numbers are by definition better than yesterday's. This is the more unfortunate because the time series constructs are biased against evidence of discontinuity. (I do not assert they are wrong, although clearly, as the disagreements show, some of them must be. For our purposes, the bias is more serious). Aggregate numbers are of their necessity composite: trends cancel out; kinks are rounded out. Insofar as the historical data are incomplete, the national accountants fill in the gaps by interpolation or extrapolation, which are of their nature smooth.

(4) The move toward quantification has resulted in a skewed recruitment into economic history. We do not get many historians any

more, and too many of the economists have stopped reading.

(5) Anachronism is the enemy of understanding. The high rates of growth of the latter half of the 20th century make those of the 18th century look trivial. Similarly, the costly technologies and spectacular product innovations of today devalue the primarily process innovations of the Industrial Revolution. Else what meaning to give such statements as that of Tranter (1981): "[...]its technology was small-scale and comparatively primitive[...]"? Comparative to what?

8. In the end, then, I come down on the side of Friedrich Engels: Steam and even more the clock, used as metaphorical symbols for a much larger complex of technological changes, transformed first Europe and then the world. The Revolution was a revolution. If it was slower than some people would like, it was fast by comparison with the traditional pace of economic change. Different aspects of life operate on different calendars (cf. Braudel's geological-geographic, socio-economic, and political times), and one must not expect to change an economy as one would a regime.

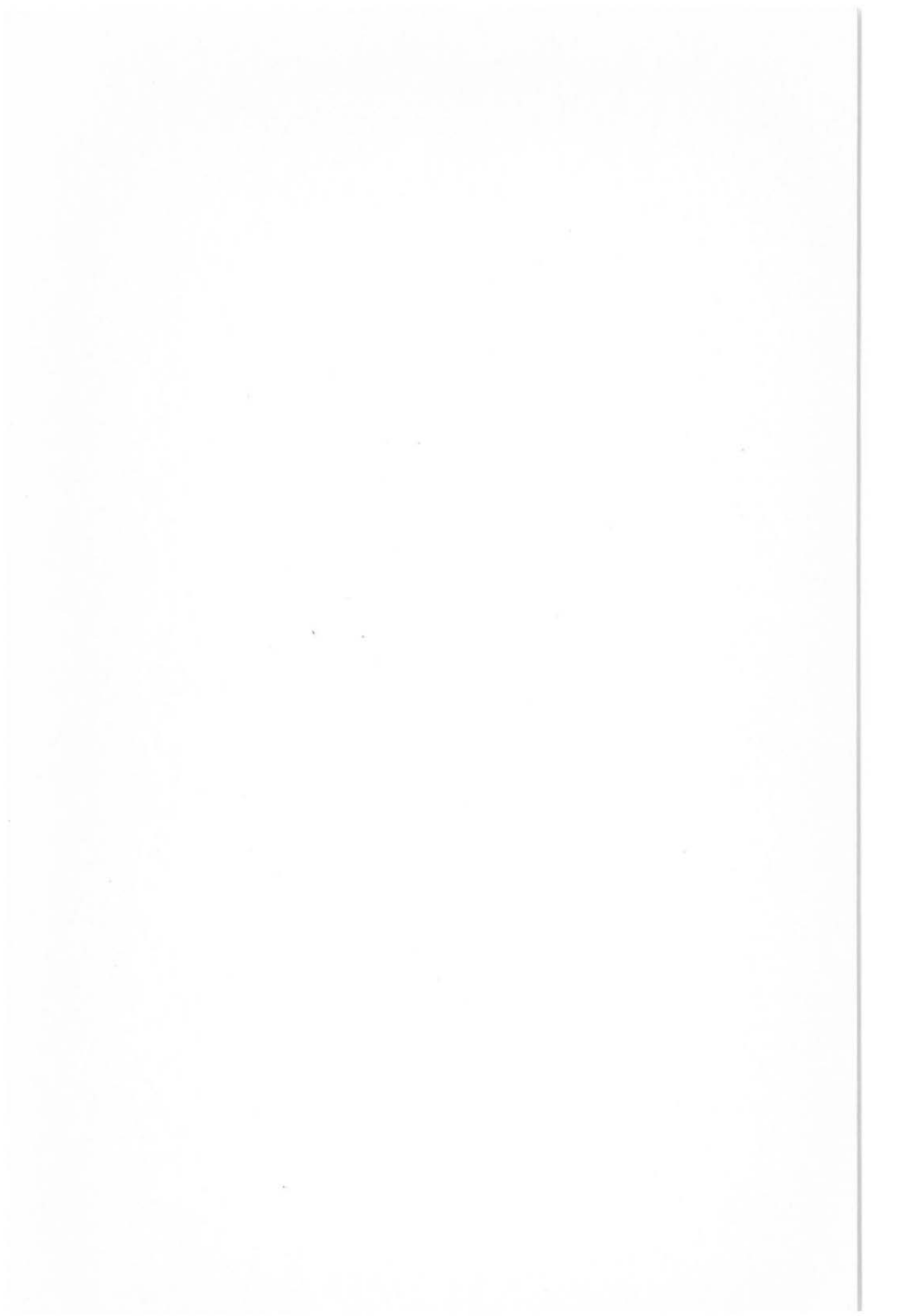
What is more, after all the revisionist work that has been done, the supposedly new picture of industrialization is not that different from the old. It is not easy to find such a positive statement of the corrected past; most generalizations take the form rather of criticisms of alleged convention, if not easy demolitions of straw men. But Knick Harley offers such a reconstruction in his latest essay — what he calls "a coherent new view of British growth" (1990, pp. 17-26). Without repeating his view in all its details, the general sense may be inferred from a few main points:

"The main growth occurred in cotton textiles. Cheaper cottons displaced competing textiles[...]. Large urban concentrations of industry occurred because the steam engine freed textile mills from water power and because the British economy redistributed labor and capital from rural agriculture to urban industry with considerable facility[...]. During this industrialization period real income grew modestly and the standard of living improved only slowly[...]. By 1840, Britain had achieved a notable economic leadership. Growth was clearly different after 1840 than it had been in previous centuries[...]. Contemporary observers and historians broadly agree on the extent of Britain's economic lead at the middle of the nineteenth century. Britain's industrial sector, in per capita terms, produced some 4 times as much as its French equivalent and 5 times as much as its German; even Belgium and Switzerland, the most industrialized continental economies, produced only about a third of British industrial output[...]. The economic change in Britain in the late

eighteenth century and early nineteenth century marked the beginnings of modern economic growth. The basic character of the economy changed from one governed by the balance of land and population to one dominated by technological change and capital accumulation”.

Thank you, Knick Harley.

There are lessons in all of this: that each generation must rediscover its past in its own way; that we see farther or think we see farther because we stand on the backs of our predecessors; and, more troubling for those of us who like to think that we engage in social science, that truth, like beauty, is in the eye of the beholder.



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