tripartite division of conics. While his contemporaries were fumbling with negative coordinates, Newton with consummate analytical skill graphed scores of beautiful new curves of third degree, later grouped into 72 species, in a systematic search for general curve properties.

This volume resembles its predecessor not only in the wealth of previously unpublished material, but also in the impeccable translations, the numerous illuminating notes, and the ample and perspicuous editorial introductions to the sections. The long-standing indebtedness of mathematicians to Newton is now complemented by the debt of gratitude which historians of mathematics owe to Whiteside.

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## Physics: Six Reviews

**High Energy Physics**. Vol. 2. E. H. S. BURHOP, Ed. Academic Press, New York, 1967. xii + 483 pp., illus. $24.

This book, with contributions by nine authors grouped under six subject headings, is the second volume of a projected three-volume treatise edited by Burhop. The first volume was reviewed in *Science* last fall (13 Oct. 1967, p. 251). The reviewer commented unfavorably there on the basic concept of such treatises, the long delay in publication, the random selection of material in any one volume, and the exorbitant cost. I can only echo most of his sentiments. The authors of articles reviewing a specialized area in physics should think seriously about publication in the review journals, with their considerably speedier publication schedule, rather than in collaborative commercial volumes that are out of date before they appear. Some of the articles in the book under review warranted better treatment than they have received. Oh, the quality of the paper and the typesetting are excellent, but the articles were read and used by some of us one-and-a-half or two years ago when they appeared in preprint form, multilithed on poor-quality stock, but readable nonetheless.

The book begins with a 70-page article by R. Gatto on the present status of quantum electrodynamics. The discussion is comprehensive and authoritative, covering the low-energy, extremely precise experiments, as well as the information from high-energy experiments with electrons and positrons. The recent, but not the very recent, developments are included. For example, the revised value of the fine-structure constant occasioned by the important measurement of $2e/h$ using the Josephson effect, published almost a year ago, is not mentioned. This is no criticism of Gatto. However, it does illustrate the rapidity of developments and the desirability of timely reviews.

The next two articles treat the strong interactions of fundamental particles at high energies. L. Bertocchi and E. Ferrari in their 146-page survey attempt to cover the whole subject, reviewing the basic experimental facts, the elements of relevant theory, elastic and inelastic processes, and also the area of ultra-high energies. The other article, by A. C. Hearn and S. D. Drell, focuses on peripheral processes. Their 45 pages overlap parts of the Bertocchi-Ferrari article, but go into considerably more detail. The time lag to publication has, unfortunately, taken the edge off both these articles. When the first version of the Hearn-Drell article was written more than two years ago, it provided a review of a subject that had just undergone interesting and extensive development in both experiment and theory. But by now other reviews have appeared in the journals and in conference and summer-school proceedings. Bertocchi and Ferrari have included fairly extensive experimental information on all aspects of high-energy collisions, rather than merely selected illustrative examples. While the material is somewhat dated, it provides a useful starting point for an outsider or graduate student who wishes to apprise himself of the salient facts. The summary of theory is likewise a useful compendium of theorems and results.

The last 200 pages of the book contain articles on interactions at very high energies by J. M. Kidd (37 pp.), neutrino physics by L. Lederman (61 pp.), and hypernuclei by D. H. Davis and J. Sacton (90 pp.). Kidd's article gives a concise survey of the experimental information obtained from cosmic-ray interactions in photographic emulsions, including multiplicities, and energy and angular spectra of particles and photons. The interpretation is made chiefly in terms of the "two-fireball" model with properties of the excited baryons extrapolated from accelerator energies. One gets the impression that progress is slow and interpretation ambiguous. Nevertheless, until storage rings for protons are operative, ultra-high energies are available only with the cosmic radiation.

Neutrino physics, as a subject of its own, is less than ten years old. In fact, ten years ago, present-day neutrino physics would have been viewed as a pot-smoker's fantasy. Lederman gives a detailed review of the experiments done at Brookhaven and at CERN, as well as the cosmic-ray experiments in progress. Experimental details on the neutrino energy spectrum, the makeup of the detectors, and their positioning are covered along with the essentials of the theory. The facts, from the discovery of two kinds of neutrinos through to the momentum-transfer dependence of the form factors, are presented in a masterly fashion, as is an optimistic outlook for future neutrino experiments.

Hypernuclear physics is in a strange position. It is neither fish nor fowl. High-energy physicists do not look to it for valuable advances in their understanding of the interactions of fundamental particles. Nuclear physicists also see the field as something apart. Its main relevance for the fundamentals is the information it can provide on $N$–$\Lambda$ and $\Lambda$–$\Lambda$ interactions. For anyone wishing to learn of the latest work in this very specialized area, Davis and Sacton present a comprehensive survey of hypernuclei, discussing the experimental data on production, binding energies, and decay modes. They then interpret these facts within the framework of the model pioneered by Dalitz and Downs.

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## Biological Control

**Regulation and Control in Living Systems**. H. KALMUS, Ed. Wiley, New York, 1967. viii + 468 pp., illus. $13.75.

Biologists have long recognized the central importance of regulation and feedback in living systems. Indeed, much of the research of the past half century has been aimed at describing and elucidating such mechanisms, and the results of such work are being rapidly incorporated into the corpus of biological science.

In addition to this essentially descriptive or "classical" approach to biologi-

cal control systems, there has arisen in recent years another line of research with great (but as yet unfulfilled) promise, namely, the application of quantitative techniques generally borrowed from mathematics and engineering to biological systems. My chief criticism of this book is that it attempts to cover both viewpoints for all of biology and is therefore generally superficial.

The book consists of separate chapters by different authors, and is divided up into general sections on Principles and Methods, Cells and Individuals, Development and Genetics, and Groups and Populations. The editor has contributed several chapters, with most of the remainder written by his fellow faculty members at University College, London, and the rest by colleagues at other British institutions.

An introductory chapter of philosophical intent is followed by two rather elementary and superficial chapters on the mathematics of linear-control-system analysis, of the type more fully treated in every electrical engineering text on the same subject. Nonlinear systems are casually treated in a few pages, although it is an unfortunate fact of life that almost every biological system is nonlinear. Chapters follow on a wide variety of material covering the biological spectrum, beginning with molecular biology and concluding with population dynamics. Most of these efforts are descriptive rather than quantitative; with the exception of the chapters on physiological control systems and genetic variability, they contain no equations and few block diagrams or quantitative statements of any sort. Their quality varies; some are adequate or even superior reviews of their particular fields, others are quite brief and fragmentary. The book concludes with a general chapter on control hierarchies.

To whom might this book appeal? The biologist may be interested in the particular chapter in his specialty as a supplement to other reviews already in the biological literature. The reader with a quantitative background but little biological sophistication may wish to peruse the discussions of questions to which his analytical methods may some day be applied.

In summary, this book consists of a brief introduction to engineering control systems and a series of descriptive chapters on biological regulation, with no particular unity in viewpoint or consistent depth of coverage and sandwiched between layers of semiphilosophical veneer, but with some interesting individual expositions.

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## Finding Optima

**Foundations of Optimization.** DOUGLASS J. WILDE and CHARLES S. BEIGHTLER. Prentice-Hall, Englewood Cliffs, N.J., 1967. xiv + 480 pp., illus. $12.50.

One of the earliest examples of optimization is provided by Queen Dido, who when founding Carthage enclosed the maximum amount of land by arranging the bull-hide rope in the form of a semicircle with the ends against the sea. Since that time there have been many other isolated examples, but it has apparently been only with the coming of large-scale digital computers that optimization has been recognized as a field in its own right. Indeed, there are those who contend that all of engineering is merely optimization in one form or another; which may merely reflect the fact that the pendulum of fashion has swung too far. The present book offers a unified approach to modern optimization theory.

The book begins with (indirect) methods that try to find the optimum by examining the nature of the optimum itself. Thus in the calculus the local extremes are given by the derivative being equal to zero, or else they occur at the ends of the interval. The case of several variables, with or without restraints, is also discussed, including Lagrange multipliers. The relatively new geometric programming method is also given.

The (direct) methods modeled on mountain climbing come next; the general case is treated first and is gradually specialized until linear programming is reached. Partial optimization (optimization of subpieces) is also covered.

The treatment is based on intuition, and at times the authors, rather than clutter up the book, refer the rigorist to other sources. They also include a good deal of opinion based on current experience rather than proven fact, and are not above making general recommendations that they realize are of necessity rather fuzzy.

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## Books Received

**Atlas of Electron Microscopy of Clay Minerals and Their Admixtures.** A Picture Atlas. H. Beutelspacher and H. W. van der Marel. Text in German and English. Elsevier, New York, 1967. xii + 333 pp., illus. $40.

**Atomic Light.** Lasers—What They Are and How They Work. Richard B. Nehrich, Jr., Glenn I. Voran, and Norman F. Dessel. Sterling, New York, 1967. 104 pp., illus. $3.95.

**The Audubon Book of True Nature Stories.** Selected and edited by John K. Terres. Illustrations by Walter W. Ferguson, Crowell, New York, 1968. x + 294 pp. $6.95. Stories reprinted from *Audubon Magazine*.

**Automated Language Processing.** Harold Borko, Ed. Wiley, New York, 1967. xiv + 386 pp., illus. $12.95. Information Sciences Series.

**Basalts.** The Poldervaart Treatise on Rocks of Basaltic Composition. Vol. 1. H. H. Hess and Arie Poldervaart, Eds. Interscience (Wiley), New York, 1967. xvi + 495 pp., illus. $22.

**Catholics in College.** Religious Commitment and the Intellectual Life. James W. Trent with Jenette Golds. University of Chicago Press, Chicago, 1967. xiv + 366 pp., illus. $9.

**The Cell Surface.** Its Molecular Role in Morphogensis. A. S. G. Curtis. Logos Press, London; Academic Press, New York, 1967. x + 405 pp., illus. $18.

**La Cellulose.** Marcel Chêne and Nicolas Drisch. Presses Universitaires de France, Paris, 1967. 128 pp., illus. Paper, 3 F. "Que Sais-je?" No. 1282.

**The Chemistry of Molten Salts.** An Introduction to the Physical and Inorganic Chemistry of Molten Salts and Salt Vapors. Harry Bloom. Benjamin, New York, 1967. xiv + 184 pp., illus. Physical Inorganic Chemistry Series.

**The Clinical Value of Electroretinography.** Proceedings of a symposium, Ghent, Belgium, August 1966, held in connection with the 20th International Congress of Opthalmology. J. Francois, Ed. Karger, Basel, 1968 (available from Phiebig Books, White Plains, N.Y.). viii + 476 pp., illus. Paper, $19.

**Dictionary of Applied Geology.** Mining and Civil Engineering. A. Nelson and K. D. Nelson. Philosophical Library, New York, 1967. viii + 421 pp., illus. $17.50.

**Dictionary of Science and Technology.** English-German. Compiled and arranged by A. F. Dorian, with the cooperation of L. Herzbruch. Elsevier, New York, 1967. 1238 pp. $29.

**Differential and Integral Calculus.** Friedhelm Erwe. Translated from the second German edition (Mannheim, 1964) by B. Fishel. Hafner, New York, 1967. x + 494 pp., illus. $9.25.

**Echinoderm Biology.** Proceedings of a symposium, London, May 1966. N. Millott, Ed. Published for the Zoological Society of London by Academic Press, New York, 1967. xiv + 240 pp., illus. $11. Symposia of the Zoological Society of London, No. 20.

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