

vised and reasonably up-to-date fourth edition of Jackson's little classic. Once again one can recommend this monograph as a good introduction to low-temperature physics.

The publication date of a book is always deceptive—this volume appeared early in 1956, but went to press in the spring of 1954. Its most obvious shortcoming, therefore, and one clearly beyond the author's control, is that it does not cover the last two years. While this is inevitable, its effect is all the more noticeable because the book cites much quantitative and thus necessarily temporary information. As such a monograph can never be more than an introduction to a subject, to be supplemented by much additional reading, it would retain its pertinence much longer by treating most subjects more qualitatively, and with less reference to specific and rapidly obsolete results, than is done here.

Two further exceptions must be taken even in a brief review. One is the book's treatment of superconductivity as part of a chapter on electrical conductivity. The other is an almost complete lack of mention (except for one brief paragraph on DeTaa's-Van Alphen effect measurements) of the various means used to obtain information on electronic effective mass, density of states, and band structure.

In spite of these and other less important shortcomings, the monograph is an important contribution to low-temperature literature and can be recommended as introductory reading.

Principles and Problems in Energetics. By J. N. Brønsted. Translated from Danish by R. P. Bell. 119 pp. Interscience Publishers, Inc., New York, 1955. \$3.50. Reviewed by R. W. Hellwarth, Hughes Aircraft Co.

It is commonly felt that classical thermodynamics represents a closed and rather unassailable body of physical knowledge. Among recent attempts by competent people to assess such matters have been a series of papers and two monographs by J. N. Brønsted written between 1936 and the author's death in 1946. In the course of his investigations Brønsted uncovered a number of logical difficulties in the classical presentations of thermodynamics which seem to have arisen naturally out of the historical nature of the subject's development. In order to resolve these difficulties and present the principles of thermodynamics in a more concise and didactically simpler fashion, Brønsted recast these principles into a form which he called "Energetics", since it deals with all macroscopic, static or quasi-static, energy transformations on a more or less symmetrical basis. Unfortunately most of the papers dealing with the subject have appeared in Danish and hence are somewhat inaccessible. However, there exists now this excellent English translation of the last of Brønsted's monographs, *Principles and Problems in Energetics*.

Briefly, here Brønsted replaces the first and second laws of thermodynamics with a principle which might

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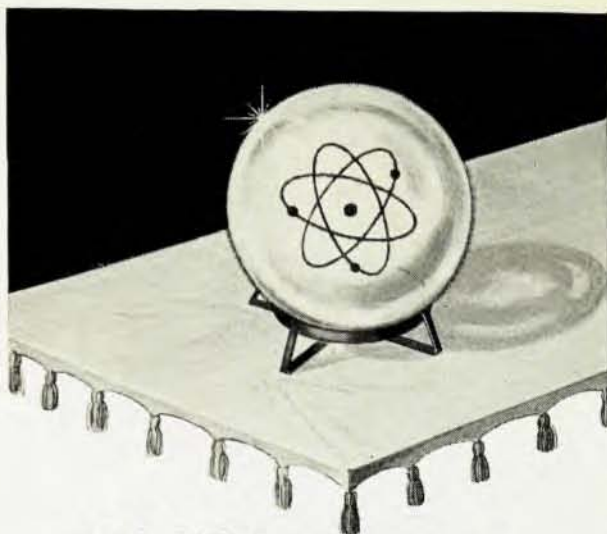
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be described as a generalization of the "principle of virtual work" that is commonly employed in static mechanics. The principle is stated in the form:

$$\sum_i (P_1^i - P_2^i) \delta K^i \geq 0,$$

and applies only to isolated systems. The quality applies to systems involving only reversible processes and the inequality to systems involving irreversible processes. The δK 's are generalized extensive quantities, e.g., mass, volume, electric charge, entropy, and the P 's are corresponding conjugate energetic potentials which for the above examples are gravitational potential, pressure, electric potential, and temperature. All extensive quantities are conserved in reversible processes and all but entropy in irreversible processes. Brønsted uses the form of the above relation and results of physical experiments to define or redefine many of the usual thermodynamic concepts in a quite straightforward manner. The book contains not only the development of "Energetics" and its application to various processes such as thermoelectric and electrochemical cells, but contains also many stimulating discussions of the work of others such as Carathéodory, Born, and Planck.

It is only natural that sympathy for a novel restatement of a time honored body of science is difficult to incite. However, such sympathy seems deserved here on several accounts. The new postulates have been shown to contain at least as much as the classical first and second laws of thermodynamics. The formulation of such basic concepts as temperature and entropy is achieved logically and simply and with close association to physical experience. The approach in general emphasizes physical structure rather than mathematical transformations. There is certainly at least didactic merit in separating clearly principles applying to reversible and irreversible processes and treating extensive quantities and conjugate potentials on general grounds. Certain useful corollaries such as a general rule of potentials follow simply. In some instances the entropy excess in irreversible processes is calculable. There may well be the possibility of extending this approach to treat processes in which classical ideas fail.

Unfortunately, there arise certain at least psychological confusions for the reader from the redefinition of certain words such as "work" to have meanings foreign to common usage. Also many concepts such as "reversibility", "coupling", and "energetic transfer" are introduced without discussion, so that the reader must hope his own feeling for the concepts is what is intended. These difficulties are not insurmountable and have been largely removed in an article in English by V. K. LaMer which is referred to in the book. This article is recommended as an introduction to the book.

Principles and Problems in Energetics should certainly be of considerable interest to all scholars and teachers of thermodynamics, both as a stimulus to fundamental thought and as an aid to improving teaching and textbook presentations of the subject.