Book Reviews

The New History of Technology

Turning Points in Western Technology. A Study of Technology, Science and History. D. S. L. CARDWELL. Science History (Neale Watson Academic) Publications, New York, 1972. xii, 244 pp., illus. Cloth, $10.50; paper, $5.

"A sense of history," writes D. S. L. Cardwell, "is a sense of civilization." Unfortunately, the histories so far written do not do justice to the vital role of technology in human affairs. Tied on the one hand to antiquarian and curatorial concerns and on the other to economics, the history of technology, something of a scholarly orphan, has lacked a distinct discipline and a sense of purpose. D. S. L. Cardwell is one of a handful of contemporary scholars who have been revolutionizing the field. Though many problems remain, one result is already clear: the history of technology is not simply a catalog of inventions but an essential part of social and intellectual history. Cardwell's particular concern has been to show the importance of technology in the history of science. In his *From Watt to Clausius: The Rise of Thermodynamics in the Early Industrial Age*, Cardwell provided a model of the new history: a thoroughly researched monograph on the interaction of power technology and science. In *Turning Points in Western Technology*, he has written an interpretative essay which ranges across the entire field of the history of technology from the later Middle Ages to the present.

Cardwell's theme is the rise of a new, scientific technology. He concentrates on four major turning points. The first was an era of invention in the late Middle Ages during which technologists opened new vistas for European civilization. Neither here nor elsewhere does Cardwell attempt a comprehensive survey; he provides analyses, often incisive, of judiciously selected examples, in this case the clock and printing press. The Scientific Revolution was the second turning point, exemplified in the complementary work of Bacon and Galileo. Bacon was the prophet and ideologist of the new, scientific technology. Galileo laid its technical foundations, notably in his works on the strength of materials and on the analysis of machines. The Industrial Revolution, the third turning point, was characterized by the massive penetration of both Galilean methods and Baconian ideology into technology. The fourth turning point represented a radical reorientation in the early 19th century, exemplified in the work of Carnot and Faraday. Thermodynamics and field theory drastically changed science, but the social result was the virtual completion of the Baconian program.

Cardwell recognizes clearly that the new history requires a new historiography. At the outset it requires an intimate knowledge of both technology and science. Because he has this, Cardwell is able to provide a point of view in which the development of technology may be seen as an organic whole and not just a catalog of particulars. Cardwell rightly insists that technology has not been simply an intellectual parasite, but has been an equal partner with science. This insight, to which many historians of technology have contributed in the last dozen years, has revolutionary implications for the history of science. Cardwell recognizes that the new history carries equally far-reaching implications for social and intellectual history, but he does not attempt to work them out, even in outline form. He was probably wise in not overloading what is essentially an essay, but his occasional discursions into social history are often illuminating. Cardwell holds that the new history should be universal and consequently free of the nationalistic prejudices which still beset political history. But his precept is better than his example, and this book centers on the rise and decline of British technological leadership. This has its drawbacks, as when essentially international developments like the automobile and the turbine are discussed almost exclusively from the point of view of British technology. But the national perspective does serve to give dramatic unity and human interest to the latter half of this book.

Cardwell has helped to initiate an important historical revolution, but much remains to be done. He has a strategic grasp of the history of technology which elevates this work far above most of its predecessors, but he is unable adequately to assimilate a great mass of material vital to the history of technology. The source of this weakness lies in Cardwell's use of Bacon's division of inventions into two categories, scientific and empirical. The essential difference is that scientific inventions "depend on the advance of knowledge" (p. 32) and can be made only when certain information has become available, whereas "empirical" discoveries depend on accident and are therefore rather more difficult to understand historically. But Cardwell gives "science" a much narrower definition than Bacon did. To Cardwell almost all mechanical inventions were empirical, including the machine tools and textile machinery that had such a radical effect on society in the 18th and 19th centuries. Thus, he writes that "the invention of textile machinery by men like Arkwright, Hargraves, Coniah Wood, Crompton and many others was totally independent of science" (p. 100). This is true if one restricts the meaning of "science" to "natural philosophy" or physics, as Cardwell does. But the advance of mechanical technology clearly did depend upon the growth of a body of technical knowledge, one which we find reflected in the tradition of engineering and machine books. In Bacon's own day this knowledge was considered "science." Thus, Cardwell's approach does provide a framework for the development of the history of technology based on "scientific inventions," but his definition of the latter is so restricted that much is still left on the level of the descriptive catalog. This limitation is compounded by his decision (made for reasons of space) not to include consideration of the technologies associated with the chemical, metallurgical, and extractive industries.

In short, Cardwell has written a brilliant, impressionistic essay which reflects the beginning of a major revolution in our views of the roles of science and technology in human affairs.

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