ankle-deep mud, but it can be done much better and much more enthusiastically on a good cinder track. This suggested program of new equipment would run into tens of millions of dollars, but the stakes involved are three orders of magnitude higher.

JOHN B. IRWIN
Goethe Link Observatory,
Indiana University

Measurement Technology

Instrumentation for Engineering Measurement. R. H. Cerni and L. E. Foster. Wiley, New York, 1962. xii + 456 pp. Illus. $12.50.

The dramatic advances in measurement technology during the last decade would justify a series of books for a variety of readers. Cerni and Foster have provided a valuable reference for nonspecialists who need practical information on how to obtain and process data in the field or laboratory. The emphasis is on the measurement aspects of instrumentation, with only incidental reference to control aspects.

Perhaps the most valuable contribution is the comprehensive review of modern measuring components and systems. The treatment of sensors and transducers is encylopedic; explanations are easily followed, and carefully selected line drawings clarify the descriptions. The typical treatment consists of a statement of basic principle of operation, a description of practical devices, a specific discussion of performance characteristics, and a summary of the advantages and disadvantages of the device in comparison with alternative devices.

A similar treatment of data indication and recording methods provides useful information on the characteristics of electrical, optical, magnetic, analog, and digital devices. This material, like that in the section on sensors and transducers, is descriptive rather than analytical, and it can be understood and used with benefit by engineers or scientists with limited backgrounds in instrumentation.

In contrast, much of the material on telemetry, data transmission, and data processing requires some specialized knowledge of communication theory for ready understanding of the brief mathematical analyses presented. Apparently telemetry is a field of special interest to one of the authors, and as a result, this topic is treated on an entirely different level from that of the material in the earlier part of the book.

Perhaps the major weakness of the book is the lack of homogeneity in the technical level. Instrumentation engineers who wish to extend their knowledge of telemetry will have no use for the elementary discussion of systematic and random errors or for the description of the D'Arsonval movement. On the other hand, mechanical engineers will have great difficulty following the brief discussion of feedback and stability or the analysis of pulse-position modulation and pulse-code modulation systems.

For the experimenter with a difficult measurement problem, this book provides a good review of a great variety of modern methods. It may not solve his problem, but by clearly pointing out capabilities and limitations of practical devices and systems, it should help him along the road to a solution.

RALPH J. SMITH
Department of Electrical Engineering,
Stanford University

Investigative Tool

Introduction to Molecular Spectroscopy. Gordon M. Barrow. McGraw-Hill, New York, 1962. xiii + 318 pp. Illus. $10.75.

Elementary Introduction to Molecular Spectra. Børge Bak. North-Holland, Amsterdam; Interscience (Wiley), New York, ed. 2, 1962. xi + 144 pp. Illus. $6.

The theory, experimental techniques, and results of molecular spectroscopy have been discussed in numerous books and summary papers, both brief and lengthy, at a wide range of levels. Any addition to this literature should be evaluated in terms of how successfully the author achieves a selected objective. Barrow and Bak indicate in the prefaces to the books reviewed here, which they undertook to prepare for beginners (that is, for students and workers in biology, organic chemistry, and so forth), concise, simple, and easily absorbed summaries of the concepts of molecular spectroscopy. Barrow was considerably more successful than Bak in attaining this goal. Neither author devoted more than a few general remarks to experimental techniques, and both found it necessary to incorporate rudimentary discussions of wave mechanics.

Barrow takes the slightly willing student by the hand and gently nudges him through 11 chapters that are graduated in mathematical sophistication and in complexity of subject material. With the aid of simplified examples and graphic illustrations he manages to bridge the gap between advanced treatises on molecular spectroscopy and the cursory treatments that may be found in unconnected chapters of the currently popular melange of "Physical Methods for . . . ." This introductory volume, which is set up in textbook form, requires no prior knowledge of quantum mechanics or of group theory. Those who follow the text seriously and correctly complete all the problems will find their efforts rewarded with a fairly good understanding of molecular spectroscopy (but not of quantum mechanics or of group theory). The chapters on the physics of absorption and emission of radiation and those on molecular symmetry, group theory, and normal mode analysis are well written. The treatment of electronic spectra is necessarily highly abbreviated, but the crucial roles played by the quantization of angular momentum and by the symmetry of the molecular wave functions are properly stressed.

The author and publishers should be commended for the format of this book. The paper, printing, and binding are very good, and there are enough carefully prepared diagrams to be of considerable help, particularly to those students who find it difficult to visualize the shapes of functions of several variables. The "order of magnitude" estimates are also instructive; quotations of values for real molecules are a bit sparse, perhaps inadequate to indicate the range in magnitudes that one encounters.

In my opinion there are two serious omissions. Raman spectroscopy is mentioned once (on page 2) and nothing is said about selection rules for Raman transitions or about how these facilitate the establishment of molecular symmetries, even though these topics were discussed at some length for infrared absorptions. The use of molecular parameters, as derived from spectroscopy, to compute thermodynamic functions is

also neglected. Indeed, the treatment of statistical distributions and of the Boltzmann equation is abbreviated to a one-page statement; partition functions are not mentioned, even though the populations of states are computed. Thus, equations 14 and 15 on page 53 are misleading since N_0 is a function of the temperature. I hope these defects will be rectified in a second edition of this useful book. Barrow might find it advantageous to summarize more clearly the diverse structural information that may be derived from spectroscopic studies, including nuclear magnetic resonance.

By comparison with Barrow's book, the second edition of Bak's compact outline suffers considerably. Except for the addition of chapter 6, on nuclear magnetic resonance spectra, the current version differs in no essential respect from the first edition published in 1954. As a compilation of formulas, this book may prove quite handy; it is suitable for a person who knows no spectroscopy but who is conversant with mathematical operations. Bak relies almost entirely on the analytic representation of the solutions of the wave equation for the various models. He discusses these solutions briefly and presents orders of magnitudes, sometimes in tabular form. Practically no data concerning real molecules are included. For each range of the spectrum, he outlines the type of molecular information that may be deduced from the data and the precision that can be attained, and he cites the appropriate expression for the corresponding factor in the partition function.

All books written for students should be scrutinized not only for errors but also for correct but awkward statements that may prove misleading. Neither author discusses what occurs when a photon interacts with a molecule in the case where the resonance condition is not satisfied or gives an adequate analysis of the sequence of events in the case where the resonance condition is satisfied. Barrow fails to explain what is meant by the term *state*. His treatment of two interacting particles, on page 31, is confusing, and on page 53 he sneaks in the condition that both the total angular momentum and its component along some direction must be quantized. There are regrettably many troublesome spots in Bak's book. The invocation of the uncertainty principles to explain the fuzziness of translational levels in many-particle systems will certainly confuse beginners. The potential function, as it is drawn on page 18, leaves a wrong impression of the relative magnitudes of r_e and r when $V = D$. The erroneous formula on page 99 was carried over from the first edition. There are others, but the last paragraph on page 98 is a dilly!

S. H. BAUER
Department of Chemistry, Cornell University

Mostly for Physical Chemists

Catalysis by Metals. G. C. Bond, Academic Press, New York, 1962. ix + 519 pp. Illus. $15.50.

Although heterogeneous catalysis is well served by a large supply of specialized review articles (for example, those in Emmett's treatise and in the annual volumes of *Advances in Catalysis*), there is a dearth of single-volume monographs. The present book makes a useful contribution by dealing in one volume with the general area of catalytic reactions on metals. The viewpoint is primarily that of a physical chemist. The author makes no attempt to deal with industrial catalytic procedures, and his coverage of descriptive catalytic chemistry is very selective. For example, the hydrogenolysis of benzylic derivatives is not mentioned, Ipatieff does not appear in the author index, and Homer Adkins appears but once. The book will not be of great utility to the organic chemist who seeks merely the best procedure for converting A to B. Rather, the treatment is aimed at the elucidation of the mechanism of heterogeneous catalysis in its broadest sense, and the selection of material is so conditioned.

The introductory portion of the book (150 pages) covers the physics and chemistry of metals, adsorption, and the kinetics of reactions on surfaces. Except for a chapter on catalytic oxidation, the remainder of the book deals primarily with catalytic reactions of hydrogen; this material is organized into chapters on various types of reactions, hydrogenation of carbon-carbon double bonds, isotopic exchange reactions between deuterium and hydrocarbons, hydrogenation of carbon monoxide and of nitrogen, and the like. Considerable emphasis is given to studies that involve isotopic tracers and to the determination of kinetic orders, activation energies, and frequency factors. Some may suspect that the author underestimates the degree to which serious concentration gradients are involved in the data he employs and others, that activation energies and frequency factors are given more space than their contribution to the understanding of the subject warrants.

One finishes the book with the feeling that, although many particular aspects have been well explained, the overall level of explanation is weak and tentative, particularly as it relates to the correlation between the catalytic properties of a particular metal and any of its other properties. This is not the fault of the author but of the present state of our understanding. Bond has written a book which will be widely used by catalytic chemists.

ROBERT L. BURWELL, JR.
Department of Chemistry, Northwestern University

Potential Laboratory Tool

Absorption Spectroscopy. Robert P. Bauman. Wiley, New York, 1962. xiv + 611 pp. Illus. $12.

This book of over 600 pages is designed both as an elementary text and as a guide for those who need a working knowledge of absorption spectra but to whom the classroom is no longer available. In view of the wide range of subject matter covered, the author has done well in presenting a clear concept of the nature of absorption spectra, of methods for measuring them, of their interpretation, and of their value in qualitative and quantitative analyses and in research.

The book is divided into ten chapters, each of which is followed by a list of pertinent problems that not only enhance the book's value as a text but should also help readers to appreciate absorption spectroscopy's great potential as a laboratory tool. One chapter is devoted to the classical optical principles around which spectrometers are built. Another treats the basic design of instruments and describes in some detail a number of currently available commercial instruments which among them cover the spectral range from infra-