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E. A. Wrigley. *Energy and the English Industrial Revolution.* Cambridge: Cambridge University Press, 2010. Illustrations, map. xiii + 272 pp. $75.00 (cloth), ISBN 978-0-521-76693-7; $30.99 (paper), ISBN 978-0-521-13185-8.

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E. A. Wrigley believes that the key to the British Industrial Revolution lies in coal. Many past and present economic historians would agree. Nothing came close to the energy a single mine could produce, and the available energy grew exponentially as a consequence, most noticeably in the period from 1600 to 1850. How this growth occurred cannot be separated from the invention of the steam engine, first by Thomas Savery and Thomas Newcomen and then most successfully by James Watt. It was "arguably the single most important technical advance of the whole industrial revolution period" (p. 44). Wrigley comes perilously close, however, to implying that the problems of drainage in mines and the need to dig at greater and greater depths called forth the discovery of a satisfactory solution. Given the material conditions innovation simply occurs.

Complex causal explanations that might involve knowledge, or beliefs and values, including the contingency of separate intellectual developments, are beyond this economic historian, as indeed many others. Wrigley can still discuss necessary and sufficient causes as if they were discoverable and self-explanatory. The forces at work in making the Industrial Revolution were impersonal and mechanical. No human agency improved agricultural yields; applied hydrostatic principles to water engineering; or experimented with steam engines, broadening their application in wool factories or breweries, in tanning and dyeing. If the student is willing to enter the world governed by a few material causes, devoid of agency, then much can be learned from Wrigley's account.

He strives to demonstrate the interconnectedness of forces that affected each other. The transportation of coal by land was prohibitively expensive, hence the growing emphasis on turnpike and canal construction. Coal transported by water was taken to be one-twentieth the cost of land transportation and economics drove the transportation revolution. Of course given the distance from Newcastle to Rotterdam versus the similar one by sea to London, the information about transportation costs only deepens the puzzle of Dutch decline over the course of the eighteenth century.

Wrigley sees the Dutch economy as the only one comparable to the English, leaves out the equally relevant Austrian Netherlands, and fails to tackle these Continental settings with sufficient rigor. If coal is the key, why did the Dutch fail to see its potential whether it was located across the North Sea at Northumberland or in the southern Netherlands from Maastricht to Mons? We should be grateful, nonetheless, to find a national historian willing to take into account, if largely from secondary sources, the dilemma of Dutch decline during the eighteenth century.

More and better food, as well as increased access to transportation put English people in motion, and, as Wrigley argues, migration to industrial centers with their higher wages needs to be factored into the story of early industrial development. He does not buy into the argument put forward by Robert Allen that high wages in Britain were the necessary key to industrial development. Without picking a fight, Wrigley notes pointedly that wages appear to be stagnant in the mid-eighteenth century, and no wage data is adequate without the earnings of women and children reckoned into the household economy. What Wrigley seeks to explain is the escape from the Malthusian trap, how England combined energy production, improved transportation, increased population, urban growth, cheap manufactured goods, and greater consumer confidence to enter a brave new world where growth, with fits and starts, is nevertheless continuous.

The student wanting to get a grasp of the industrial world will have to be prepared for a fair amount of academic jargon, much of it beloved by economic historians. We learn that the "expectation of life at birth was 28 years but fertility was high with a GRR of about 2.6"; "peat was

first exploited in the low lying bogs of the alluvial areas"; and "with the change in the structure of aggregate demand there was necessarily a matching change in occupational structure, a shift from primary to secondary and tertiary employment" (pp. 159, 222, 230). Not every undergraduate will take to this book despite the great learning on display and the genuine effort on the part of the author to communicate. That said, it will be a long time before anyone dares to argue against coal as a major key to the first Industrial Revolution.

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