

Problems are given at the end of all chapters except the last, and 40 pages of answers and solutions are included at the end of the text.

The general technical level of the material is similar to that of Frederick Reif's, *Fundamentals of Statistical and Thermal Physics*; however, detailed motivation and illuminating examples such as simple spin models, which both Charles Kittel and Reif have used so effectively, do not play as prominent role in Terletskii's book.

In sampling the translation I found that certain typographical errors that existed in equations in the Russian edition have been corrected; however, as if by some treacherous conservation law, new misprints have appeared elsewhere; for example, in the Chebyshev inequality, equation 2.29; in the discussion of the author's proof of the recurrence theorem; and in equation 21.8.

In summary, if one is involved in the teaching of graduate statistical mechanics, this book appears worth considering as a reference, particularly with respect to Gibbs's approach. For those fortunate enough to read Russian, the 1966 Russian edition, recently available in New York for \$1.50, is a real bargain.

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The Raman Effect. Volume 1: Principles

Anthony Anderson

404 pp. Marcel Dekker,
New York, 1971. \$28.50

Discovered in 1928 by C. V. Raman, the effect named for him consists of the appearance of new lines in the spectrum of the monochromatic light scattered by molecules, the frequencies of the new lines being characteristic of the molecules that did the scattering. The Raman effect is thus useful for the identification of molecules, for the determination of their structures and for the solution of a wide range of problems in physics and chemistry.

Early work in Raman spectroscopy was hampered by the lack of intense light sources of a suitable geometry. Since the appearance of strong laser light sources, there has been a resurgence of interest in this field, and there have been many new developments. The aim of this book is to provide a basic coverage of the theoretical and experimental principles of Raman spectroscopy and to discuss important applications in physics and chemistry.

The book has several authors. R. S. Krishnan, who has made important



RAMAN

contributions in this field since the discovery of the Raman effect up to the present time, discusses the early history, theory, techniques and developments during this interval and lays the foundation for the more specialized treatment given by the other authors. He also presents an extensive detailed review of Brillouin scattering.

G. W. Chantry gives a detailed, lucid, and interesting review of the polarizability theory of the Raman effect, including the classical and quantum theories, the theory of the intensities of Raman bands and Wolkenstein's band-polarizability theory, and concludes with a discussion of the present state of the theory of Raman spectroscopy.

R. A. Cowley reviews the theory of Raman scattering from crystals, including discussions of symmetry properties, one- and two-phonon Raman effects, anharmonicity, defects in crystals and scattering by electronic excitations.

C. E. Hathaway discusses light sources, techniques of illumination, detection and measurement, monochromators, and commercial spectrometers.

And P. Lallemond discusses the theoretical analysis, experimental studies, and applications of the stimulated Raman effect (an effect in which the intensity of the light scattered per unit solid angle and per unit frequency bandwidth is not proportional to the intensity of the incident light beam).

The book will be useful for graduate students and other researchers in Raman spectroscopy and related spectroscopic fields, as well as for those working in fields such as lattice dynamics, crystal structure and chemical equilibria. It is one of the few books that give a comprehensive treatment of Raman spectroscopy to include the re-

New Books from North-Holland

Foundations of Electrodynamics

By S. R. de Groot and L. G. Suttorp

Contents: Part A: Non-relativistic classical electrodynamics. Particles: their fields and motion. Statistical description of fields and matter. Part B: Covariant formulation of classical electrodynamics. Charged point particles. Composite particles. Covariant statistics: The laws for material media. Part C: Non-relativistic quantum-mechanical electrodynamics. The Weyl formulation of the microscopic laws. Quantum-statistical description of material media. Part D: Covariant and semi-relativistic quantum-mechanical electrodynamics. Dirac and Klein-Gordon particles in external fields. Semi-relativistic description of particles with spin. Semi-relativistic quantum statics of spin media. Index.

1972, 535 pp., \$48.50

Microwave Ultrasonics in Solid State Physics

By J. W. Tucker and V. W. Rampton

Contents: Introduction. Elasticity and lattice dynamics. The generation and detection of microwave ultrasonics. Attenuation of ultrasonic waves in dielectrics. Ultrasonic waves in semiconductors. Microwave ultrasonic propagation in metals. The interaction of light with microwave ultrasonic waves. Appendices. Author index. Subject index.

1972, 428 pp., \$45.00

Progress in Optics Volume X

Edited by E. Wolf

Contents: Bandwidth compression of optical images (T. S. Huang). The use of image tubes as shutters (R. W. Smith). Tools of theoretical quantum optics (M. O. Scully and K. G. Whitney). Field correctors for astronomical telescopes (C. G. Wynne). Optical absorption strength of defects in insulators (D. L. Dexter and D. Y. Smith). Elastooptic light modulation and deflection (E. K. Sittig). Quantum detection theory (C. W. Hellstrom). Acknowledgement. References. Author index. Subject index.

1972, 400 pp., \$34.50

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SCIENCE MADE SIGNIFICANT

FUNDAMENTALS OF AIR POLLUTION by Samuel J. Williamson, New York University. This is an interdisciplinary text for advanced undergraduates or graduate students; prerequisites are a year of college chemistry and physics, and calculus is used in only one chapter. To relate the causes, evolution, and effects of air pollution, Williamson draws from the fields of psychology, medicine, chemistry, physics, engineering, and the atmospheric sciences.

NUCLEAR ENERGY—ITS PHYSICS AND ITS SOCIAL CHALLENGE by David Rittenhouse Inglis, University of Massachusetts. The overriding aim of the book's organization is to provide a basis for understanding both the technical and the socio-political aspects of nuclear problems—for a reader without prior knowledge of either. This book may be used as the basis for a semester course for either science or non-science students.

PROBLEMS OF OUR PHYSICAL ENVIRONMENT: ENERGY—TRANSPORTATION—POLLUTION by Joseph Priest, Miami University, Ohio. This book is written for non-science students taking a short course in physics or physical science with an environmental orientation. Priest concentrates on physical problems of the environment, such as energy, air pollution, thermal pollution, noise pollution, transportation, waste recycling, and environmental sensing.

INTRODUCTION TO CONCEPTS AND THEORIES OF PHYSICAL SCIENCE, SECOND EDITION. By Gerald Holton, Harvard University—revised and with new material by Stephen G. Brush, University of Maryland. Holton's original book, published in 1952, was a landmark in the movement to present science as a creative human activity instead of as a dry collection of facts and formulas. Preserving the viewpoint of the original text, including the emphasis on the history and philosophy of science, the revision contains new material on the breakdown of the Newtonian mechanistic view of nature and how this was replaced by a modern world view.

Another new book of interest. . .

OPTICS by Eugene Hecht and Alfred Zajac, Adelphi University. This intermediate-level undergraduate text is a modern presentation of the science of optics. The contemporary nature is evidenced by discussion of such topics as multilayered thin films, fiber optics, spatial filtering, transfer functions, quantum optics, nonlinear optics, modulation, holography, and the laser. All these contemporary subjects are presented in addition to a detailed development of classical optics.

All of these books are in press and will be available in early 1973. Write to Mary Clare McEwing for your examination copies.

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cent developments that have been made since the advent of the laser as a light source.

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Color and Symmetry

A. L. Loeb

179 pp. Interscience,
New York 1971. \$14.95

A. L. Loeb is a scientist and a humanist, on the staff of the Ledgemont Laboratory of the Kennecott Copper Corporation and on the faculty of Harvard University in a department of "Visual and Environmental Studies." The origin of his book can be traced to a new derivation of the 17 plane groups of symmetry operations, which he, jointly with Philippe LeCorbeiller, presented at the Rome Crystallographic Congress in 1963.

The study of symmetry in the 19th century dealt with the possible arrangements of points in space, that is the number of symmetry groups G_d^t with t independent translations in d dimensions (32 G_3^0 , 230 G_3^3). The problem was stated in its full generality in 1884 by Pierre Curie: "To find all possible spatial arrangements of points endowed with any physical property." The first generalized results appeared in 1929 (H. Bethe) and 1930 (H. Heesch). A point could be "black" or "white"—a symbolic way of expressing any duality (+ or -, future or past, clockwise or counterclockwise). Just as a rotation followed by a reflection gives a "rotoreflexion," any symmetry operation combined with a black-to-white reversal R creates an "antisymmetry operation." Hence the new groups $G_d^{t'}$. The Russian school of crystallography, tremendously active in this field during the past 20 years, enumerated the 1191 $G_3^{3'}$ (1651 if monochromatic and gray groups are included). The results apply to magnetic structures, where R stands for time reversal, twinning, where "black" and "white" represent the two crystals in a twin, and so on. Further generalizations introduce double and multiple black-white groups, groups of more than two colors, groups in which the property associated with a point is a vector or a tensor.

Against this background Loeb's book stands out as an elegant original, purely geometrical solution of a threefold problem. To find, in the [one-sided] plane ($d = 2$, $t = 0, 1, 2$), all the possible point assemblages that are: (a) monochromatic (4 G_2^0 , 7 G_2^1 , 17 G_2^2); (b) black-white (monochromatic and gray excluded) (7 $G_2^{0'}$, 17 $G_2^{1'}$, 46 $G_2^{2'}$);

(c) polychromatic (monochromatic and mixed colors excluded).

Symmetry elements in the plane reduce to rotation points, renamed "rotocenters" and reflection lines (glide lines and mirror lines). Two rotocenters of different kinds, A_k and B_l , separated by the distance $A_k B_l$ of closest permissible approach, create a rotocenter C_m of a third kind. The smallest rotations, $2\pi/k$, $2\pi/l$, $2\pi/m$ [the last one clockwise if the first two are counterclockwise], are related by the Diofantine equation

$$(1/k + (1/l) + (1/m) = 1$$

simply because the angles of the triangle ABC add up to π ! (Note the analogy with the Euler-Rodrigues construction in 3-space to get axis C from axes A and B.) Task (a) above is essentially performed from this one postulate of closest approach, in 63 pages. Task (b) takes only 37 pages, following the remark that a symmetry operation is now either "reversing" or "normal," according as it does or does not change the color, just as, under (a), the operation was of the second or first kind according as it did or did not change the "hand." Task (c) requires 61 pages. All cyclic permutations and reversals of colors are equivalent from the color-symmetry standpoint. A second Diofantine equation

$$(p/k) + (q/l) + (r/m) = 1$$

relates the known k, l, m to the corresponding "color parameters" p, q, r . When N colors designated $0, 1, \dots, p, \dots, N$ are used, N being equal to k or a fraction of k , the color parameter of one rotocenter A_k will be p if a $2\pi/k$ rotation is combined with color change 0 to p . We have $N = 1$ for $p = 0$, $N = k$ for $p = 1$, as extreme cases. The results are summarized (for several rotocenters) in 101 brightly colored patterns ($2 < N < 12$), modestly referred to as "Fig. 88," in fact a beautiful 16-page album that makes you forgive the price of the book. Five intriguing plane-filling constructions by the late Dutch "graficus" M. C. Escher are reproduced and analyzed.

In an otherwise delightful foreword, William T. Holser agrees with the author that gray groups should be left out. Many will disagree. (A gray region is "gray" owing to the superposition of black and white; it is invariant under reversal. Example: the contact slab in a contact twin belongs to both crystals.) According to Theorem 24 "only evenfold rotocenters can be reversing." I submit that this follows from the postulated nonexistence of gray groups—gray groups are not ruled out by it. Bad, albeit prevalent, usage mars page 196: "in any system based on the rotoinversion axis rather than a rotoreflexion axis, the regular octahedron has threefold, not sixfold rotation-

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