inclusion of a section on heteroaromatic reactivity is curious, since the section does not deal with a physical method at all, but with calculations of electron densities and localization energies. The chapter on x-ray diffraction, which is restricted essentially to the heterocycles present in nucleic acids, is so short that it is of limited value. Perhaps the most valuable chapters are those on ionization constants and polarography and potentiometry; numerous tables of data provide thorough coverage of the most important heterocyclic systems.

Volume 2, on spectroscopic methods, is an extremely well-done and worthwhile volume. Three really first-rate chapters—on infrared (Katritzky and A. P. Ambler), ultraviolet (S. F. Mason), and nuclear magnetic resonance spectroscopy (R. F. M. White)—constitute the bulk of the book. Each is systematic and thorough, with many tables of relevant data; these chapters are sure to make this volume a standby for the many chemists working on heterocyclic compounds. The sections on infrared and ultraviolet spectra in particular are characterized by high-level discussions of the fundamental origins of absoption bands, discussion that is rare in books on spectroscopy for nonexperts. The only error that I noted is an unfortunate mistake in the definition of tau in the chapter on nuclear magnetic resonance. A discussion, necessarily brief, of nuclear quadrupole resonance in heterocycles (E. A. C. Lucken) rounds out a volume that can be highly recommended, a book that every organic chemist would find worthwhile.

RICHARD K. HILL
Frick Chemical Laboratory,
Princeton University

Physiology

Physiological Measurements of Metabolic Functions in Man. C. Frank Consolazio, Robert E. Johnson, and Louis J. Pecora. McGraw-Hill, New York, 1963. x + 505 pp. Illus. $14.50.

In the preface this book is described as a compilation of procedures which have worked satisfactorily in the authors' laboratories. This means that the selection of material was not necessarily based on its physiological importance, and the scope of the book is thus limited.

I should have liked to find more about measuring isotope concentration, more about new types of gas analysis by gas chromatography, spectrometry, and heat conductivity, and a more thorough explanation of Pauling's magnetic oxymetry. On the other hand, several equations seem superfluous, and various passages could have been shortened—for example, the 5-page discussion of an article in which "Weir showed by computation that the energy expenditure can be approximated closely from only two measurements, the volume of the expired air and its oxygen content." This appears less formidable, if one remembers that several generations of physiologists have approximated energy expenditure from oxygen consumption alone and that even beyond the field of bioenergetics this simple estimate, which is based on "Thornton's rule," is still used.

The book seems to be written mainly for instructors who are engaged in training laboratory technicians. It contains very detailed checklists of the apparatus and materials necessary for each measurement described; even notes about where the listed items can be purchased and helpful hints on what pitfalls to avoid are included. But some trivialities, such as "be very careful," should have been avoided. The illustrations are very good. One shows various respiratory valves, whose air resistance is indicated in a plot and a table. The section on preparing anticoagulant solutions and their minimal concentration is bound to be especially useful.

The checklists for materials and the directions for the procedures do not seem to afford much leeway for the instructor's own ingenuity, but the book leaves a lot of opportunity for a teacher to explain principles, to evaluate methods, and especially to clarify the physiological meaning of results. Only rarely do the authors express their own opinions. One such exception is their question at the end of a 27-page chapter that involves nearly 100 references: "Is it possible to measure fitness performance and stress?" The question seems to remain open.

There are several slips that escaped editorial attention, among them, for example, an index given as the sum of a time, a frequency, and a concentration (p. 390) and this statement "If the weight factor had an unusually large volume of extra cellular water . . ." (p. 258). The first sentence on page 1, "The production of heat or energy" conflicts with the law of conservation of energy, which is mentioned on the same page, but could be made to agree with that law by the statement "heat or *other forms* of energy."

Because this book, which is rich in useful detailed information on physiological measurements, is intended as a teaching aid, it is especially important that semantics should be carefully considered.

MAX KLEIBER
Pacific Biomedical Research Center,
University of Hawaii

Francis Bacon

Francis Bacon and the Modern Dilemma. Loren Eiseley. University of Nebraska Press, Lincoln, 1962. vi + 98 pp. $3.

Loren Eiseley, anthropologist and interpreter of science, invokes the image of a great "statesman and strategist of science" of 400 years ago, Francis Bacon. With ardour and poetry Eiseley rekindles the importance of Bacon's thought and evokes its depth as well as its modern relevancy.

Bacon beheld a world "where the unexpected and coruscating illumination" constitutes our faith in reality, but where the mind of man, "by the help of art," can make "a match for the nature of things." He saw that it was man's destiny "to vex" nature, "not just to live in nature, but to create a new nature." Bacon was "a kind of lens . . . through which thought gathered, was reorganized, and radiated outward again in new forms."

Bacon, one of the first cultural relativists, understood the role of technology even before the tide of industrialization swept across the Western world. The differences of human conditions, he wrote, come "not from soil, not from climate, not from race, but from the arts." Lighting the torches of inductive thinking and empiricism, he drove back the shadows of medieval dogma, posing "a new set of questions to mankind."

At the same time, Bacon foretold the ambiguity of science, both for good and for mischief, and the need for reference to "the uses of life," for which science must be ever "an enlightened servant."

Eiseley, author of such prize-winning books as *Darwin's Century* (1958) and

The Firmament of Time (1960), is seen at his best, as poet and educator, in this slim volume. These three essays surely deserve publication in book form and a broad audience. In the strongest tradition and finest style, these meditations offer the best appreciation of the adventure and beauty of the scientific quest, and they will inspire the young to join the great unfinished work.

H. L. NIEBURG
Case Institute of Technology

Genetics

Methodology in Mammalian Genetics. Walter J. Burdette, Ed. Holden-Day, San Francisco, 1963. xiv + 646 pp. Illus. $6.

Questions about what the various presentations had to do with methodology were heard frequently by participants at the 1960 symposium on methodology in mammalian genetics (held at the Jackson Laboratory), the symposium on which this book of collected papers is based. Because of the usual presentations and particularly of the ensuing discussions, the questions were probably pertinent, but the published manuscripts vindicate use of the word methodology in the title of the book and by and large justify this effort by the Genetics Study Section of the National Institutes of Health, which sponsored the conference. In fact, in reading the papers a new or an old student in the field of genetics will acquire very useful information on techniques and will find many suggestions for future work in the various areas; furthermore he will realize the extensive possibilities for genetic understanding which can come from work with mammals.

At least two papers seem to have been updated and revised and as a result the comments of the discussants are somewhat without point. But this is a minor fault that is almost unavoidable in view of the rapid development in some areas and the publication delay. Another fault is perhaps the exclusion of papers that deal primarily with farm mammals, a decision that makes even more pronounced the heavy emphasis on the mouse; but the line had to be drawn somewhere, and the basic principles and methods of mammalian genetics are illustrated with laboratory forms.

Topics covered in the volume, which includes seven appendixes as well as 17 regular papers, range from stock lists, breeding methods, and linkage techniques through radiation genetics, immunogenetics, biochemical genetics, cytogenetics, and the very important new area of the genetics of somatic cells. In the largest section, which is entitled "Physiologic genetics," there are grouped seven rather different but very important papers illustrating special areas in which work with mammals has contributed perhaps most uniquely to genetics; they include papers on genic interaction, behavioral studies, and teratology, as well as a review of neoplasia and an important summarization of quantitative inheritance.

In addition to those who classify themselves as mammalian geneticists, anyone working with laboratory mammals, especially mice, who is at all concerned with genetic controls and genetic implications in his work should have the book, partly because of the distinguished scientists who have contributed comprehensive and thoughtful papers, partly because of the useful list of 1470 references, and partly because of the representative methodologies and genetic philosophies that are implied even if they are not always stated.

HERMAN B. CHASE
Biology Department,
Brown University

Analytical Chemistry

Ion Exchange Separations in Analytical Chemistry. Olof Samuelson. Almqvist and Wiksell, Stockholm; Wiley, New York, 1963. 474 pp. Illus. $9.50.

Workers in the ion exchange field have eagerly awaited this book. It is a sequel to the author's *Ion Exchange in Analytical Chemistry* (1952), the first definitive monograph on this subject. So much has happened since 1952 that Samuelson has written an entirely new book, somewhat more restricted in scope than the first but nearly twice as long.

The book's 17 chapters are divided into three sections: "General part," "Practical part," and "Applications." The first part reviews the nature of ion exchanging materials and the ion exchange process; equilibria, kinetics, and column theory are discussed. The second discusses the choice of exchangers and the technique of using ion exchange columns. The third part, about half the book, describes specific applications in the separation and concentration of inorganic substances. Organic and biochemical analyses, to which Samuelson has himself contributed so much, are excluded from the scope of the book, save for occasional mention.

The strongest section is the second. At one time or another every laboratory worker who has used ion exchange as an analytical tool has been frustrated by the difficulty of converting a strong base anion exchanger from the chloride to the hydroxide form, by the odd tenacity with which iron and other metals are held by cation exchangers in concentrated hydrochloric acid, or by the inordinately large solution volumes which accumulate from a column that was ten times too large in the first place. Samuelson warns of these pitfalls, and every page bears the stamp of the practical man who has used ion exchange since the modern resins were in their infancy. (His doctoral thesis, a masterpiece of thoroughness and imagination that, even today, is all too little known in the English-speaking world, was published in the Swedish language in 1944.)

The third section, "Applications," is detailed and comprehensive, almost to a fault. (Is it really necessary to name *all* the salts that have been quantitatively converted into their respective acids for analytical purposes?) But the reader can find reference to almost any application in inorganic analysis, and the coverage of Russian and European literature is especially complete. Literture citations run through early 1961.

The first section, "General part," is quite adequate for the purposes of this book, but it does not provide a scholarly insight into the physical chemistry of ion exchange. For this purpose one should have Helfferich's book, *Ion Exchange.*

The Swedish edition was published by Almqvist and Wiksell, and apparently this edition was printed in Sweden. The printing and makeup are superb, but there is one small, irritating fault. The author provided abundant cross-references by chapter number and subsection; although the chapter title is printed at the head of each page, the chapter number is omitted.

HAROLD F. WALTON
Department of Chemistry,
University of Colorado