development is one of logical deduction without pretense of excessive mathematical rigor. The partition function is introduced and the properties of the monatomic perfect gas derived. The free energy (Helmholz) is defined in terms of the partition function, and its properties and usefulness derived and discussed. Equilibrium and the equipartition of kinetic energy are the subjects of the next two chapters. The simple crystal, the ideal diatomic gas, phase equilibrium, dielectric constant of a gas, and chemical equilibrium are then taken up, and the book finishes with a short chapter on Fermi–Dirac and Bose–Einstein distributions.

The author assumes a knowledge of elementary calculus on the part of the student, and as much knowledge of physics and chemistry as might be held by a bright high school graduate, or a more average student who has had freshman courses in these two subjects.

It is inevitable that a reviewer well acquainted with the field should contemplate how he himself would have presented the material, and where he feels that the author had made an omission of logical step, or a mistake in emphasis. In the first chapter the reviewer would have preferred to state the conservation of mechanical energy, potential plus kinetic, as a consequence of the fact that no frictional forces exist on a molecular scale, rather than as a consequence of the Newtonian Laws, which it is not. So also the derivation of the equipartition of kinetic energy seemed to this reviewer to omit one important and necessary step in view of the knowledge expected of the student. It does not follow from the quadratic dependence of the kinetic energy on the velocities, but on the quadratic dependence on momenta. The one example of Guggenheim presumption in the book, the assertion that there is no ground for the statement that thermal expansion depends on non-harmonic terms in the vibrations, seems to be gratuitous. Although Guggenheim has cleverly, and quite rightly, avoided discussing the non-harmonic terms, his tacit assumption of a dependence of frequency on volume in the crystal requires the existence of such terms. This reviewer would have justified the use of the logarithm of the largest term of a sum of positive terms for the logarithm of the sum by comparing numerically the logarithm of the number of terms with that of the largest term. However, the admirable brevity and conciseness of such a meaty, and truly tiny book, requires that steps which some might consider essential must be omitted, or treated extremely shortly.

THE ENRICO FERMI INSTITUTE FOR NUCLEAR STUDIES
UNIVERSITY OF CHICAGO JOSEPH E. MAYER
CHICAGO 37, ILLINOIS

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**Catalysis. Volume III. Hydrogenation and Dehydrogenation.** Edited by PAUL H. EMMETT, Gulf Research and Development Company's Multiple Fellowship, Mellon Institute, Pittsburgh, Pennsylvania. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1955. vii + 504 pp. 16 × 23.5 cm. Price, $12.00.

The third volume of this treatise on "Catalysis" passes from the realm of basic underlying theory treated in the first two volumes to particular catalytic reactions. Hydrogenation and dehydrogenation reactions are the processes here reviewed. The choice is a logical one since it includes reactions which have been the objective of the most intensive study in the recent scientific development of catalytic research. This arose from the great technical importance of ammonia synthesis, the production of methanol, the hydrogenation of fats and of hydrocarbons with dehydrogenation of the latter from petroleum sources to yield butadiene and styrene as raw materials for synthetic rubbers. Furthermore, the hydrogen–deuterium exchange, the hydrogenation of isotopic hydrogen, whose study became possible early in the 1930's, made possible for the first time studies of the action of a catalyst surface in opening up the bonds of a chemical molecule. What was thus begun with H–H and D–D bonds has been extended to C–H, N–H, C–C and N–N bonds and the list is lengthening yearly both with respect to bonds and the surfaces which activate them.

The authors selected, including veterans such as Frankenburg and Natta and younger workers such as Eley, Trapnell, Bond and a group of Dutch workers, guarantee an approach to the problems with both authority and fresh outlook. Trapnell's initial chapter on parahydrogen conversion and hydrogen–deuterium exchange while very nearly exhaustive in coverage is not conclusive even in this the simplest case of bond activation. Bokhoven and his colleagues in Holland reviewing the research on ammonia synthesis since 1940 themselves reach a similar conclusion, admiration for ingenuity displayed and inability to provide "an unambiguous answer to the questions facing us" . . . but with "a few bright spots" . . . an increase in our understanding of fundamentals, but "many problems are still unsolved" and "many new problems have arisen." Natta is somewhat more optimistic concerning methanol synthesis. Kearby gives a very revealing analysis of a phenomenal technical development of World War II which made possible butadiene production in partial vacuum-type systems and the alternative of butene dehydrogenation in presence of diluent steam. It was an incalculably vital contribution to the war effort at a critical period. In the hydrogenation of unsaturated hydrocarbons, Eley on ethylene and Bond on acetylenic compounds give excellent surveys of the basic science while Corson and Feuge take up the practical problems with olefinic hydrocarbons and glycerides, respectively. In these latter cases selectivity is a practically important and theoretically baffling problem. So there are still problems for the neophytes even in these well-tilled areas of catalytic science.

DEPARTMENT OF CHEMISTRY
PRINCETON, N. J. HUGH TAYLOR

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