

means and styles of exposition. Necessarily such a compilation must be considered foremost for its reference value even though the editor does express the desire to accomplish the needed changes as a common thesis.

Seldom are articles so well annotated. The publication is of real value if for no other reason than the fact that it is a storehouse of reference material and sources for each separate area of science education. Each separate article includes a considered list of all types of publications providing a rich set of references to auxiliary material.

Perhaps the strongest contribution of articles is included in *Comparative Aspects*, which compares certain aspects of science education in the United States with those in Great Britain and the U.S.S.R. The compact summary of science education U.S.S.R. provides a maximum of information in a brevity of space.

The challenge of science education is evident in a turmoil of a variety of expressions; no battles are won but the circumstances are well described.

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Thermodynamics, An Introduction to the Physical Theories of Equilibrium Thermostatistics and Irreversible Thermodynamics. HERBERT B. CALLEN. Pp. xvi + 376, John Wiley & Sons, Inc., New York, 1960. Price \$8.75.

This is a textbook, intended as "an introduction to thermodynamics for advanced undergraduate or first year graduate students," and has been taken "successfully" by seniors specializing in physics, chemistry, or engineering at the University of Pennsylvania. Professor Callen foresees the day when the pressure of topics at the graduate level will force classical thermodynamics back to the exclusively undergraduate level. This consideration seems to a large extent to dictate the tactics of the book, which is to find a method which will compress the greatest amount of material into the smallest amount of space. With this object in view the adoption of the postulational method, as contrasted with the more usual method of induction from crucial experiments, is easily understandable. The essentials of the particular postulational approach adopted here were conceived by Professor Laszlo Tisza of MIT and Professor Callen freely acknowledges his indebtedness to the teaching of Professor Tisza.

The background of the postulational development is the modern frame of mind which regards kinetic theory and statistical mechanics as offering the soundest and most understandable approach to macrophysics. Thus the author says, "The situation has, in fact, so far reversed that we now consider quantum mechanics and quantum statistical mechanics to be more trustworthy than our macroscopic sciences." In formulating the postulates, the

basic parameters taken as intuitively known, and therefore undefined, are volume, internal energy, and the mol fractions which fix the chemical composition. By including the mol fractions at the beginning a degree of generality is attained which in the more conventional treatments is reached only in the later chapters. There are four basic postulates: the existence of equilibrium states, the existence of an entropy, and two postulates on the properties of the entropy, one of which is equivalent to the third law. The consequences of these postulates are developed by a rigorously mathematical analysis and identification made between some of the mathematical expressions which naturally turn up and such every day parameters as pressure. Temperature makes its first appearance on page 37.

The bulk of the book is occupied with working out mathematically relationships between expressions which can be seen to be of some practical or experimental interest. A number of well chosen problems bring the attention of the student back to the more mundane side of thermodynamics in case he has a tendency to lose his head in the mathematical clouds. Two topics are treated with unusual and welcome fullness: Tisza's theory of second-order transitions, and the Onsager treatment of such irreversible processes as permit the definition of an entropy in terms of thermodynamic parameters, including in particular thermoelectric effects and the various thermomagnetic effects. To this latter Callen has himself made contributions which he did not take the space to reproduce in his book. It seems to me, however, that this treatment of thermomagnetism would have much benefited if it had been less purely formal, and if some experimental figures had been given to indicate the agreement with theory.

There can be no question, I believe, that the author has exhibited a mathematical machinery by which he has compressed an enormous amount of material into a small space, and furthermore has made it possible for the reader to answer an enormous number of practical questions provided he can find the appropriate mathematical manipulations. But I cannot help wondering whether the subject has not been made too abstract for the average student, nor can I help missing the feeling of personal contact with the founders of thermodynamics which the more conventional inductive approach can be made to give. For example, in a postulation approach it would seem to have been natural to distinguish more explicitly the roles played by Kelvin and Caratheodory in formulating the concept of absolute temperature, and in discussing the reduction of measured temperatures to absolute temperatures near absolute zero it would have been natural to say that Simon first showed how to do this. The same impersonalness is shown by the references. These are seldom to the original papers and the original authors are sometimes not mentioned, but the reference is more likely to be to another textbook or to a collection of tables.

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