linear optical properties omits a number of important theoretical works including those of James Phillips and James Van Vechten, Barry Levine, David Aspnes and Michael Bell. Also, Zanio misspells Nicolåas Bloembergen's name on page 209 and in the references.

In spite of some of these shortcomings the book makes a significant contribution to the field and is an important reference volume for workers in this area.

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Vibration Spectra and Symmetry of Crystals

H. Poulet, J. P. Mathieu
571 pp. Gordon and Breach, New York, 1976. $39.00

The spectra of vibrations of the atoms in a crystal may be studied by several experimental techniques. Two of the oldest are infrared-absorption (or reflection) and Raman-scattering measurements. In a first approximation these measurements give information about those *principal vibrations* (vibrations with null wave vector) that are infrared-active or Raman-active. The number of active principal vibrations depends on the symmetry of the crystal, and this also determines the selection rules for the nature of the infrared or Raman activity. The frequencies of the active vibrations depend upon interatomic force constants and hence on the nature of the bonding of the atoms in the crystal lattice. The strengths of the infrared or Raman spectra depend upon modulation by the active principal vibrations of the charge density and optical polarizability of the crystal, and the shapes of the principal vibration spectra are determined by damping of the principal modes due to interactions with other modes. This incomplete list of the nature of the results of vibrational Raman and infrared measurements on crystals indicates why these measurements are so important to crystal physics and chemistry. Measurements of vibrational spectra at nonzero wave vector by inelastic neutron and x-ray scattering complement the infrared and Raman measurements and in many cases allow a more complete model to be constructed of the interatomic forces.

The most appropriate time for Raman and infrared measurements on a given crystalline solid is when single crystals are available and after a few of the bulk physical properties have been measured and the microscopic crystal structure has been determined. It is then possible to predict the number of principal vibrations, their symmetry and the infrared and Raman selection rules for active vibrations. Henri Poulet and Jean Paul Mathieu have been active in this field for several decades, and their *Vibration Spectra and Symmetry of Crystals* provides a full treatment of the theory of these effects, the most self-contained known to me.

Workers in the field of infrared and Raman spectroscopy of solids and students preparing to enter this field will find the book extremely valuable because of its detailed treatments of such topics as symmetry properties (including several appendices on group theory), quantization of lattice vibrations, and interactions of vibrations with electromagnetic radiation. Important phenomenological parameters, such as force constants, infrared effective charges and polarizability derivatives, are clearly defined, but the authors do not discuss detailed microscopic (that is, quantum-mechanical) calculations of such quantities.

Poulet and Mathieu include a nice discussion of two-phonon infrared and Raman processes, but they omit any mention of Fermi resonances between one-phonon and two-phonon processes. As its title implies, the book does not discuss infrared and Raman interactions with electronic excitations such as magnons or plasmons or with coupled phonon–electron modes. One type of coupled mode that is discussed in some detail is the infrared polariton. The authors have limited their discussion to a single polarization wave and have emphasized the dispersion relations and the physical coupling mechanisms. They have not provided the response function formalism necessary for a discussion of line-shapes. They mention only briefly the subject of soft-modes and phase transitions.

This book is for the committed reader who wants to learn how group theory explains the properties of principal lattice vibrations and their interactions with electromagnetic radiation, and who wants to use these results in his research. Its curt style will discourage the causal reader who does not have at least qualitative prior knowledge of the subject matter. There are many useful tables. In addition to the expected character tables for the 32 point groups, there are tables of irreducible representations, correlation tables and tables summarizing infrared and Raman selection rules for all point groups.

There is a large bibliography, but I was disappointed not to see references to several general works that partly overlap Poulet and Mathieu's book, namely M. M. Sushchinskii's *Raman Spectra of Molecules and Crystals* (1972), his review article with V. S. Gorelik in *Soviet Phys-*

ics-Uspekhi (1969), and G. Turrell's *Infrared and Raman Spectra of Crystals* (1972).

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Memoirs of a Physicist in the Atomic Age

W. M. Elsasser
216 pp. Science History (Neale Watson), New York, 1978. $15.00

The period between the world wars evoked strong passions and creative impulses in physics as in society at large. In Germany, quantum mechanics emerged in 1926 amid acrimonious debate over its meaning but provided much of the long-sought explanation of atomic and molecular processes. Nuclear physics was born, at almost the same time as the Third Reich, out of discovery of the neutron. Perhaps surprisingly, in this complex and troubled environment, many physicists thrived in research, at least before Hitler's seizure of power in 1933. Among them were individuals like Werner Heisenberg, Max Born, Erwin Schrödinger, and Arnold Sommerfeld, whom we now revere as the founders of modern physics.

Some who are less well-known contributed important works also. One was Walter Elsasser, quantum theorist, meteorologist and pioneering geophysicist. His life story might have been a significant chronicle of the times in physics, for he studied at some of the most fertile centers of physical research in Europe and migrated to the United States in 1936, even if, according to his account, his achievement was much in spite of the social and physics environments in which he worked. But Elsasser's memoirs are disappointing, for they reveal little new about his chosen major theme—the make-up and achievements of his fellow scientists.

His is a curious autobiography indeed. While it is not really unconventional in form, it is an unusually personal, sometimes psychological reconstruction of the seventy years since his birth in 1904. His view of the world bears the imprint of his youth and especially of a hard six years of emotional instability in the late nineteen-twenties and early thirties. Through the book he draws several dozen sketches of fellow students, professors and major influences, most only a page or two of summary, by way of telling us who accompanied him on the difficult path of life. Now and again he stops to speculate on philosophical issues that have arisen along the way: on "reductionism" in chemistry and biology, on "conceptual" versus "mathematical" thought, on the

ELSASSER (summer 1932)

relationship of basic science to technology, on the need for the irrational in studying life, on the Mormon religion. Sketches and speculations both seem disconcertingly superficial, less analytical, given his approach, then we might expect of his highly personal memoir.

Seven of ten chapters are devoted to Elsasser's first thirty years, and though they embrace the most exhilarating and important period in physics since the seventeenth century (the implicit reason for his dwelling on those years, after all), we cannot sense the excitement of the time nor can we draw out a salient thread of achievement. Elsasser remembers Paul Ehrenfest for his "psychological problems whose exact nature was unintelligible to me," as it is also to the reader. He presents a sordid and unenlightening anecdote in lieu of explanation. But his unwillingness (or inability) to develop and interpret his character is no singular aberration. We learn little of Sommerfeld's character in a second-hand account of his work. Even Elsasser's one-time adviser James Franck appears as a shadowy, almost mythical figure, remembered emptily as "extremely restrained," with "no detectable personal vanity" (for suppressing celebration of his Nobel prize) and with "a certain gentle humility that he never seemed to lose even under provocation." Here and in others of these cursory sketches Elsasser displays meager effort to comprehend the character, motives and achievements of the persons whom he has chosen to cite. The stories usually reveal weaknesses of their subjects. It is almost as if he had set about to demean all around him in order better to debase himself, for there is manifold evidence of self-contempt.

The book fails, I think, because its author has not given us enough of himself, much less of his associates. He has spoken repeatedly of his experiences with psychoanalysis, "depth psychology," and the profound influence they exerted on him. But in truth we cannot tell how or why they influenced him, even though an entire chapter is devoted to his psychological musings. We fail to learn the nature, as he speaks in passing, of his emotional problems, which evidently were so severe that they prevented him from gaining an academic appointment until he was almost thirty, though nine years before he had published a work of some significance in quantum theory. Nor do we discover why, after difficulty holding jobs through the 1930's, he began to rise in academic rank.

Elsasser has not even told us how his scientific achievement added to the fields in which he studied. He remarks that from 1937 through 1941 he was engaged in analyzing the properties of far-infrared atmospheric radiation. But of the methods he used there is the barest outline, and of the importance of his work to him and to his colleagues there is no substantial judgment. He relates a sort of reason why he refused to embrace aeronautical theory around 1940 in a celebrated tiff with Theodore van Karman ("I felt no desire to give up everything I knew by then about modern physics . . ."), but he gives no hint of why this did not prevent him from undertaking in 1946 the study of magnetism of the earth, which involved no "modern physics" either. Apparently his major accomplishment after the war, even this study he seems driven to deprecate as he compares it to the work of his "competitor," the Swede Hannes Alfvén.

If a writer of autobiography cannot advance his own achievements—to show that he at least, if no one else, understands his motives and values—can he deal on a psychological level, as Elsasser tries to, with the events and people that inform his world? It is our misfortune that this book is evidence, in its self-defeating defensiveness, that he cannot.

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A Shell Model Description of Light Nuclei

I. S. Towner
383 pp. Clarendon (Oxford U.P.), New York, 1977. $24.50

Given the diversity of nuclear ground-state properties throughout the periodic table, the richness of nuclear excitation spectra, and the variety and precision of electromagnetic, leptonic and hadronic probes presently available, finite nuclei pose one of the most challenging problems in many-body theory known to theoretical physics. In his book, Ian S. Towner undertakes the formidable task of tracing the steps from the interactions between