ways the most unusual part of this chapter is an unhurried and clear review (by Chiu and Zaidi) of quantum field theory, which is quite orthodox in its "bookwork" but illustrates the methods by applications to neutrino processes and other astrophysical problems (it also contains reprints of two papers on neutrino astrophysics which are a little dated by now, but still enjoyable). A chapter by H. Reeves on "High-energy nucleosynthesis" has a similar flavor, with an unhurried review of the relevant parts of nuclear reaction theory and general nucleosynthesis preceding the main topic. Twin chapters on the origin of cosmic rays, a mathematical but clear treatment by E. Schatzman and a delightful qualitative one by V. L. Ginzburg, conclude this volume.

EDWIN E. SALPETER
Laboratory of Nuclear Studies, Physics Department, Cornell University, Ithaca, New York

Some Looks at Dielectrics

Ferroelectricity. Proceedings of a symposium, Warren, Mich., Sept. 1966. EDWARD F. WELLER, Ed. Elsevier, New York, 1967. xiv + 318 pp., illus. $29.

You have heard the parable about the committee of blind men who examined an elephant to find out the nature of the beast. This book is their report; the mythical beast is called "Ferroelectricity." Fortunately, no one dares to state what ferroelectricity is; for ferroelectricity is all the various phenomena and points of view which are discussed by the authors who contributed to this excellent volume. And probably a good deal more, besides. The reference to blind men is not intended to carry the implication that any of the 21 authors exhibits any kind of blindness. On the contrary, the general excellence of the book I attribute to the choice of perceptive authors. Each has felt free, however, to examine the beast myopically and, instead of reporting encyclopedically, to do his own thing.

The book begins with three short contributions. J. C. Slater presents the anharmonic potential picture and the now standard Cochran discussion of the soft-mode theory of displacive ferroelectricity. H. Fröhlich writes about dielectric instabilities, mentioning especially the importance of electronic effects in triggering instabilities. Lars Onsager discusses some measurements and speculations about ferroelectricity in that well-known but little understood substance, ice.

Then all hell breaks loose. Joseph L. Birman gives a marvelously Birmanesque and detailed discussion of the use of group theory in the Landau theory of second-order phase transitions. He finishes with a brief review of electronic contributions to displacive transitions.

Another short contribution follows, from W. Cochran, on the lattice dynamics of several diatomic crystals with the NaCl structure, which unexpectedly exhibit soft-mode behavior, that is, possess an infrared active phonon mode with low and strongly temperature-dependent frequency.

A. A. Maradudin now does his thing. He presents a complete anharmonic theory of lattice dynamics, which aims at encompassing both ferroelectric and paraelectric phases in one crystal Hamiltonian. The Hamiltonian is used to calculate thermodynamic quantities, such as the free energy important in the Devonshire theory. A major problem is the handling of the terms in the Hamiltonian which describe unstable modes, that is, which give imaginary frequencies at low temperatures. I am unprepared to judge the success of Maradudin's venture: I marvel.

B. T. Matthias appears, to take us on an all too short tour of his world. This involves, in seven pages, a history of ferroelectricity, a catalog of mechanisms, a tour of the periodic table, and a brief look at connections between various cooperative phenomena such as ferroelectricity, ferromagnetism, and superconductivity. Wow!

Light scattering in ferroelectric crystals, a subject which has justly brought him renown, is discussed by Herman Z. Cummins. Cummins is concerned primarily with Brillouin scattering, which discloses the coupling of the acoustic phonons with polarization fluctuations near the ferroelectric transition temperature. There is a brief section on critical Rayleigh scattering, or opalescence.

By now, it is time for A. S. Barker, Jr., to present an impressive review of infrared dielectric behavior. He discusses everything of importance: the Lyddane-Sachs-Teller relation derived from Kramers-Kronig relations; local field effects, particularly in the perovskite lattice; the unfolding of infrared reflectivity data to get the dielectric function, and the complications of frequency-dependent damping. He then reviews measurements in several perovskites and hydrogen-bonded ferroelectrics.

I shall deal more briefly with the remaining papers in the volume, largely for reasons of personal interest, even though, perhaps, in doing *my* own thing, I do an injustice.

I. P. Kaminow reviews electrooptic materials and the connection between electrooptic and other phenomena such as nonlinear optics and the Raman effect.

Lithium niobate is presented by K. Nassau.

There are two papers on KNO_3, by Michel A. Nusimovici and J. G. Gay. Nusimovici discusses exhaustively the group theory of the three known phases, whereas Gay concentrates on the ferroelectric phase and discusses possible mechanisms causing a spontaneous dipole moment.

B. C. Clark, R. Herman, D. C. Gazis, and R. F. Wallis discuss size and shape effects on the stability of crystal lattices, an important problem, for example, when one wishes to study ferroelectricity in thin films.

Polycrystalline KNO_3 films are discussed by J. P. Nolta, N. W. Schubring, and R. A. Dork; film charging by dielectrics, by H. L. Stadler.

The Prague Conference on Ferroelectrics, 1966, is summarized by Joseph Lajzerowicz, and the summary of the conference from which this book sprang is presented by M. Balkanski. The final item in the book is an after-dinner speech prepared by P. Debye, on the solid state around 1910. He recalls the contributions of Planck, Einstein, and others, including himself, in those exciting and germinal years.

The book possesses an author index, and a somewhat uneven subject index, but it does not much matter. For it will not replace any of the excellent standard monographs on the subject of ferroelectricity (Fatuzzo and Merz, Jona and Shirane, and Megaw). Instead, it portrays the current (1966) thrust of research on ferroelectricity, ignoring such important achievements of the past as Devonshire's thermodynamic formulation, in favor of the current microscopic point of view. The book is important, not for its completeness, but because of its intensity.

J. M. WORLOCK
Bell Telephone Laboratories, Holmdel, New Jersey