the Harvard physicist Gerald Holton who introduces the reader systematically into the three-dimensional space in which scientific theories, or, as a matter of fact, any theories are constructed. He equates the x axis with the empirical and the y axis with the analytical components or statements of a theory. The meaning of this two-dimensional x-y plane is familiar to, and accepted by most scientists.

Holton then proceedes with the same attractive geometric analogy and with ample quotations from Newton, Descartes, Leibniz, Galileo and other authorities showing that the concepts that are analogous to points in the x-y plane consist in reality largely of projections on this plane, out of the third dimension, which he calls z.

This delicate matter, not readily accepted by the average scientist—the less so, the less consciously a scientist lives—is introduced most elegantly, avoiding carefully the impression that one is getting analyzed psychologically. The z dimension is the world of themata: "... the essence of the genial contributor to science is often, ... sensitivity in the z direction even at the expense of success in the x-y plane. For, while the z dimension is never absent even in the most exact of the sciences as pursued by actual persons it is a direction in which most of us must move *without* explicit or conscious formulation and without training .... Therefore it is difficult to find people who are bilingual in this sense. I am not surprised that for most contemporary scientists any discussion that tries to move self-consciously away from the x-y plane is out of bounds. However, it is significant that even in our time the men of genius—such as Einstein, Bohr, Pauli, Born, Schrödinger, Heisenberg—have felt it to be necessary and important to try just that" (pages 102 and 103).

Holton shows that presuppositions can not be avoided, but that they are very often subconsciously made. And the source of them is in the z dimension. He disagrees with Ortega y Gasset and many others in stating that "we shall not make the mistake of thinking that science and nonscience are at bottom somehow the same activity." Nevertheless he considers an interest of scientists in the thematic direction as necessary.

Holton's lecture is well organized and subdivided into seven parts (a number which may originate consciously or subconsciously from the z dimension). Although he refers often to examples of details of language, a reference to many excellent works on the philosophy and psychology of language are missing (for example, Hutten: *The Language of Modern Physics,* 1956; or Worf: *Language, Thought and Reality,* 1956).

It is clear from Holton's lecture—even though not spelled out so explicitly—that an active interest and study of dimension z must provide the scientist with a most valuable instrument for a critical approach to his own methods and his own thinking.

The foregoing outlines of the four sections *Science as a Cultural Force,* show in detail why each one of the lectures is a valuable contribution. It is needless to emphasize, therefore, the value of the book for anyone in a responsible position as an administrator, scientist or educator.

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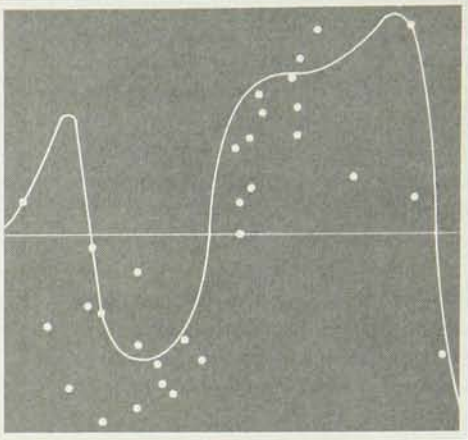
Groups, a reference work

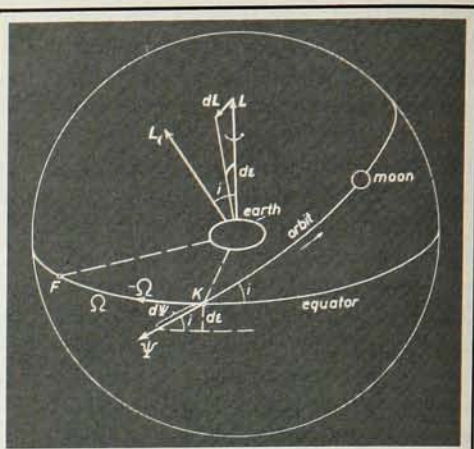
THEORY OF GROUPS IN CLASSICAL AND QUANTUM PHYSICS. Vol. 1, Mathematical Structures and the Foundations of Quantum Theory. By Théo Kahan, et al. Trans. from French by H. Ingram. 566 pp. American Elsevier, New York, 1966. $37.50

by D. B. Lichtenberg

This book is in reality two books bound in one cover, with an index and a few cross references. The first of these "books," part 1 of the present volume, is a highly condensed and abstract work on axiomatics, with definitions and theorems following one another in rapid succession. The remainder of the volume, comprising parts 2 through 7, treats a variety of topics in group theory, group representations, and the axioms of quantum mechanics. The second "book" will be more readily comprehended by

Four New Books From Freeman





$$\bar{n}(\mathbf{p}) = \frac{\sum_n n \exp\left[-n\left(\beta \frac{\mathbf{p}^2}{2m} + \alpha\right)\right]}{\sum_n \exp\left[-n\left(\beta \frac{\mathbf{p}^2}{2m} + \alpha\right)\right]} = -\frac{\partial}{\partial \alpha} \log \sum_n \exp\left[-n\left(\beta \frac{\mathbf{p}^2}{2m} + \alpha\right)\right]$$

Principles of Statistical Mechanics

The Information Theory Approach

AMNON KATZ,
Weizmann Institute of Science, Rehovoth, Israel

In this book the author approaches statistical mechanics in the uniquely consistent and unified way made possible by information theory—something that has not been done in as much detail or in book form before. Utilizing the clarifying power of information theory, the author constructs the laws and tools of statistical mechanics and solves some apparent paradoxes between microscopic physics and certain formulations of statistical mechanics. *1967, 200 pages.*

Quasi-stellar Objects

GEOFFREY BURBIDGE and
MARGARET BURBIDGE,
University of California, San Diego

This monograph is a summary of the state of knowledge and speculation about quasi-stellar objects as of late 1966. The authors draw together in a coherent fashion the observational data on this new class of astronomical objects and critically evaluate the various theoretical or semi-empirical ideas concerning their nature. *1967, illustrated.*

Physical Geodesy

WEIKKO A. HEISKANEN,
Director, Isostatic Institute of the International Association of Geodesy, and
HELMUT MORITZ, Technical University of Berlin

In a unified presentation, the authors cover both standard topics and recent developments in physical geodesy. This book is the first of its kind to treat such modern topics as the computation of the gravity field outside the earth and the use of statistical methods in physical geodesy. *1967, illustrated.*

Fourth Coral Gables Conference on

Symmetry Principles at High Energy

University of Miami: January 25-27, 1967

Edited by BEHRAM KURSUNOGLU and
ARNOLD PERLMUTTER, University of Miami

Here are the complete proceedings of the 1967 Coral Gables Conference, which brought together some of the foremost experts in particle physics. *1967, illustrated, paperbound.*

W. H. Freeman and Company

660 Market St., San Francisco, California 94104/Warner House, 48 Upper Thames St., London, E. C. 4

those physicists not already very familiar with group theory. Indeed, parts 2 through 7 cover many of the same topics as part 1, but in a much more leisurely fashion. For this reason a reading of the second "book" can serve in part as a preparation for the first.

The duplication of subject matter probably arises, in part at least, because different authors have written different sections. Part 1, entitled "Theory of Groups and Axiomatized Mathematics for the Use of Physicists," is by P. Cavaillès and Kahan. Part 2, on the inhomogeneous Lorentz group, is by T. D. Newton; part 3, by R. Gouarné, is on abstract groups; parts 4 and 5, by G. Rideau, are on group representations and the symmetric group; part 6, by Kahan, is on the axioms of quantum mechanics; and part 7, by R. Nataf, is on the rotation group. The ordering of these sections seems mysterious to me. Why, for example, should the rotation group be treated after the Lorentz group, when the former is simpler? Why should the section on the symmetric group be sandwiched between a section on group representations and another on quantum mechanics? Furthermore, the symmetric group is considered, not only in the part devoted to it, but in at least three other sections as well. If learning proceeds by repetition, the reader of this volume will learn about certain aspects of the symmetric group exceedingly well. The index refers to the treatments in parts 1 and 3, but inexplicably, not to those in parts 5 and 7.

I have some quarrel with the emphasis of certain sections. For example, in discussing the axiomatic foundations of quantum mechanics, Kahan makes the observation that "The difficulty of the new ideas is due largely to the unfamiliar character of these physical postulates." Surely, the basic physical ideas of quantum mechanics are by now well known to the theoretical physicists for whom the book is intended. The author's statement might have been timely if written in the late 1920's, but not today.

Although the work lacks unity as a whole, most of the individual parts contain considerable information about group theory that is of value to physicists. Especially useful, although too brief, is Newton's treatment of the Lorentz group. The information contained in this volume is available elsewhere, but not always with the same emphasis or clarity, and not all collected in a single reference work. For these reasons, the book will be valuable in the library. But because of the shortcomings of the work, coupled with its extremely high price, it will probably not find its way to the individual bookshelves of many physicists.

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Physics in biology

PHYSICAL TECHNIQUES IN BIOLOGICAL RESEARCH. (2nd ed.) Arthur W. Pollister, ed. Vol. 3, part A: Cells and Tissues. Academic Press, New York, 1966. $13.50

by Joseph G. Hoffman

The revision of the first edition required two volumes of which part A covers the following major subjects: phase contrast and interference microscopy, birefringence and dichroism of cells, x-ray microscopy and absorption analysis, microtomy, manometric techniques for single cells, and electron microscopy of microörganisms.

Each of the six chapters is well documented and each brings its topic up to date, and in some instances indicates the general trend to be expected in the future. In the ten years since the first edition technical developments in all six fields have burgeoned greatly. This is apparent from a casual perusal of the pages because the contributors present excellent photographs exemplifying the several physical techniques found applicable in biologic experimentation. The text, although on an interdisciplinary subject, makes for reading that will appeal to physicists as well as biologists because of the remarkable gadgets described. One unique device is the Cartesian diver method described by Holter and Zeuthen for detecting single-cell gas respiration at rates of picoliters per hour. Another, more sophisticated device, described by Barer, is the electronic interference microscope permitting measurements of optical path differen-