Book Reviews

Technology and Civilization

After the Seventh Day. The world man created. Ritchie Calder. Simon and Schuster, New York, 1961. 448 pp. Illus. $6.95.

This is a book with a message founded on the premise that if man takes heed of his past mistakes he can solve his major problems of the present and deal intelligently with his future. Ritchie Calder writes, with the traditional mechanistic orientation of the Western world, that, with the foresighted application of technical knowledge now current or in the process of development, man's future lies completely in his own hands. In this sense it is an optimistic book despite its note of warning and of urgency.

Calder is a distinguished journalist who has devoted much of his life to popular science writing. He has traveled widely for United Nations organizations and he draws heavily on extensive reading, personal observation, and personal contacts with an impressive variety of human beings from different environments, different specialities, and from different cultural traditions. The resulting book contains much out-of-the-way information, many sharp insights, and a persistent theme.

Unfortunately, however, the book's basic organization is almost completely obscured by division into ten parts, each with a catchy title; the parts are further fractionated into 194 separate, brief, titled units. The structure of the argument itself thus tends to get lost. Actually, the first major section, of six parts, takes up approximately two-thirds of the entire volume. This section attempts to review man's cultural history from its earliest beginnings to the present day with an almost exclusive focus on the proposition that cultures and civilizations rose and prospered as man, through technological development, expanded his relationship to his environment in a harmonious fashion, and that his civilizations fell and disintegrated when man destroyed his own ecological balance. The last third of the book, despite its arbitrary division into four parts, really consists of only two themes, the present and the future. Parts 7 and 8 scan modern problems, particularly those caused by radioactivity, by ecological considerations in planned developments, by oil, water, and fossil soils in the Sahara, by soil salinity, and insect pests and disease; part 9 deals exclusively with the population explosion, and part 10 concentrates on what to do about the future.

Calder sees no possibility that birth control policies will make a significant contribution to the solution of the population problem during the critical period of the next 20 years, particularly in the face of our progress in "death control"—the raising of life expectancy in areas where it is still shockingly low. His answer lies in the utilization of potential resources (many until recently quite unknown) by emerging techniques and, with due regard to the mistakes of the past, to render fruitful and habitable the arctic and desert wastes, the high altitudes and the tropical forests, and also to exploit intelligently the enormous food-producing possibilities of the sea. Envisioning a world population of 4,000,000,000 by 1980, Calder sees this situation as a vast international challenge. The industrialized nations of the north temperate zone, who broke first from the starting gate by virtue of the fact that the overwhelming preponderance of fossil fuels lies north of 20 degrees north latitude, must contribute to the development of the lands to the south of it where 80 percent of all the hydroelectric potential of the world lies largely undeveloped.

This is a book that should be widely read, and many of its lessons should be, and apparently some are being, taken to heart. It is at the same time a very annoying book, for one feels that much has been sacrificed in the effort to popularize and condense. Furthermore, as already noted, its structure is not clear; the titles of the sections and subsections are catchy rather than informative; and the treatment of culture history, which takes up the first two-thirds of the book, is very uneven, extremely sketchy, one-sided, and sometimes inaccurate. In like vein, one wonders whether the author does not over-assess some of the possibilities of our present ecological, technological, and biological knowledge, and environmental potentialities.

On net balance, it is my judgment that this book is well worth reading and that it will repay the effort to plow through its very choppy but often brilliant seas.

Calder closes with this thought:

"With the resources of modern science and technology, tempered by wisdom, we can escape from the limitations of past civilizations and succeed where they failed.

"But, remembering the 4,000,000,000 people who will share this planet in twenty years time, science and statesmanship will have to work fast."

I wish I could be as sanguine as Calder.

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Objectives, Methods, Models

Design of Water-Resource Systems. New techniques for relating economic objectives, engineering analysis, and governmental planning. Arthur Maass, Maynard M. Hufschmidt, Robert Dorfman, Harold A. Thomas, Jr., Stephen A. Marglin, and Gordon M. Fair. Harvard University Press, Cambridge, Mass., 1962. viii + 620 pp. Illus. $12.50.

In response to growing feelings that the methods of planning basin-wide, multiple-unit water-resource systems were not adequate, faculty and students at the Harvard Graduate School of Public Administration began, in 1955, a study of the methodology of system design. The resulting book represents a carefully considered viewpoint on system design, presented as a compendium of 15 chapters by different authors. In part 1 the discussion considers the objectives of water resource development, sets forth some possible economic models, and reviews some deci-

sion-making tools. Methods are discussed in part 2; primary focus is on the simulation of a typical system (the Clearwater River, Idaho) on a digital computer, utilizing synthetic hydrologies derived statistically. Part 3 consists of one chapter (by Maass) on the role of the political process in system design. Realizing the complexity of the problem, the authors preface each part with a general nonmathematical statement; these chapters alone will give the nontechnical reader a good summary of the text.

Interesting material is here for engineers, economists, political scientists, and others concerned with the water problem. Each group will find that some part of the text is written in familiar terms and that other portions will need a second reading. The authors admit the book does not present the final solution to the problems of water-resource design. Emphasis is on the methodology of analysis, and the limitations of various methods and models are freely discussed. It is assumed that the necessary input data are known, but many readers will realize that this assumption is far from valid. It is interesting to note that the difference in net benefits for the test basin, as determined by a rather elaborate machine simulation program and by a conventional manual analysis, is only approximately 10 percent. This suggests that, although the manual methods currently used are certainly subject to improvement, they are not really so bad after all. Much larger errors could conceivably result from improper measurement of the inputs.

The book is well written and shows evidence of careful coordination between chapters. A mathematical approach is used throughout, but there is liberal use of graphic presentation for those who find the mathematics difficult. Engineers may be amused by the rather elaborate discussion of the Rippl or mass diagram which they have utilized for years, and some readers may wonder about the need for the elaborate discussion of the test basin in chapter 7.

The book will certainly be the subject of considerable discussion and almost certainly many points will be challenged; but it is a good beginning that should stimulate useful discussion and further research both within the universities and among practicing engineers.

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Finite Positive Entropy

The Third Law of Thermodynamics. John Wilks. Oxford University Press, New York, 1961. viii + 142 pp. Illus. $2.40.

Of this book the publishers say, "Although primarily intended to give a comprehensive survey of the Third Law the book should be suitable for undergraduate reading for an Honor School. It therefore includes a treatment of such elementary statistical mechanics as are necessary for an understanding of the Law." In the preface the author writes, "Nernst originally put forward the Heat Theorem which was to become the Third Law in order to predict the equilibrium conditions of chemical reactions. . . . I have attempted to cover all the significant aspects of the Third Law in a manner intelligible to an Honors undergraduate, and have therefore included a treatment of such elementary statistical mechanics as are necessary for an understanding of the Law." He should be congratulated on his evident success. For those not familiar with the required syllabus for the Honors degree in English universities, it should be mentioned that the syllabus, while slowly changing, is somewhat rigid and that it corresponds roughly to what is required for the master's degree in a good American university.

To some chemists the author's statement in the preface about the status of the Heat Theorem in relation to the Third Law will certainly be provocative. Those of us who were educated at the University of California when the late Gilbert Newton Lewis used to preside over countless seminars will remember that the Nernst heat theorem was not held in quite the same awe that it is at Oxford.

There are a number of chemists who feel that the third law of thermodynamics is a consequence of statistical mechanics and the uncertainty principle, as soon as one accepts the second law as established and deduces therefrom the rules of statistical mechanics—for example, equation 6.1 on page 71, for the situation at absolute zero, reduces to $W = g$.

This is exactly the condition for the entropy of such a system at the absolute zero. It is not zero but $R \ln g$.

This point has been discussed by Linus Pauling and by the late E. D. Eastman [*J. Chem. Phys.* **4**, 393 (1936)]. Then on page 8 there is the following statement: "Hence the procedure adopted previously is no use for indistinguishable particles, and in general more powerful techniques outside the scope of this book have to be employed, principally the method of ensembles developed by Gibbs. . . ." In view of the publisher's claim concerning the comprehensive nature of the book, this is a strange statement indeed.

I recommend the book, enthusiastically to those who wish to get a feeling for the variety of physical facts dependent on the third law of thermodynamics. I cannot recommend it as a comprehensive survey for those seriously interested in the subject. It is ideal for university students studying the subject for the first time.

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A Rich Lode

Medical Teaching in Western Civilization. William B. Wartman. Year Book Medical Publishers, Chicago, Ill., 1961. 307 pp. Illus. $7.50.

This admirable anthology, which ranges from Hippocrates to Atchley, has been brought together with perceptiveness and skill by an academician who has a feeling for the sweep of history and a willingness to allow men to speak for themselves. Only in rare transitional paragraphs, which provide both perspective and continuity, does Wartman insert himself. For the rest, the words are those of the great teachers he has selected, as they (or their proxies) describe their purposes and their practices in helping others to become physicians. The book is not designed to be complete, nor to provide a precise evolutionary account of medical education. It is instead a book of men and their works.

Inevitably the choice of material from the classical period and the Dark Ages is limited, but the selected accounts of Greek and Alexandrian teaching, of the appalling irresponsibility in Rome, of the inflexible dogma in the Middle Ages convey vividly the nature of the teaching in those times. With the Renaissance the pace quickens and the words of Vesalius, Boerhaave, Frank, and Sydenham set forth clearly and colorfully the values of the age as well as their methods of instruction.