Book Reviews

Our Industrial Society

Technology: Man Remakes His World. J. Bronowski, Sir Gerald Barry, James Fisher, and Sir Julian Huxley, Eds. Doubleday, Garden City, N.Y., 1964. 367 pp. Illus. $12.95.

Can the highly complex technology of our industrial society be made clear to the public in a picture book? Probably not. But the publishers keep trying, and in the process they have produced some handsome books with beautiful photographs and colorful charts. This volume, like its counterparts, is lavishly illustrated and beautifully designed (it was printed in Italy); written by a group of British scholars and popularizers in fast-paced prose, with the properly "gushy" tone (which is peculiar to such works) of awe and amazement at the wonders of technology; and presided over by a distinguished editorial board—J. Bronowski, Sir Gerald Barry, James Fisher, and Sir Julian Huxley—which overlooked but did not oversee.

Unlike most of its competitors, this volume is not loosely hung together on a chronological framework; instead it claims to be an encyclopedic reference book which follows "a systematic information theme," with "one subject leading to another," rather than the usual alphabetical sequence. Thus, the topics (in sequence) are as follows—Reshaping Our World; Measurement Basic Techniques; Power: Energy at Work; Riches of the Earth; Chemical Technology; Metals and Their Uses; Ceramics and Glass; Food and Agriculture; Textiles and Leather; Building: Materials and Methods; Land Transport; Water Transport; Air Transport; Military Technology; Communications and Control; and Technology: A Summing Up. Surprisingly enough, the result is not chaos—but neither is it clarity, for mere juxtaposition of related items does not always suffice to demonstrate their interrelatedness.

Despite its organization, this book suffers from the usual faults of its genre. There is first of all the concentration on machines, devices, and techniques, to the exclusion of other important elements of technology. Yet, as Peter Drucker has frequently pointed out, technology is not about things; it is about work. The Egyptians and Romans, for example, were able to erect great edifices and monuments with only the simplest of tools because of the highly sophisticated way in which they organized their work. And, interestingly enough in a book that stresses machines and techniques, machine tools, which are basic to the creation of other machines, are almost totally disregarded.

Then there is the fallacy of the historical present. Because so much of our contemporary technology is inextricably intertwined with science, the assumption is made that this has been the case throughout history. A typical statement reads as follows: "All progress in technology depends on a scientific understanding of the way in which nature works. . ." (p. 9). Nonsense! For most of human history, when technological progress was dependent on the crafts tradition, no "scientific understanding" was involved in technological advance. Even today much engineering development is based on a strictly empirical foundation; only later do we achieve a scientific explanation of the technical workings.

In a collaborative volume of such wide scope, one expects some contradictions. But these authors contradict themselves as often as they contradict one another. On page 308, J. G. Crowther makes the following statement: "The whole progress of technology since the Renaissance has been marked by this dependence on deep scientific thought." On page 309, he approvingly quotes Thomas Edison's dictum that "Invention is one-per cent inspiration and ninety-nine per cent perspiration." (He does not tell us whether the "deep scientific thought" is to be found in the inspiration or perspiration.) And on page 310 Edison is cited as "the most prolific and talented American inventor of his age"; that is true, but Edison's career certainly makes hash of the generalization that technological progress is dependent on "deep scientific thought."

There are other inconsistencies, contradictions, and outright "howlers." What is one to make of such a statement as this—"Technology has been the agent of social change, but it neither seeks to alter (nor could it alter) the pattern of family life" (p. 304)? Is the pattern of family life for a modern two-car family no different from what it was for a family in the horse-and-buggy days, to say nothing of the differences between family life in contemporary urban civilizations and that in hunting and food-gathering societies?

The book closes on an optimistic note. In addition to the usual remarks about the need for man to control himself rather than destroy his civilization by the forces of technology, there is a plea for social psychology, "a wonderful tool that can enable man to make the most of his societies. Indeed, we are really on the threshold of a new technology—that of social engineering. Despite the curious label, we should not despise this, for it can do much to increase the total sum of human happiness" (p. 315). True, perhaps, but one cannot help feeling somewhat uneasy when social engineering is held forth as a panacea by writers who seem unaware of elementary sociological and anthropological factors and who, in a volume that presumes to "tell the detailed and orderly story of men and their machines," seem quite ignorant of the processes of invention. What is worse, in this book technology is presented as progressing in a virtually linear development; there is no recognition of the fact that technology has had its failures, or even more importantly, that some of these very failures have been responsible for later successes.

However, there is little point in quarreling with the philosophical assumptions underlying this book. Despite its pretensions, this is basically a picture book that describes how machines work and how things are made. It tells us such things as how ore is smelted, how glass is molded and blown, how plastics are produced, how fibers are spun and woven; in the proc-

ess it provides us with a great deal of interesting data and many fascinating pictures. The book is so up-to-date that it describes satellite telemetry and masers, but it neglects to explain how a simple telephone works or how a standard radio receiver operates; it tells us about binary codes for computers and photolithography but does not describe an ordinary printing press. This book is supposed to answer the "questions that intelligent children ask their parents." Well, let's face it, children are asking different questions nowadays. But their intelligent questions deserve more than superficial answers.

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History of Technology

Engineers, Inventors, and Workers. P. W. Kingsford. St. Martin's Press, New York, 1964. 272 pp. Illus. $4.95.

This easily read book traces certain aspects of the technical and industrial development of Great Britain during the past 250 years. Kingsford gives about two dozen short biographical sketches of such men as Newcomen and Watt, who designed the steam engine; the Darbys, who were ironmakers; Bramah, Maudslay, and others, who were builders of machine tools in the period between 1775 and 1860; and George Stephenson and his son Robert, who were builders of railroads and locomotives. Throughout the book a change of pace is developed by presenting two or three biographies and then providing glimpses of successive stages of the trade union movement.

It is, as Kingsford suggests, necessary to know something about antecedents if one is to understand the technological facts of the present. There are occasional flashes of light that illuminate the questions raised by a mechanized present—a remark made at age 30 by Thomas Telford (1757–1834), the prominent civil engineer, "I think I have observed that there has always been a bustle where I was," and another quoted by the author, who after recording the loss of 100 lives in the building of the Box tunnel of the Great Western Railroad, quotes a glowing appreciation of the builder, an appreciation which closes with the observation that "great things are not done by those who sit down and count the cost of every thought and act." In general, however, the book provides a rather uncritical recounting of a standard but superficial story. The standard errors and some absurdities are also present. To give but one example, Hero in 130 B.C. built a steam turbine; Branca in the 17th century invented another turbine; the latter "was too crude to be successful and nothing more was done until the nineteenth century." This, unfortunately, is the accepted way of saying that we happen to know of the two examples of turbines (one a description, the other a picture); nobody has yet looked into the question carefully, so we can, unencumbered by data, draw a conclusion.

In writing a book, it is quite impossible to avoid all errors, but an author who discusses technical devices should be well enough informed to recognize and reject improbable statements made by earlier authors.

The sections on trade unions are interesting, but their connection with the rest of the book is tenuous. The machines and processes developed by the men discussed in this book did change radically the work required of craftsmen and laborers, but in the long run the conditions of employment were set by the entrepreneurs and men of capital, not by the machines or the inventors and engineers.

The story of the industrialization of Great Britain is inherently exciting and significant. Properly told, plausibly and critically, it can help us to understand how and why technological imperatives tend to shoulder aside mere human considerations. But I fear this book will do little to enhance that understanding. It should be noted that the book, which was published and printed in England, sells in England for 18s. (about $2.54).

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Undergraduate Textbook

Physical Chemistry. Gilbert W. Castellan. Addison-Wesley, Reading, Mass., 1964. xvi + 717 pp. Illus. $12.50.

In this book Castellan continues the trend that is characteristic of other physical chemistry textbooks published during the past 5 years—the trend toward a more rigorous and mathematically sophisticated approach in modern undergraduate physical chemistry courses. He recognizes the impossibility of adequately covering all areas touched by physical chemistry, and attempts to treat basic fundamentals with only some applications in depth.

In the first five chapters, the author deals primarily with some very basic chemical concepts, macroscopic and microscopic properties of gases, and some related macroscopic properties of condensed phases. Thermodynamics is introduced in chapter 6; the laws of thermodynamics and the general conditions for equilibrium are developed in the next four chapters, and are applied to chemical and phase equilibria for ideal systems in chapters 11 and 12. The next three chapters consider solutions and equilibria in ideal condensed phases. The treatments of the concept of activity and electrolytic solutions (chapter 16) lead logically to electrochemistry (chapter 17). The next seven chapters are devoted primarily to studies of the structure of matter and elementary quantum mechanics applied to intramolecular and intermolecular forces, and to the interpretations of macroscopic and thermodynamic properties of systems from the microscopic behavior of individual components. Surface phenomena, transport properties, and conduction are considered in the following chapters. The final three chapters cover chemical kinetics, including adsorption, electrolysis, and photochemistry.

Problems, most of which are rather straightforward, are included at the end of each chapter, and answers to all the problems are provided at the end of the book. A reasonable number of pertinent and logically worked numerical examples are given in the text, particularly in the chapters on thermodynamics, and derivations are, for the most part, mathematically rigorous and complete.

The book is clearly written and contains excellent discussions of many basic principles and concepts of physical chemistry. Certain misleading or wrong concepts are carried over from earlier textbooks (for example, the discussion of the minimum work in an isothermal compression), but fortunately these are few. Modern symbols are used throughout, following in general the recommendations of the International Union of Pure and Applied Chemistry's Commission on Physicochemical Symbols and Termi-