

phone Laboratories, is to present a brief account of the Mössbauer effect itself as well as a survey of the numerous applications based on it. The book opens with a simple explanation of the nature of the recoil-free emission of gamma rays from nuclei and the resonant absorption of such gamma rays. Typical energy ranges and absorption cross-sections are quoted, and the remarkably small value of the line widths of zero-phonon gamma rays is stressed. There follows a short chapter describing the instrumentation necessary for the experimental realization of the effect.

Subsequent chapters discuss the relation between the Mössbauer effect and relativity, its use in determining the motion of lattice atoms, its value in the study of hyperfine structure and the magnetism of metals and alloys as well as its chemical applications. The ability it provides for a terrestrial measurement of the gravitational red shift is particularly fascinating. Application of the theory of the effect to the so-called thermal red shift has made possible a solution of the famous "twin" paradox of relativity that agrees with Einstein's result.

The book is well illustrated by carefully drawn diagrams, and there is an adequate bibliography. Those seeking a relatively brief and simple introduction will find the book of considerable value.

AQUEOUS SOLID STATE

STRUCTURE AND FUNCTION IN BIOLOGICAL MEMBRANES, VOLUME 2. By J. Lee Kavanau. 760 pp. Holden-Day, San Francisco, 1965. \$14.75.

by Joseph G. Hoffman

Until we know more about the rationale of the living process within cells, books like this will help us to assimilate the findings of experimental research and to make mental notes here and there about how the data might fit whatever general theory one imagines. Only in the past 15 years has exact physico-chemical information about submicroscopic events in

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cells become available. This book shows that there is but a beginning in our understanding. Living matter is unique, to say the least, and its very special properties have yet to be described in sufficient detail even to permit hypotheses about how life in the form of organisms can exist.

Kavanau has made a compilation of current knowledge about membranes because they seem to be central in the description of the spontaneous behavior of living things. The cytoplasm is a mesh of invaginated membranes that are at times invaginations of the cell wall and also evaginations of the nuclear envelope. The various bodies in the cytoplasm, such as the myeloid bodies in amoebae and the mitochondria in mammalian tissue cells, are fantastic geometries of invaginated and stratified membranes. The ingestion of food or liquid by a cell involves the engulfing of the external medium by a membrane. And it is almost commonplace to point to the exquisite specificity that many different membranes have in their permeabilities toward ions and molecules.

The special properties of membranes that seemingly violate the second law of thermodynamics arise in a state of matter that is neither solid nor liquid. Many and varied functions are described and documented as completely as possible in a subject whose literature is growing rapidly. The electron-microscope photographs, elaborate line drawings and careful descriptions give the reader a clear image of the truly astounding devices life has contrived at the submicroscopic level. It reminds one of Max Delbrück's remarks of 20 years ago that the more one sees of biological processes, the more astounding they become. While the author has assembled much data, he wisely refrains from theoretical interpretations of its meaning. In the present state of knowledge, comprehensive theories tend to be teleological.

Volume 2 is highly recommended to physicists who want a clear and thoroughly documented summary of current work about the aqueous solid state of living membranes. The format is excellent: there is a table of contents of Volumes 1 and 2, and an author and subject index.

BOOKS RECEIVED

ASTRONOMY & ASTROPHYSICS

Advances in Astronomy and Astrophysics, Volume 3. Zdeněk Kopal, ed. 391 pp. Academic, New York, 1965. \$14.00

Neighbors of the Earth. Planets, Comets, and the Debris of Space. Thornton Page and Lou Williams Page, eds. 336 pp. Macmillan, New York, 1965. \$7.95.

BIOPHYSICS & MEDICAL PHYSICS

Progress in Biocybernetics, Volume II. Norbert Wiener and J. P. Schädé, eds. 273 pp. Elsevier, New York, 1965. \$14.50.

A Symposium on Non-Heme Iron Proteins: Role in Energy Conversion. Anthony San Pietro, ed. 473 pp. Antioch Press, Yellow Springs, Ohio, 1965. \$12.50.

Ultrasonic Energy. Biological Investigations and Medical Applications. Elizabeth Kelly, ed. 387 pp. University of Illinois Press, Urbana, 1965. \$12.50.

CHEMISTRY & CHEMICAL PHYSICS

Stable Radicals. By Anatolii Leonidovich Buchachenko. Transl. from Russian by C. Nigel Turton and Tatiana I. Turton. 180 pp. Consultants Bureau, New York, 1965. \$15.00.

Inorganic Chemistry. Vol. 1. Principles and Non-Metals. By C. S. G. Phillips and R. J. P. Williams. 685 pp. Oxford University Press, Oxford and New York, 1965.

Treatise on Electrochemistry. (2nd ed.) By G. Kortüm. 637 pp. American Elsevier, New York, 1965. \$30.00.

Diamagnetism and the Chemical Bond. By Ya. G. Dorfman. Transl. from the Russian by Scripta Technica. 182 pp. American Elsevier, New York, 1965. \$10.00.

Oxidation of Metals. By Karl Hauffe. 452 pp. Plenum Press, New York, 1965. \$19.50.

Annual Review of Physical Chemistry, Volume 16. H. Eyring, ed. 584 pp. Annual Reviews, Palo Alto, Calif., 1965. \$8.50.

EXPERIMENTAL TECHNIQUES

Practical Vacuum Techniques. By William F. Brunner, Jr., and Thomas H. Batzer. 198 pp. Reinhold, New York, 1965. \$8.25.

Scintillation Counters in High Energy Physics. By Yu. K. Akimov. Transl. from Russian by Scripta Technica. Academic, New York, 1965. \$9.50.

High Energy Beam Optics. By Klaus G. Steffen. 211 pp. Interscience, New York, 1965. \$9.50.

Neutron Radiography. Methods, Capabilities, and Applications. By Harold Berger. 146 pp. Elsevier, New York, 1965. \$9.00.

GEOPHYSICS & EARTH SCIENCES

Advances in Geophysics. Vol II. H. E. Landsberg and J. Van Meighem, eds. 349 pp. Academic, New York, 1965. \$14.00.

Handbook of Geophysics and Space Environments. Shea L. Valley, ed. Air Force Cambridge, Research Laboratories, Bedford, Mass., 1965.

HANDBOOKS, TABLES, ETC.

A Dictionary of Astronautics. By J. L. Nayler. 316 pp. Hart Publishing Co., New York, 1965. Cloth \$6.95, paper \$2.65.

Handbook of Microwave Ferrite Materials. Wilhelm H. von Aulock, ed. 518 pp. Academic, New York, 1965. \$12.00.

Handbook of Ultraviolet Methods. By Robert G. White. 363 pp. Plenum Press, New York, 1965. \$17.50.

HISTORY & PHILOSOPHY OF SCIENCE

The Art of Research. A Guide for the Graduate. By B. E. Noltingk. 142 pp. American Elsevier, New York, 1965. \$5.75.

Science and Culture. A Study of Cohesive and Disjunctive Forces. Gerald Holton, ed. 348 pp. Houghton Mifflin, Boston, 1965. \$6.00.

The Mystery of Matter. Louise B. Young, ed. 712 pp. Oxford University Press, New York, 1965. \$7.50.

The Wonder of Electricity. By Hy Ruchlis. 218 pp. Harper & Row, New York, 1965. \$3.95.

The Questioners: Physicists and the Quantum Theory. By Barbara Lovett Cline. 274 pp. Thomas Y. Crowell, New York, 1965. \$5.00.

Stonehenge Decoded. By Gerald S. Hawkins. 202 pp. Doubleday, Garden City, New York, 1965. \$5.95.

The Sorby Centennial Symposium on the History of Metallurgy. (Cleveland, Oct. 1963) Cyril Stanley Smith, ed. 558 pp. Gordon and Breach, New York, 1965. \$29.00 (reference edition), \$12.50 (professional edition).

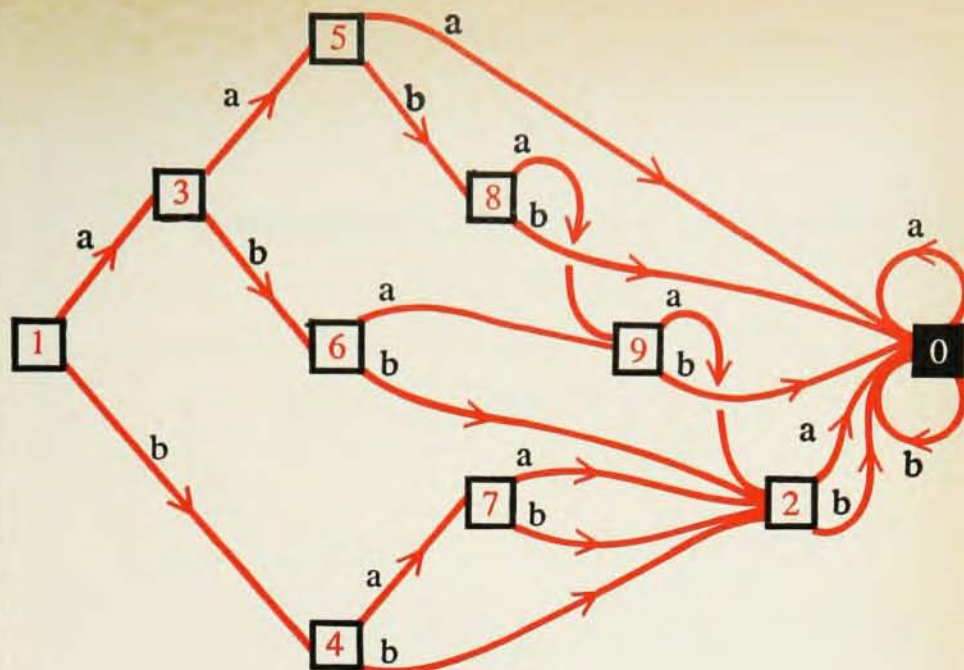
Conceptions de la physique contemporaine. Les interprétations de la mécanique quantique et de la mesure. By Bernard d'Espagnat. 154 pp. Hermann, Paris, 1965. 24 F.

From Atoms to Infinity. Clifford D. Simak, ed. 330 pp. Harper & Row, New York, 1965. \$4.95.

The New Intelligent Man's Guide to Science. By Isaac Asimov. Basic Books, New York, 1965. \$12.50.

MATHEMATICS

Finite Graphs and Networks: An Introduction with Applications. By Robert G. Busacker and Thomas L. Saaty. 294 pp. McGraw-Hill, New York, 1964. \$11.50.



LIBRARY AUTOMATON

Spinoff from research in automata theory at Sandia may someday help solve industry's information-retrieval problems. A library automaton is under study in the Mathematics Departments which, if fully developed, would provide quick access to any part of a large file, given any identifying quotation from the part being sought.

The diagram above illustrates the basic idea in a hypothetical library containing the phrases aabaa, abb, bab, and their parts. To determine if a phrase is in the library and if other terms follow it, begin at 1 and follow the lines letter by letter. If you complete your phrase before encountering the black square, the phrase is in the library; otherwise it is not. Information related to the phrase is indicated by lines between the black square and the point representing completion of the phrase.

This is just one of many special projects of Sandia's Mathematics Departments. The departments are concerned with a variety of applications of mathematical research to Sandia's immediate and long-range interests, particularly in the areas of applied mathematics, statistics, computer science, and systems analysis.

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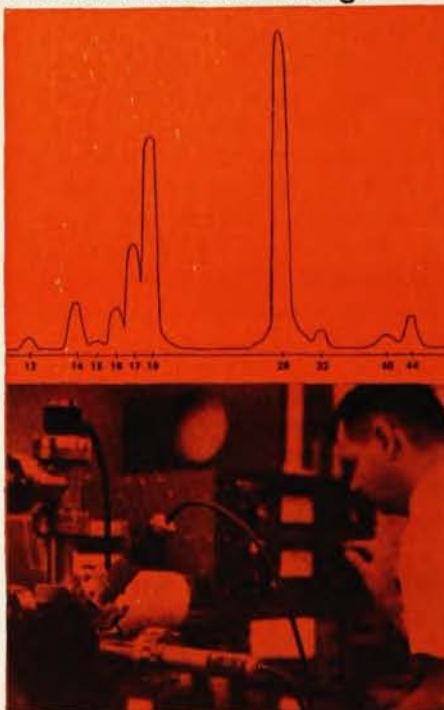
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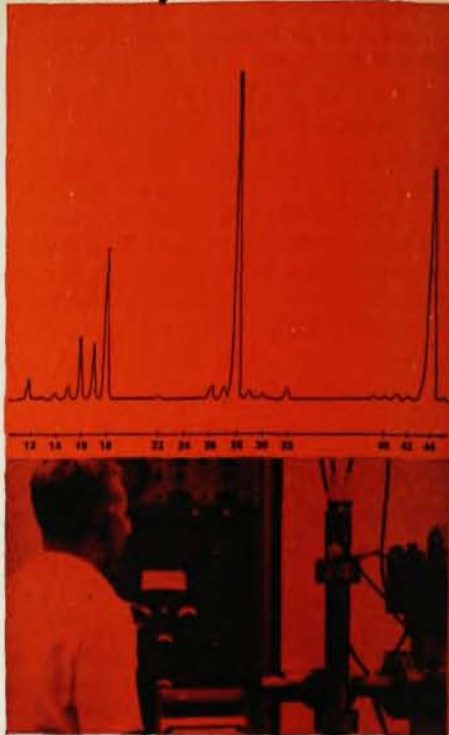
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Quasilinearization and Nonlinear Boundary-Value Problems. By Richard E. Bellman and Robert E. Kalaba. 206 pp. American Elsevier, New York, 1965. \$8.50.

Handbook of Laplace Transformation. Fundamentals, Applications, Tables, and Examples. (2nd ed.) By Floyd E. Nixon. 260 pp. Prentice-Hall, Englewood Cliffs, N. J., 1965. \$10.00.

Nonlinear Partial Differential Equations in Engineering. By W. F. Ames. 511 pp. Academic, New York, 1965. \$16.00.

Introduction to the Theory of Similarity. By A. A. Gukhman. Transl. from Russian by Scripta Technica. 254 pp. Academic, New York, 1965. \$12.00.

Complex Variable Methods in Science and Technology. By J. Cunningham. 178 pp. Van Nostrand, Princeton, N. J. 1965. \$7.50.

A Theory of Sets. By Anthony P. Morse. 130 pp. Academic, New York, 1965. \$7.95.

Ordinary Differential and Difference Equations. By F. Chorlton. 284 pp. Van Nostrand, Princeton, N. J., 1965. \$8.50.

Approximation of Functions. Henry L. Garabedian, ed. Conf. Proc. (Warren, Mich., 1964). 220 pp. American Elsevier, New York, 1965. \$13.00.

Theory of Functions of a Complex Variable. By A. I. Markushevich. Transl. from Russian by Richard A. Silverman. Vol. 1, 459 pp., Vol. 2, 333 pp. 1965. \$32.00 per set.

Geometric Invariant Theory. By David Mumford. 145 pp. Academic Press and Springer-Verlag, New York, 1965. \$5.50.

Les Distributions. Tome 3, Théorie des équations différentielles. I. M. Guelfand and G. E. Chilov, eds. Transl. from Russian by Serge Vasilach. 250 pp. Dunod, Paris, 1965. 42 F.

SOLID STATE PHYSICS

The Theory of Metals. (2nd ed.) By A. H. Wilson. 346 pp. Cambridge University Press, Cambridge, England, 1965. Paper \$2.95.

Crystals Perfect and Imperfect. By Allan Bennett, et al., 237 pp. Walker, New York, 1965. \$5.95.

Electron and Ion Emission From Solids. By R. O. Jenkins and W. G. Trodden. 84 pp. Dover, New York, 1965. Paper \$1.35.

The Thermal Properties of Solids. By H. J. Goldsmid. 72 pp. Dover, New York, 1965. Paper \$1.35.

Solid Semiconductors. By A. K. Jonscher. 91 pp. Dover, New York, 1965. Paper \$1.35.

Electrical Conduction in Solids. By H. Inokuchi. 56 pp. Dover, New York, 1965. Paper \$1.35.

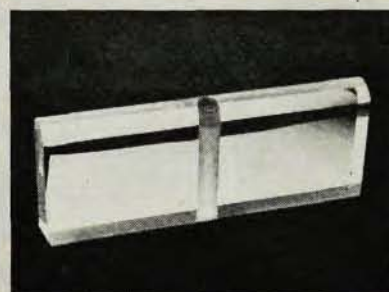
Les Matériaux semi-conducteurs. By M. Rodot. 288 pp. Dunod, Paris, 1965. Paper 37 F.

The Nature of Solids. By Alan Holden. 241 pp. Columbia University Press, New York, 1965. \$6.95.

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