quartz slowly inverts to beta quartz at 573°C. On page 171 the statement is made that granites melt within a range of 1215° to 1260°C, whereas on page 173 the more nearly correct statement is made that dry granites begin to melt at 900° to 950°C. I also noted the standard errors of omission—for example, the statement that calcite at normal pressure undergoes dissociations at 910°C but at 20 bars pressure the temperature of dissociation is 1110°C. The unwary student may not realize that the pressure here involved is actually partial pressure of carbon dioxide and not total confining pressure.

GEORGE C. KENNEDY
Institute of Geophysics and Planetary Physics, University of California, Los Angeles

Microbial-Molecular Biology

Tetrapyrrole Biosynthesis and Its Regulation. June Lascelles. Benjamin, New York, 1964. xii + 132 pp. Illus. $7.70.

This book can be highly recommended, to both students and specialists, as a compact introduction and review of the biosynthetic chain that is concerned with the synthesis of the two major pigments of protoplasm, heme and chlorophyll. The student of biochemistry will find here more detailed and extensive information than that provided by the chapter reviews now available; and the specialist will find a useful review of the porphyrin biosynthetic chain in microorganisms, for the author is a recognized authority in this field. The most novel part of the volume is a review of the recent studies of control mechanisms of heme and chlorophyll biosynthesis, a subject that has been greatly enriched by the author's own contributions.

The book contains five chapters. The first is concerned with the nomenclature and formulas of the various tetrapyrrole pigments, characteristics of their absorption spectra, and general principles of isolation, all briefly summarized with adequate references.

The second chapter summarizes the distribution of heme proteins with especial attention to the heme proteins of the lower organisms. These include the hemoglobins of fungi, protozoa, and legume-root nodules, and the cytochromes of fungi, photosynthetic purple-sulphur bacteria, and the aerobic and anaerobic bacteria. The distribution of the porphyrins of photosynthetic and nonphotosynthetic bacteria, the vitamin B_{12} group, and the chlorophylls is also reviewed.

Chapters 3 and 4 describe the individual steps of biosynthesis from succinate and glycine to heme and chlorophyll.

The control mechanisms are discussed in the last chapter. Evidence for feedback inhibition and repression of heme biosynthesis in *Rhodopseudomonas spheroides* is reviewed. The intriguing effects of the presence or absence of oxygen on the hemoglobin level in vertebrates, and on the formation of various cytochromes in higher and lower organisms, are discussed. Finally, the regulation of heme synthesis in animal tissues is reviewed.

This book is the second of a series of specialty monographs on areas of microbial and molecular biology. The editors are to be congratulated on their excellent choice of an author who knows firsthand the material discussed, and who has lucidly synthesized the story of heme and chlorophyll formation from an intimate knowledge of the biology and biochemistry of both the lower and higher forms of life.

S. GRANICK
Rockefeller Institute, New York

Low-Energy Nuclear Physics

Introduction to the Atomic Nucleus. J. G. Cunninghame. Elsevier, New York, 1964. xii + 220 pp. Illus. $9.

The author has succeeded admirably in his purpose which is "to present the essentials of the physics of the atomic nucleus in a way which will be intelligible to those scientists who are not nuclear physicists, but who need some knowledge of nuclear physics in their work." The book is concise (210 pages), and Cunninghame's approach is descriptive rather than mathematical. The book is especially concerned with nuclear phenomena at low excitation energies. Physical concepts are emphasized with illustrations that are quite relevant and helpful. Where necessary —for example, in treating the theory of beta decay—mathematical expressions are used, but the reader is not burdened with their justification. The expression itself is used to elucidate the physical situation. An excellent bibliography, which refers to more advanced texts or, in many cases, to the original literature, is given at the end of each chapter.

Because attention is directed to low-energy nuclear physics, where applications are more likely, the nuclear shell model and the liquid drop model are stressed, although the collective models are only briefly mentioned. Direct reactions and the optical model are not treated.

A short but pertinent historical introduction precedes a general description of nuclear properties and forces. Natural and artificial radioactivity are discussed quite adequately, with additional chapters on alpha and beta decay and gamma emission. The major aspects of nuclear fission are well described in the chapter devoted to this subject.

Those who are concerned with applications of nuclear physics should find the concluding chapter quite useful. In that chapter the author discusses the interaction of heavy charged particles, electrons, gamma rays, neutrons, and fission fragments with matter. The salient features of each type of interaction are concisely but accurately presented, and many references are provided for those who wish additional information.

This book should be most welcome to the nonnuclear scientist in that it provides an excellent survey of the principal features of low-energy nuclear physics in a thoroughly readable manner.

J. A. JUNGERMAN
Physics Department, University of California, Davis

Documents on Modern Physics

Motion of Charged Particles in the Earth's Magnetic Field. Joseph W. Chamberlain. Gordon and Breach, New York, 1964. x + 33 pp. Paper, $1.95; cloth, $3.95.

This booklet, which is published as a part of the Documents on Modern Physics Series, contains one of the series of lectures presented at the Les Houches Summer School of Theoretical Physics (1962), and published in

the proceedings volume, *Geophysics: The Earth's Environment* (Gordon and Breach, 1963), edited by DeWitt, Hieblot, and LeBeau.

The monograph is a brief, but clear, exposition of the basic background physics necessary for understanding the motions of energetic charged particles in the earth's magnetic field. The first 12 pages are devoted to Størmer's exact theory of charged-particle motion in a dipole field; here the treatment differs little from that given by Størmer and included in his book *The Polar Aurora*. The second section (15 pp.) covers Alfven's guiding-center approximation and its development in terms of the adiabatic invariants of motion which are so useful in describing motions of particles in the earth's radiation belts. The third section (3 pp.) gives the briefest of introductions to the application of the continuous-fluid relations of hydromagnetics to particle drifts.

On the whole the book will be useful to workers in the field, since only the most pertinent material is included, and the side issues that tend to befog the issue in more detailed treatments are not included. One could have wished for some mention of the conditions under which the longitudinal and transverse invariants break down, since this may be of major importance in geophysics; I also failed to detect any discussion of the third adiabatic invariant (the flux invariant) whose nonconservation leads to inward diffusion of trapped particles, and is of great importance.

GEORGE C. REID
Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado

Astronomy

Reference Catalogue of Bright Galaxies. Being the Harvard Survey of galaxies brighter than the 13th magnitude of H. Shapley and A. M. Ames, revised and enlarged. Gerard de Vaucouleurs and Antoinette de Vaucouleurs. University of Texas Press, Austin 1964. viii + 268 pp. Illus. $12.50.

This monumental volume provides the long-needed and long-awaited revision and extension of the classical catalog by Shapley and Ames. Comparison of the new *Reference Catalog* with its predecessor shows impressively the progress of extragalactic research. In fact, very little remains from the older catalog which gives a few basic data—Hubble type, estimated photographic magnitudes, and apparent diameters—for 1249 galaxies. The new catalog tabulates for 2599 galaxies a wealth of information on types, diameters, magnitudes, colors, radial velocities, and published photographs. Complete references are given. Many of the tabulated values are averages of observed data corrected to a uniform system. To quote the observed data for diameters would not have been practical; to find these data, the references must be used. The observed data on magnitudes and colors are given in appendices. Much information is in an appendix that gives coded descriptions of the galaxies and references to detailed investigations.

To collect the data, to reduce them to uniform systems, and to organize them properly was a tremendous task. The authors must be admired for having undertaken it and for having, on the whole, successfully finished it. One problem with which the authors were faced was that of deciding what was to be tabulated, what was to be placed in the appendices, and what was to be omitted. Such decisions are difficult and cannot be expected to please everybody. One might ask, for instance, whether it was really necessary to include the old galactic coordinates, which can be obtained easily from available conversion tables, and whether it would not have been more useful to include data such as magnitudes corrected for absorption, which are needed to obtain ratios of mass or radio emission to optical brightness. Only colors corrected for absorption are tabulated. The complete suppression of spectral types and the exclusive use of the not yet generally accepted "supergalactic" coordinates for displays of the distribution of galaxies in the sky seem to indicate a tendency to let predilections influence the content. The degree of satisfaction with this catalog will depend somewhat on the specialized interests of the user. But nobody should deny that the *Reference Catalog* is a magnificent source of information and promises to be an indispensable tool for extragalactic research.

R. MINKOWSKI
Radio Astronomy Laboratory, University of California, Berkeley

New Books

Mathematics, Physical Sciences, and Engineering

Investigations into Electrical Discharges in Gases. B. N. Klyarfel'd, Ed. Translated from the Russian edition (Moscow, 1958) by D. Cossutta. T. R. Foord, Translation Ed. Pergamon, London; Macmillan, New York, 1964. 295 pp. Illus. $12. Contains 12 papers by L. G. Guseva; I. V. Krapivina; B. M. Aleshkov; A. V. Rubchinskii; V. M. Mantrov; Ya. Ya. Udris; F. S. Kovelev; A. A. Timofeev and N. A. Neretina.

Lines and Surfaces in Three-Dimensional Affine Space. L. K. Tutaev. Translated from the Russian edition (Minsk, 1962). Israel Program for Scientific Translations, Jerusalem; Davey, New York, 1964. 102 pp. Illus. $3.75.

Low Temperature Techniques. The use of liquid helium in the laboratory. A. C. Rose-Innes. Van Nostrand, Princeton, N.J., 1964. 176 pp. Illus. $4.75.

Lunar Missions and Exploration. C. T. Leondes and R. W. Vance, Eds. Wiley, New York, 1964. 689 pp. Illus. $17.50. Lectures presented at the University of California, Los Angeles, in cooperation with the Department of Engineering during the spring of 1963. Contributors: W. R. Laidlaw, M. Eimer, G. P. Sutton, G. H. Stoner, M. S. Agbabian, C. G. Pfeiffer, R. K. Cheng, G. C. Szego, E. Rechtin, R. A. Fischer, H. M. Schurmeier, C. W. Frick, E. G. Cole, and H. Hornby.

Maintainability: A Major Element of System Effectiveness. A. S. Goldman and T. B. Slattery. With contributions by S. Firstman and J. Rigney. Wiley, New York, 1964. 298 pp. Illus. $12.50.

Mechanical Working of Metals. F. A. A. Crane. Macmillan, London; St. Martin's Press, New York, 1965. 91 pp. Illus. Paper, 13s. 6d.

Mechanics of Solids. Grover L. Rogers. Wiley, New York, 1964. 266 pp. Illus. $8.95.

Methods in Polyphenol Chemistry. Proceedings, Plant Phenolics Group symposium (Oxford), 1963. J. B. Pridham, Ed. Pergamon, London; Macmillan, New York, 1964. 156 pp. Illus. $7.50. Twelve papers, by B. R. Brown; J. B. Harborne; H. Wagner; R. J. Abraham; J. W. Bridges; E. C. Bate-Smith; V. Thaller; L. Hörhammer; H. Weigel; J. B. Pridham; R. O. C. Norman, J. R. Lindsay Smith, and G. K. Radda; and T. Swain and J. L. Goldstein.

Modern Pure Solid Geometry. Nathan Altshiller-Court. Chelsea, New York, ed. 2, 1964. 369 pp. Illus. $6.

Molecular Complexes in Organic Chemistry. Lawrence J. Andrews and Raymond M. Keefer. Holden-Day, San Francisco, 1964. 204 pp. Illus. $8.75.

Motion of Charged Particles in the Earth's Magnetic Field. Joseph W. Chamberlain. Gordon and Breach, New York, 1964. 43 pp. Illus. Paper, $1.95; cloth, $3.95.

Nuclear Energy in Space. Erik S. Pedersen. Prentice-Hall, Englewood Cliffs, N.J., 1964. 528 pp. Illus. $19.95.

Periodic Differential Equations. An in-

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