Books

Principles of Thermodynamics and Statistics. Vol. 3, Part 2 of Handbuch der Physik. Edited by S. Flügge. 678 pp. Springer-Verlag, Berlin, Germany, 1959. DM 160.00 (subscription price DM 128.00). *Reviewed by Rolf Landshoff, Lockheed Missiles and Space Division.*

OUR knowledge that heat can be put to work dates back to the 2nd Century B. C. when Hero of Alexandria devised the first steam apparatus. Around 1700 steam advanced from driving a mere toy to driving a useful machine and by 1780 Watt had developed a basic form of the modern steam engine. The science of thermodynamics which grew out of this was brought into being by Carnot's first investigation (1824) of what we now call the second law. The first law was formulated about 20 years later following the discoveries by Mayer and Joule. Kinetic theory can be traced back to Daniel Bernoulli's *Hydrodynamica* (1738) in which he postulates that a gas is composed of particles, stating that heat may be considered as an increasing internal motion of these particles. This idea led later at the hands of Maxwell, Boltzmann, Gibbs, and others to the statistical interpretation of the laws of thermodynamics.

The venerable history of thermodynamics and statistical mechanics has produced a well-established body of knowledge which is presented by E. A. Guggenheim in the first of six parts of this new volume of the *Handbuch*. The presentation is concise "with emphasis on the most convincing and most powerful methods of approach". A selection on this basis is clearly a matter of taste and in the field of statistical mechanics Guggenheim chooses to follow closely the approach by Tolman. There is of necessity a considerable overlap between Guggenheim's "Thermodynamics, Classical and Statistical" and A. Münster's article "Prinzipien der Statistischen Mechanik". The latter article, however, covers the subject much more thoroughly, looking at it from many points of view. Without going into detailed arguments it presents a review of the most important investigations of both principles and methods. The article concludes with an interesting general discussion of fluctuations and of phase transitions.

The logical structure of thermodynamics is traced by G. Falk and H. Jung, joint authors of the article "Axiomatik der Thermodynamik". The presentation differs markedly from the traditional approach of Carathéodory by assigning the temperature concept a less central position. It is interesting to note the contrasting points of view expressed in Guggenheim's statement "that temperature is the most important concep-

tion in thermodynamics" and in Falk and Jung's thesis that a consistent analysis of the physical situation demonstrates that there is no need to use the temperature concept. Although they claim this to be true in principle they do, of course, introduce the temperature as a useful secondary concept and they also show that the concept of a negative temperature recently introduced by N. F. Ramsey fits into the proposed formalism.

It is known from classical thermodynamics that the direction of irreversible processes such as electrical and heat conduction, chemical reactions, etc. insures an increase of the entropy of closed systems. The theory can be extended to relate the rate of such processes to the rate of the entropy increase. This formalism is discussed by J. Meixner and H. G. Reik in their article "Thermodynamik der irreversiblen Prozesse". This is a phenomenological theory which centers around linear equations—similar to Ohm's law—between various fluxes and forces. Reciprocity relations between the coefficients of these equations which have been developed by Onsager are derived from kinetic theory. As an application the effect of irreversible processes on sound propagation is investigated.

Every article of this volume touched upon so far makes extensive use of statistical concepts. Anyone capable of reading this book has certainly acquired some familiarity with these concepts and understands them intuitively. The mathematician, considering statistics as being in his bailiwick, rightfully frowns upon intuition as an ambiguous point of departure. To provide a solid basis for the physicist who wishes to employ statistical concepts, Alladi Ramakrishnan undertakes in the last article "Probability and Stochastic Processes" a presentation of stochastic theory. The emphasis is on results which the physicist can use "without being diverted by mathematical details or trammelled by the demands of rigour".

In toto this is a very useful collection of articles worthy of the reputation of the *Handbuch*. It is remarkably up to date with ample references to the original literature. It is an interesting sidelight that both Guggenheim and Ramakrishnan have decided that certain thoughts they wanted to express have been expressed to perfection by previous authors, i.e., Tolman and Khinchin; with permission of the publishers they have incorporated the respective passages into their texts.

The Magnetodynamics of Conducting Fluids: Symp. Proc. (Palo Alto, Calif., Nov. 1958). Edited by Daniel Bershader. 145 pp. Stanford U. Press, Stanford, Calif., 1959. $4.50. *Reviewed by J. Gillis, The Weizmann Institute of Science.*

THE development of magnetohydrodynamics during recent years has been so vigorous and on so wide a front that any textbook on the subject would probably be out of date before it was printed. Cowling's excellent little book was a notable exception, but that is chiefly