seven blocks is a section that deals with such miscellaneous subjects as measuring astronomical distance, radio astronomy, and life in the universe. I suspect that a number of astronomers, particularly those with extragalactic tastes, will be disappointed that the greatest realm in the hierarchy—the universe of galaxies—does not rate a separate major section and that cosmology receives little attention. I would contend that a major and current research theme like stellar evolution is accessible to most readers and that today it also merits strong emphasis.

Viewed as a whole, however, *Pictorial Astronomy* is a generally fine account. And it contains some highly original writing that is downright fun. Especially provocative are several chapters such as the one on the visit of Arcturus to the earth, where we watch that star come into view a half million years ago, serve as a pretty fair pole star several times, make its closest approach in the "near" future, and another half million years hence move, dimmer and dimmer, far into the southern celestial hemisphere. Things afar make us impatient with their apparent pokiness, and it is always good to get a feel for the real spatial and temporal picture over the millions of years. The authors succeed admirably in that endeavor.

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Chemical Analysis

Standard Methods of Chemical Analysis. vol. 2, *Industrial and Natural Products and Noninstrumental Methods*. Pts. A and B. Frank J. Welchner, Ed. Van Nostrand, Princeton, N.J., ed. 6, 1963. 2637 pp. Illus. $50.

This sixth edition of the second volume of *Standard Methods of Chemical Analysis* is the work of some 67 contributors. Only four of these authors contributed chapters to the fifth edition; thus, although many of the chapter titles are the same in both editions, the contents and the treatment are often quite different. In addition, 23 new chapters have been included; consequently volume 2 has doubled in size and has had to be bound in two parts.

Roughly one-fifth of volume 2 is devoted to discussion of noninstrumental methods. This section includes chapters that deal with laboratory apparatus, sampling, the detection of cations and anions by spot tests and by a systematic qualitative analysis scheme, and the statistical treatment of data. Various methods for performing separations are treated in chapters on mechanical separations, precipitation separations, electrolysis, solvent extraction, distillation and evaporation, chromatography, and ion exchange. Finally, noninstrumental methods for completion of the analysis are covered in chapters devoted to final gravimetric treatment, titration methods, acid-base titrations in nonaqueous solvents, colorimetric *p*H methods, electrometric *p*H measurement, the use of the microscope, quantitative microchemical analysis, organic functional group analysis, solubility measurements, and the determination of water.

Eighty percent of volume 2 is devoted to standard methods for the analysis of industrial and special substances. This section contains 11 new chapters: "Air pollutants," "Amino acid analysis of protein hydrolyzates: chemical analysis in clinical medicine," "Fertilizers," "Gas analysis—vacuum techniques," "Pesticides," "Plastics," "Silicates," "Glasses, rocks, and ferrous slags," "Soils," and "Vitamins."

The parts of this volume that are devoted to noninstrumental methods provide much general information which will be useful to the practicing analytical chemist. The chapters on microchemical analysis, organic analysis, and titration methods are particularly good, and they offer sufficiently detailed instructions to make the volume useful as a primary source of information for those who work in these fields. Other sections are so brief that they provide only outlines of their subject and, thus, are useful only for their literature references—for example, the sections devoted to homogeneous precipitations, the determination of water, and separations by electrolysis.

The bulk of volume 2 is a compilation of selected standard procedures for the analysis of a variety of common materials; enough detail is given so that, in many instances, reference to the literature is not necessary. Thus, the volume should serve as a useful source book for the analyst, and it deserves a place in most technical libraries.

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Mathematics

Retracing Elementary Mathematics. Leon Henkin, W. Norman Smith, Verne J. Varineau, and Michael J. Walsh. Macmillan, New York, 1962. xviii + 418 pp. Illus. $6.50.

Principles of Modern Mathematics. vol. 1. William E. Harnett. Harper and Row, New York, 1963. xvi + 416 pp. Illus. $7.75.

Although these books are quite different in most respects, they have one important aspect in common. Both attempt, and in general the attempts should meet with success, to draw the reader into the discussion, to make him cognizant of desirable goals and of why certain steps are taken to reach these goals. For too long mathematics books have presented "well-polished" results with little indication of "why."

Henkin and his coauthors give a well-constructed development of the real number system. They start with a modification of the Peano postulates for the positive integers and progress through the several subsystems of the real numbers in such a fashion that each system is *actually contained* in the following system. This contrasts with more usual developments where each system is contained in the following only up to isomorphism. This gain is obtained at the cost of added abstraction at each stage. The transition from rationals to reals is obtained by a modification of the Dedekind Cut concept.

Early in the book the authors devote considerable attention to the idea of proof. The reader who works his way through the book will gain comprehension about the nature of proof and, equally important, about when he has a proof. Those for whom this book is intended cannot rush through the early chapters, but certain sections can be omitted. This, coupled with the complexity of later chapters, limits the book's usefulness in the classroom on a one-semester basis; for a two-semester course on foundations, this book is excellent.

Hartnett does not seem to have a theme, unless it be a discussion of various basic concepts of present-day mathematics. The real number system is discussed, not developed; this discussion is intended as a base for future examples and developments. The author proceeds with sets, relations, and functions; then with groups, rings, fields, and vector spaces; and then with

sequences, limits, continuous functions, differentiability, and integrability. All of this is carried through on a highly abstract plane; however, examples are legion, and through them much of the formal abstraction becomes meaningful. The reader will gain understanding of the concepts of *relation* and *function*, but he will have difficulty with *operation*. This latter term is treated informally, but the reader is left to infer a precise definition. Hartnett has personalized his book not only by a "conversational" approach, which is good when not overdone, but also by a concocted language. For example, he uses "splitting relation" and "external product" for the more usual *equivalence relation* and *scalar product*, respectively; the usual terminology is not mentioned. When two definitions are given for the same concept, their relationship should be shown (see definitions 9.1.3 and 9.3.3). The practice of stating definitions in problems is questionable; this is done for "ideal in a ring," and the concept is used later in textual material.

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Theoretical Interpretations

Solids Under Pressure. William Paul and Douglas M. Warschauer, Eds. McGraw-Hill, New York, 1963. xviii + 478 pp. Illus. $15.

This book, a collection of 13 articles written by different authors, describes the use of high pressures for studying solids. The major topics covered are the influence of high pressures on the electrical, magnetic, optical, and mechanical properties, on kinetic processes, and on phase equilibria. Some of the more descriptive chapter titles are: "Pressure as a parameter in solid-state physics," "Effect of high pressure on diffusion," "Continuum models of the effect of pressure on activated processes," "The equation of state of solids at low temperature," "Some geophysical applications of high-pressure research," "The role of pressure in semiconductor research," "Magnetic resonance in solids under high pressure," and "Magnetic properties of solids under pressure." Major emphasis is on the theoretical interpretation of the effect with respect to properties rather than on experimental techniques for maintaining high pressures. Experimental techniques used to measure the properties in question are discussed, and the excellent, indexed bibliography provides references to general techniques for high pressure experimental research.

Contributors to this well-edited volume were carefully selected. When several authors contribute to a book, there are often problems in achieving continuity and avoiding repetition. In this volume, no attempt was made to achieve continuity; each article is an independent discussion of a particular topic. Although repetition has been kept reasonably low, two chapters deal extensively with phase transformations in metallic solids, but none is devoted exclusively to those of nonmetallic solids. Since a great deal of the recent interest in high pressure physics resulted from the influence of high pressures on the phase transformations in nonmetallic solids, this subject seems to merit a chapter devoted to its treatment.

Although the book probably will not appeal to the average scientist as a source for general information (its high price and compartmentalized treatment will prevent this), it is an extremely valuable reference for those working in these areas of research. It also provides a valuable link between the solid state theorist and the high pressure experimentalist. This book is indeed a fitting memorial to Percy W. Bridgman.

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Geometry

Projective and Euclidean Geometry. W. T. Fishback. Wiley, New York, 1962. x + 244 pp. Illus. $7.50.

The author intends this book to serve a dual purpose: chapters 4 to 10 are intended for use as an introductory textbook in a one-semester course on projective geometry, and chapters 1 to 6, 10, and 11, for use in a one-semester course on the foundations of geometry. After reviewing the deficiencies of Euclid's axioms for elementary geometry and introducing Hilbert's axioms, Fishback initiates a heuristic discussion of the projective plane and of three-space, which he defines by adjunction of ideal elements. A synthetic development based on Desargues' triangle theorem is the theme of chapter 5; homogeneous coordinates derived from rectangular Cartesian coordinates are considered in chapter 6. A short treatment of vectors and matrices precedes the three longest chapters of the book: "Fundamentals of analytic projective geometry" (chapter 8), "Conics" (chapter 9), and "Axiomatic projective geometry" (chapter 10). The final chapter contains a minimal development of affine geometry and a brief mention of several other related geometries. Lastly, a ten-page appendix treats permutations, determinants, and linear equations.

The book is designed for students who have little preparation beyond the rudiments of analytic geometry. Thus, for example, three pages of chapter 6 are concerned with the determination of the solution set of two independent homogeneous linear equations in three unknowns, and chapter 5 contains a more general discussion of function and relation concepts than is usually provided at elementary levels. On several occasions a theoretical development is undertaken only subsequent to a presentation of the basic content in a numerical situation. It is apparent that the author has constantly kept in mind the needs of the student, and he has produced a book which the beginning student should find entirely readable.

The axiomatic development of chapter 10, with its major emphasis on projective planes over arbitrary fields and over ordered fields, is the high point of the book. Postulating the Desargues and Pappus properties in addition to the usual existence and incidence axioms, the author develops the field properties of the projective line, coordinatizes the plane, and proves that lines have linear equations. Fano's axiom on the existence of an infinite net of rationality and Vailati's separation axioms are used to create ordered planes, and the author states, without proof, that an Archimedan axiom and a completeness axiom suffice for the real plane. Thus, the author has made available to the beginning student important material that previously has been largely inaccessible to him.

This book should prove to be very useful not only to the high school teacher but also to any student who wishes his first glimpse of projective geometry to be in its historical perspective as a generalization of Euclidean geometry.

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