Lattice Dynamics

The Physics of Phonons. J. A. REISSLAND. Wiley-Interscience, New York, 1973. xii, 320 pp., illus. $19.95.

The appearance of this book testifies to the continuing interest in lattice dynamics, one of the oldest branches of solid state physics. The first four of its eight chapters take the reader through such introductory material as the establishment of the Hamiltonian operator for the atomic motions in a crystal and in the harmonic approximation, the equations of motion that follow from it, its simplification in terms of normal coordinates, the solution of the equations of motion for the frequencies of the normal modes of vibration and the associated polarization vectors, Brillouin zones, interatomic potentials for different crystal types, the relation of elasticity theory to the long wavelength limit of lattice dynamics, the distribution function for normal mode frequencies, the quantization of lattice vibrations, and the thermodynamic properties of solids, including phenomenological treatments of thermal expansion and melting. The presentation of this material is clear, and the emphasis appears to be on the use of simple crystal models for the establishment of results rather than on obtaining results in the greatest generality.

The second half of the book is devoted to the study of the interaction of phonons with other phonons and with other elementary excitations in solids, such as infrared photons, x-rays and gamma-rays, neutrons, electrons, excitons, and magnons. These chapters present the perturbation theory for weakly anharmonic crystals and its application to the calculation of equilibrium properties such as the Helmholtz free energy and to the calculation of time-dependent properties through the Matsubara thermodynamic Green's function approach. Thermal expansion, the temperature dependence of the elastic constants, ultrasonic attenuation, thermal conductivity, dielectric properties, piezoelectricity, and ferroelectricity are discussed in a deliberately "thumbnail-sketch" fashion in order to illustrate the utility of the preceding theoretical methods in a variety of physical phenomena in which lattice dynamics plays a fundamental role, as well as to introduce the phenomena themselves.

A set of nine appendices presents a variety of specialized topics that bear on material presented in the text but are peripheral to it. Each chapter is followed by a summary and a set of chapter notes that generally provide details of derivations in the text in addition to references.

There is no discussion of the use of symmetry and group theory in the solution of lattice dynamical problems, except for the role of lattice periodicity in the establishment of wave vector conservation laws. The majority of the material presented presupposes a perfect, infinitely extended crystal: There is almost no mention of the effects of defects on lattice vibrations. The discussion of the mean square displacement of an atom in section 4.8 is incorrect in its assumption that cross terms between different Cartesian components disappear, and does not apply even to cubic crystals, for which the expression given is too large by a factor of 3. Nevertheless, because of the range of topics it does cover, its extensive use of simple models and examples to make its points, and the general clarity of its presentation, the book is a useful addition to the literature of phonon physics.

A. A. MARADUDIN
Department of Physics, University of California, Irvine

Harriot's Achievements

Thomas Harriot. Renaissance Scientist. JOHN W. SHIRLEY, Ed. Clarendon (Oxford University Press), New York, 1974. x, 182 pp., illus., + plates. $21.

There is probably no early European scientist so distinguished and yet so poorly known as Thomas Harriot. Harriot, who lived from 1560 to 1621, was roughly contemporary with Galileo and Kepler—and the available evidence suggests that his intellect was the equal of theirs. For example, Harriot appears to have been the first to discover the sine law of refraction (which eluded Kepler); he studied ballistic curves and proved them to be parabolic; he made telescopic observations of the moon within several weeks of Galileo's first telescopic observation of the heavens (without knowledge of Galileo's work), and his observations of sunspots were superior in some respects to Galileo's; he was one of the earliest proponents of Keplerian ellipses in all of Europe (by 1610); he belonged to a circle of philosophers instrumental in introducing the atomic philosophy into England as an alternative to Aristotelian natural philosophy; he made important contributions to the early development of algebra and explored the characteristics of a binary number system; he studied the mathematics of navigation and suggested improvements in navigational practice; and, finally, he made important studies in the natural history and ethnography of North America, which he visited at least once.

Harriot spent most of his adult life in the employ of two patrons, Sir Walter Ralegh and Henry Percy, ninth Earl of Northumberland. He tutored Ralegh in mathematics and the art of navigation and participated in Ralegh's adventures in the New World. When Ralegh was committed to the Tower of London, Harriot became a member of the Earl of Northumberland's household, "an intellectual companion, and an associate free to follow his interest in mathematics and experimental sciences" (p. 26). Northumberland surrounded himself with scientific books and some of England's brightest intellects, and of the latter Harriot was clearly preeminent. Our ignorance of Harriot's achievements is largely the result of his failure to carry his researches through to completion and commit his findings to print. His only printed works are *A Briefe and True Report of the New Found Land of Virginia* (London, 1588) and his posthumous *Artis analyticae praxis, ad aequationes algebraicas nova . . . methodo resolvendas* (London, 1631). However, some 10,000 pages of his scientific manuscripts are extant, and these are beginning to yield their secrets to historians of science.

The volume under review, a collection of seven articles originally presented at a Thomas Harriot symposium in 1971, represents a cross section of current research. The articles and their authors are "Harriot's science, the intellectual background," by Edward Rosen; "Sir Walter Ralegh and Thomas Harriot," by John W. Shirley; "Thomas Harriot and the New World," by David B. Quinn; "Harriot's earlier work on mathematical navigation: theory and practice," by Jon V. Pepper; "Henry Stevens and the associates of Thomas Harriot," by R. C. H. Tanner; "Harriot, Hill, Warner and the new philosophy," by Jean Jacquot; and "Thomas Harriot and the first telescopic observations of sunspots," by John North. The articles are followed by a useful bibliography of Harriot's papers and printed literature dealing with his life and labors.

For the most part the articles are a specialized lot, and the reader should not expect to find in them a general assessment of Harriot and his scientific achievements. But most of the articles are good ones. Shirley's discussion of Ralegh and Harriot is a careful and intelligent account of Harriot's career, especially those aspects of it touched by Ralegh. Jacquot's discussion of the natural philosophies of Hill and Warner, two of Harriot's associates, is probably the most interesting paper in the book, dealing as it does with the introduction of Giordano Bruno's philosophy into England and its impact on the Northumberland circle. And fresh ground is broken in John North's important paper on Harriot's telescopic observations.

This book will thus be useful and important to the specialist. The casual reader may also find much to interest him; but it appears that for a thorough, general account of Harriot's scientific career, we will have to wait until many more specialized researches, of the kind reported in this volume, have been completed.

DAVID C. LINDBERG
Department of the History of Science, University of Wisconsin, Madison

Books Received

Advanced Concepts and Techniques in the Study of Snow and Ice Resources. Proceedings of a conference, Monterey, Calif., Dec. 1973. Henry S. Santeford and James L. Smith, Eds. National Academy of Sciences, Washington, D.C., 1974. x, 790 pp., illus. $11.

Advances in Quantum Electronics. Vol. 2. D. W. Goodwin, Ed. Academic Press, New York, 1974. xii, 298 pp., illus. $21.

Advances in the Zoology of Tapeworms, 1950–1970. Robert A. Wardle, James A. McLeod, and Sydney Radinovsky. University of Minnesota Press, Minneapolis, 1974. xvi, 274 pp., illus. $18.50.

Air Pollution. Part B, Prevention and Control. Joe O. Ledbetter. Dekker, New York, 1974. xviii, 286 pp., illus. Paper, $11.75. Environmental Health Engineering Textbooks, vol 2.

Analytical Chemistry of Transplutonium Elements. B. F. Myasoedov, L. I. Guseva, I. A. Lebedev, M. S. Milyukova, and M. K. Chmutova. Translated from the Russian edition (Moscow, 1972) by N. Kaner and D. Slutzkin. Halsted (Wiley), New York, and Israel Program for Scientific Translations, Jerusalem, 1974. x, 404 pp., illus. $30. Analytical Chemistry of the Elements.

Animal Cell Culture and Virology. Robert J. Kuchler, Ed. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1974. xviii, 460 pp., illus. $24. Benchmark Papers in Microbiology.

Animal Parasites. Their Life Cycles and Ecology. O. Wilford Olsen, Ed. University Park Press, Baltimore, ed. 3, 1974. xii, 562 pp., illus. $16.50.

Annual Review of Biochemistry. Vol. 43. Esmond E. Snell, Paul D. Boyer, Alton Meister, and Charles C. Richardson, Eds. Annual Reviews, Palo Alto, Calif., 1974. x, 1086 pp., illus. $16.

Antoine Laurent Lavoisier. Der Forscher und Seine Zeit 1743–1794. Ferenc Szabadváry. Wissenschaftliche Verlagsgesellschaft, Stuttgart, Germany, 1973. 246 pp., illus. DM 28.50. Grosse Naturforscher, Band 36.

Archaeology of the Mammoth Cave Area. Patty Jo Watson, Ed. Academic Press, New York, 1974. xxii, 256 pp., illus. $16. Studies in Archaeology.

Art on the Rocks of Southern Africa. D. N. Lee and H. C. Woodhouse. Drawings by Marion Didcott. Scribner, New York, 1974. 166 pp., illus. $15.

Aspects of Neurogenesis. Gilbert Gottlieb, Ed. Academic Press, New York, 1974. xvi, 288 pp., illus. $18.50. Studies on the Development of Behavior and the Nervous System, vol. 2.

Astronomy and Astrophysics Abstracts. Vol. 10. Literature 1973, Part 2. S. Bohme, W. Fricke, U. Guntzel-Lingner, F. Henn, D. Krahn, U. Scheffer, and G. Zech, Eds. Published for Astronomisches Rechen-Institut by Springer-Verlag, New York, 1974. x, 662 pp. $35.10; by subscription, $28.10.

Atlas of Vertebral Angiography. Mutsumasa Takahashi. University Park Press, Baltimore, and Igaku Shoin, Tokyo, 1974. xx, 384 pp., illus. $65.

Behold Man. A Photographic Journey of Discovery inside the Body. Lennart Nilsson in collaboration with Jan Lindberg. Translated from the Swedish edition (Stockholm, 1973) by Ilona Munck. Drawings by Bernt Forsblad. Little, Brown, Boston, 1974. 254 pp., illus. $25.

Biochemistry Series One. Vol. 4, Biochemistry of Lipids. T. W. Goodwin, Ed. Butterworths, London, and University Park Press, Baltimore, 1974. xii, 294 pp., illus. $19.50. MTP International Review of Science.

Biology and Chemistry of Eucaryotic Cell Surfaces. Proceedings of a symposium, Miami, Fla., Jan. 1974. E. Y. C. Lee and E. E. Smith, Eds. Academic Press, New York, 1974. xiv, 366 pp., illus. $15. Miami Winter Symposia, vol. 7.

The Cell Nucleus. Vol. 2. Harris Busch, Ed. Academic Press, New York, 1974. xxvi, 564 pp., illus. $45.

Chemotaxonomy of Flowering Plants. R. Darnley Gibbs. McGill-Queen's University Press, Montreal, 1974. Four volumes, illus. Vol. 1, Constituents, xxii + pp. 1–680; vol. 2, Families, iv + pp. 681–1274; vol. 3, Orders, iv + pp. 1275–1980; vol. 4, Bibliography and Index, vi + pp. 1281–2372. $135.

Claude Bernard and Animal Chemistry. The Emergence of a Scientist. Frederic Lawrence Holmes. Harvard University Press, Cambridge, Mass., 1974. xxii, 542 pp., illus. $18. A Commonwealth Fund Book.

Comparative Morphology of Vascular Plants. Adriance S. Foster and Ernest M. Gifford, Jr. Freeman, San Francisco, ed. 2, 1974. xii, 752 pp., illus. $17. A Series of Books in Biology.

The Cybernetic Theory of Decision. New Dimensions of Political Analysis. John D. Steinbruner. Princeton University Press, Princeton, N.J., 1974. xiv, 368 pp., illus. $14.50.

Ecophysics. The Application of Physics to Ecology. James Paul Wesley. Thomas, Springfield, Ill., 1974. xxviii, 340 pp., illus. Cloth, $19.75; paper, $13.95.

Error Coding for Arithmetic Processors. T. R. N. Rao. Academic Press, New York, 1974. xiv, 218 pp., illus. $16.50. Electrical Science.

Exercise and Sport Science Reviews. Vol. 2. Jack H. Wilmore, Ed. Academic Press, New York, 1974. xiv, 382 pp., illus. $25.

Experiments in Physical Chemistry. David P. Shoemaker, Carl W. Garland, and Jeffrey I. Steinfeld. McGraw-Hill, New York, ed. 3, 1974. x, 726 pp., illus. $12.95.

The Flora and Vegetation of Japan. M. Numata, Ed. Kodansha, Tokyo, and Elsevier, New York, 1974. x, 294 pp., illus. + maps. $30.80.

Forensic Science. An Introduction to Scientific Crime Detection. H. J. Walls. Praeger, New York, ed. 2, 1974. xiv, 258 pp. + plates. $13.95.

Hebrew Christianity. The Thirteenth Tribe. B. Z. Sobel. Wiley-Interscience, New York, 1974. xiv, 414 pp. $12.50. Contemporary Religious Movements.

Higher Consciousness. The Evolutionary Thrust of Kundalini. Gopi Krishna. Julian, New York, 1974. x, 198 pp. $7.95.

The Insect Societies. Edward O. Wilson. Belknap (Harvard University Press), Cambridge, Mass., 1974. xii, 548 pp., illus. Paper, $7.95. Reprint of the 1971 edition.

International Review of Cytology. Vol. 38. G. H. Bourne, J. F. Danielli, and K. W. Jeon, Eds. Academic Press, New York, 1974. x, 418 pp., illus. $29.

Liquefied Natural Gas. W. L. Lom. Halsted (Wiley), New York, 1974. viii, 178 pp., illus. $18.

Mechanical Properties of Polymers and Composites. Vol. 2. Lawrence E. Nielsen. Dekker, New York, 1974. xvi + pp. 257–556.

A New Key to the Yeasts. A Key for Identifying Yeasts Based on Physiological Tests Only. J. A. Barnett and R. J. Pankhurst. North-Holland, Amsterdam, and Elsevier, New York, 1974. xiv, 274 pp., illus. $24.

Numerical Methods in Weather Prediction. G. I. Marchuk. Translated from the Russian edition (Leningrad, 1967) by K. N. Trirogoff and V. R. Lamb. A. Arakawa and Y. Mintz, Transl. Eds. Academic Press, New York, 1974. x, 278 pp., illus. $21.50.

On Machine Intelligence. Donald Michie. Halsted (Wiley), New York, 1974. xii, 200 pp., illus. $6.95.

Probability Theory. A Historical Sketch. L. E. Maistrov. Translated from the Russian edition (Moscow, 1967) and edited by Samuel Kotz. Academic Press, New York, 1974. xiv, 282 pp., illus. $22.50. Probability and Mathematical Statistics, vol. 23.

The Problem of Chemical and Biological Warfare. A Study of the Historical, Technical, Military, Legal and Political Aspects of CBW and Possible Disarmament Measures. Stockholm International Peace Research Institute. Almqvist and Wiksell, Stockholm, and Humanities Press, New York, 1973. 5 vols. Vol. 1, The Rise of

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