AN INDUSTRIAL REVOLUTION IN THE SIXTEENTH AND SEVENTEENTH CENTURIES?

L. A. Clarkson

Professor J. U. Nef's account of the growth of large-scale industry in England during the sixteenth and seventeenth centuries is well known. Equally familiar is his thesis of an 'early industrial revolution'. This was first advanced in 1932 when Professor Nef suggested 'very tentatively that the late sixteenth and seventeenth centuries may have been marked by an industrial revolution only less important than that which began towards the end of the eighteenth century.' Thereafter the theme recurs constantly in Professor Nef's work. In 1936 he wrote: There have been at least two 'industrial revolutions' in Great Britain. The first occurred in the period preceding the Civil War. A similar statement was made in a book published in 1940; and ten years later the idea of an early industrial revolution had become stronger and more far-reaching: Between 1570 and 1640 an early 'industrial revolution' occurred in the island (British Isles). For the character of modern civilization in Great Britain ... this industrial revolution was no less important than that of the eighteenth century.

Finally, in 1958 Professor Nef developed his thesis still further: There are ... grounds for speaking of an early industrial revolution in the north of Europe and particularly in Great Britain. They do not rest upon statistics of increasing output, impressive though such statistics sometimes are. They do not rest upon the growth in the scale of industrial enterprise, though there was a remarkable increase in the scale ... in many industries, from mining and metallurgy to the manufacture of alum and brewing. They rest in a novel movement during the late sixteenth and early seventeenth centuries, especially in Great Britain, towards a concentration of industrial enterprise upon the production of cheap commodities in large quantities. ... The early industrial revolution prepared the way for the later and more celebrated industrial revolution at the juncture of the eighteenth and nineteenth centuries.

It is interesting to observe how the concept of the early industrial revolution has developed in Professor Nef's work. At first it is a tentative suggestion; later it becomes a bold assertion of fact, although no more evidence is produced to support it. Originally Professor Nef wrote of the revolution occurring in the sixteenth and seventeenth centuries; later it becomes limited to the hundred years or so before the Civil War. This limitation of the period adds to the comparison between the early and later industrial revolution. But more important, the nature of the early industrial revolution changes between its first appearance in print and its later expressions. Professor Nef first used the term to sum up the considerable industrial activity in sixteenth and seventeenth century England that his researches had uncovered. But in his later works it is evident that Professor Nef regards the early industrial revolution as a swing towards an industrial society, as important in its way as its more famous successor. In short, the early industrial revolution, from meaning technical change, came to mean a change in the nature of the economy.
Two questions arise from this important thesis. How strong is the evidence that supports it? And, is the interpretation of that evidence as an ‘industrial revolution’ justified?

At first sight the evidence presented by Professor Nef in his book on the coal industry and in a number of articles is strong. It is not possible to examine this evidence in detail, but it is proposed to look at three aspects of it: the growth of industrial output; the development of large-scale industrial organization; and the introduction of new technical methods into English industry.

For evidence of the growth of production during the sixteenth and seventeenth centuries, Professor Nef’s work on the coal industry is of the greatest importance. In the mid-sixteenth century coal output in Britain was around 210,000 tons per annum; by the 1630’s it was 1,500,000 tons; and by the 1680’s it had reached nearly three million tons. There was a fourteen-fold expansion in production over a century and a half, compared with a three-fold increase in the following century.

The coal industry is one of the very few that yields tolerably accurate statistical evidence of increases in output in the period; but its importance to Professor Nef’s argument goes beyond this. The increase in output was achieved in part by an increase in the scale of production, as well as by sinking new pits; and the industry therefore illustrates Nef’s point concerning the growth of large-scale enterprise. Furthermore, the increasing use of coal—which followed from the increase in supply—in such occupations as glass and brick-making, brewing, and many others, made necessary the introduction of new or improved technical methods in those industries. But most important of all, the expansion of coal production is regarded by Professor Nef as some measure of growth in other industries:

While the expansion in coal-mining was undoubtedly more rapid than in other industries, this expansion was not an isolated phenomenon in British economic history, but part of a general development, the importance of which has not yet been fully appreciated.

The last point requires elaboration. Several reasons are advanced by Professor Nef for the increase in the output of coal, but the most important was the substitution of coal for wood as a domestic and industrial fuel. This was necessary because of a growing shortage of wood fuel—a ‘timber crisis’—brought about by the expansion of heavy industry. Thus the expansion of industry caused a shortage of wood fuel, which led, in turn, to an increased demand for coal; and the increase in the production of coal therefore reflected the general industrial expansion.

Was there a ‘timber crisis’ in the sixteenth and seventeenth centuries? If so the connexion between the increase in coal output and industrial expansion can be accepted; if not, Professor Nef’s case is weakened. It is obviously necessary to examine the evidence for the shortage of timber.

Professor Nef offers four types of evidence for a ‘timber crisis’. First of all there were contemporary complaints of a shortage of timber, particularly for such purposes as shipbuilding. There were frequently coupled with allegations that the iron industry was causing de-afforestation. Secondly, there were in the sixteenth century a number of acts of parliament placing restrictions on the cutting of timber. Thirdly, it has been generally believed that iron production in England
was checked by about 1629 because of a shortage of suitable wood fuel. Finally, it has been argued by Professor Nef that in the hundred years after 1540 the price of timber in England rose much more than the general price level. 9

Some doubts have been thrown on the nature of the ‘timber crisis’ in a recent article by Mr. G. Hammersley. 10 Following a survey of Crown woodlands in various parts of the country, he concluded that no great commercial value was placed upon this type of land despite the alleged shortage of timber. Frequently trees were left to rot, and where attempts were made to exploit woodlands commercially, they failed. The evidence suggests that there was no general shortage, although there may have been local shortages in areas where urban demands, or the needs of the iron industry or shipyards had depleted supplies. In any case, there was an important distinction between wood fuel and building timber. It is true that shipyards sometimes found it difficult to get the kind of timber they wanted; but they had special demands, for solid stuff, usually oak, often of particular dimensions, and from localities restricted by the difficulties of transport. But the existence of a timber shortage does not demonstrate the existence of a fuel shortage. Wood fuel was of small growth, generally unsuited to building; and in the case of the iron industry it preferably came from coppice trees of about twenty years growth.

Many of the contemporary complaints of a timber shortage referred to building timber, particularly for ships. Still, there were also complaints of a wood fuel shortage. Some of these, Mr. Hammersley points out, came from aggrieved persons who had made use of woodlands to which they had no legal right, and who were deprived of that use when the legal owners commenced systematic arboriculture. Others were genuine complaints that can be accepted as evidence of fuel shortages in the areas from which they came, but not of a general shortage. Similarly, three of the four timber acts passed between 1540 and 1590 dealt with particular localities—London and the coastal areas. Only one act (35 Hen. VIII, cap. 17) was national in scope and that was designed to protect woodlands from ploughing up and wandering animals rather than the depredations of industrial users.

There remains the evidence of relative price movements mentioned by Professor Nef. Even the very best price series for the sixteenth and seventeenth centuries have to be used with great caution. In the case of timber they are especially unreliable because of the great variations in the quality of the material and because the very high cost of transporting such a bulky commodity as timber overland meant that there was no such thing as a national price for timber or wood fuel. Professor Nef’s figures showing a seven-fold increase in prices between 1540 and 1640 are random figures and can have no general application.

‘The decay of timber in England is no very formidable thing . . .’ wrote Sir William Petty in 1699. If Mr. Hammersley has not conclusively demonstrated the point, he has at least cut away one of the main props in Professor Nef’s argument. It is by no means certain that coal was being used increasingly in industry because industrial expansion was outrunning wood fuel supplies. It could equally well be argued that coal was being used more and more because for many purposes it was a more efficient fuel than wood, giving out greater heat and with lower transport costs since it was transported mainly by sea and river. As for the fourteen-fold increase in output between the mid-sixteenth and the late seven-
teenth century, the figure is less impressive when it is remembered that the increase took place from a very low initial level.

Apart from coal production, there are few other industries for which output statistics can be calculated in the sixteenth and seventeenth centuries. For iron, Professor Nef suggests a five-fold increase in production between 1540 and 1625; but as with coal the increase took place from a very low level. The production of salt between 1540 and 1640, increased from 15,000 tons to 50,000 according to Nef. And on the same authority glass production increased fifteen times between the mid-sixteenth and late seventeenth century when production 'may have exceeded 10,000 tons'. There is no other direct evidence of the growth of industrial production in the period. Professor Nef is therefore compelled to rely on indirect evidence. For example, increases in production can sometimes be inferred from evidence of increases in demand: the production of metal goods and shipbuilding are cases in point. Sometimes there are contemporary references to increased output, for example of salt-petre and beer. Finally the presence of additional or larger enterprises—paper mills, alum works, cannon foundries, etc.—implies increased production. It is evidence of this nature that Professor Nef has produced (principally in his book on the coal industry) and has strung along the thread of increasing coal production in order to illustrate his thesis of an 'early industrial revolution'.

Let us now turn briefly to Professor Nef's evidence of the development of large-scale industrial organization, and the introduction of new technical methods into English industry. Nef's examples of large-scale production are drawn from a wide range of occupations, including mining, metallurgy, chemicals, shipbuilding, paper making, and others. In one of his most vigorous passages Professor Nef writes:

Between 1540-1640 tens of thousands of work people had been swept . . . into hundreds of new, capitalistically-owned enterprises. The introduction of new industries and of new machinery, tools and furnaces in old industries had brought about technical changes in the methods of mining and manufacture only less momentous than those associated with the great inventions of the late eighteenth and early nineteenth centuries.12

This aspect of Nef's argument has been criticized by Dr. D. C. Coleman.13 He has pointed out that Professor Nef frequently generalizes from single or untypical examples of a large-scale enterprise; and sometimes, on close examination, the examples turn out not be large-scale at all—paper mills fall into this category.14 It is true that examples of large-scale enterprises can be found in the sixteenth and seventeenth centuries, but they seem to be scattered undertakings and there is no evidence to suggest that they became common forms of industrial organization.

Much the same can be said of the introduction of new techniques to English industry. Examples can certainly be found, particularly in mining and metallurgy and the embryonic chemical industry. But we may doubt whether this was a general feature of English industry. In such fundamental industries as textiles and leather the level of technology was low and unchanging in the sixteenth and seventeenth centuries.

III

These criticisms of Professor Nef's evidence—and they can be summarized by saying that he rests his case too heavily on a single industry (coal) and generalizes
from examples that are not typical and are occasionally misleading—should not lead us to assert that the sixteenth and seventeenth centuries were innocent of technological and industrial development. Professor Nef has left historians of the period in his debt by demonstrating that the English economy did not consist only of agriculture and wool. There was a good deal of industrial activity in the period, and it was increasing. But was it sufficient to be described as an 'early industrial revolution'? In order to answer this question let us pose two others. What was the fundamental structure of the English economy during the sixteenth and seventeenth centuries and did it undergo significant change? And, secondly, what is an 'industrial revolution'?

The English economy of the sixteenth and seventeenth centuries was based on agriculture. The bulk of the population—probably at least a half and perhaps considerably more—obtained most of its income from farming. The most important industries of the time were those engaged in the processing of agricultural products and in supplying the essential needs of a predominantly rural society. The manufacture of cloth was without doubt the most important industry of the time, and there is good evidence for believing that the leather and small metal crafts (producing a range of articles from nails to plough shares) vied for second place in terms of value of output and as a source of employment. We know very little about the building industry, but it must have been very important. By the side of these occupations—and other non-agrarian pursuits such as retail trading—the industries examined by Professor Nef assume a smaller importance. Professor Nef says nothing about the leather industry and little about woollen textiles and building. Both cloth and leather were essential consumer goods and no doubt the output of both increased as the home market grew with the growth of population in the sixteenth and seventeenth centuries. But it is by no means certain that production in these two industries grew at a faster rate than population; and neither displays any major symptom of an early industrial revolution: new techniques, large-scale investment in fixed plant, or the concentration of labour in factory-like enterprises. It is true that in the case of woollen textiles there was a development in the manufacture of new draperies in the later sixteenth century, but this was more a compensation for the decline in production of old draperies for the export market rather than a new source of expansion. It is also true that there was some expansion in the production of other textiles, cotton for instance, in the early seventeenth century, but these did not assume importance before the eighteenth century.

In spite of the growth of particular industries it is clear that the general characteristics of the English economy at the end of the seventeenth century did not differ very much from that of the mid-sixteenth century. Agriculture was still the main source of wealth, and in the industrial sector the traditional industries such as wool and leather were still more important than the newer 'heavy' industries described so vividly by Professor Nef. The typical industrial unit was still one employing little fixed capital and labour. Impressive though the growth of the coal, iron, chemical and other industries may have been during the sixteenth and seventeenth centuries, their contribution to total national production was still small at the end of the period.

This brings us to our second question: What is an 'industrial revolution'? As Sir George Clark and others have pointed out, the phrase has sometimes been
used to mean the application of new techniques to an industry, and sometimes to describe changes in the industrial sector, both in techniques and organization. There is a third usage which is best summed up in the words of T. S. Ashton: “The industrial revolution is to be thought of as a movement, not as a period of time.” This is in the tradition of Toynbee who in his original lectures on the industrial revolution regarded population growth, urbanization, agrarian changes, the development of the factory system, the expansion of trade, the redistribution of incomes, and the widening gap between capital and labour, as the ‘chief features of the revolution’. 17

There is much to be said for regarding an industrial revolution in this light. And it is surely the definition we must use in judging the ‘early industrial revolution’ since Professor Nef so often develops his argument by means of an analogy with the industrial revolution of the late eighteenth and early nineteenth centuries. Even if we were to accept in full all of Professor Nef’s evidence of industrial growth in the sixteenth and seventeenth centuries, it cannot be claimed that it constituted an industrial revolution in this sense. It should not be thought that the question is merely one of terminology, though it is important to be certain of the meaning of such phrases as ‘industrial revolution’. The economy of Tudor and Stuart England was far more complex and displayed a much more vigorous growth than the early historians of the classical industrial revolution realized. 19 But it is misleading to project back into the early modern period phrases used to describe the economic developments of the late eighteenth and early nineteenth centuries. Professor F. J. Fisher has suggested that the sixteenth and seventeenth centuries are the ‘Dark Ages’ of English economic history. 20 Notions of an ‘early industrial revolution’ do little to relieve the gloom.

NOTES
11. According to Professor Nef iron production ceased growing in the 1620’s because of the shortage of wood fuel. This view has recently been challenged by M. W. Flinn who argues that the shortage of fuel was not a serious problem, except perhaps in the Weald of Kent. See M. W. Flinn, ‘The Growth of the English Iron Industry’, Econ. Hist. Rev., 2nd ser., XI (1938), 144-53.
14. Professor Nef infers that paper mills employed ‘scores of hands’ and needed capital worth £1,400-£1,500. Dr. Coleman shows that, in fact, such mills normally employed far fewer workers and could be established with much less capital.
19. Note, for example, Toynbee’s statement that ‘the essence of the Industrial Revolution is the substitution of competition for the mediaeval regulations which had previously controlled the production and distribution of wealth’.