analysis, with lots of figures and numerical values and discussion as to how things depend on the optical model parameters; one chapter is given to a review of recent work on the subject. The theory, mostly elementary, is derived as needed, and as a result we have a self-contained account that will be found useful by the student and nonexpert as well as by the initiate. Beyond the most elementary things, there is a good account of velocity-dependent and nonlocal interactions and of echoes, the glory, the rainbow, and other things like that in the semiclassical theory of scattering. Much more could have been said, however, about McVoy's analysis of the role of giant resonances in the nucleon-nucleus scattering. And the nuclei dealt with are simply too often regarded as spherical. True, there is a sketchy account of nuclear deformations, but the authors don't make much either of the static or of the dynamic effects due to these deformations. An opportunity has been missed also to give some detail about the superheavy elements which are currently of such great interest and the present theory of which draws heavily on extrapolations of single-nucleon effects.

There is no use complaining that the single-nucleon viewpoint is a very narrow one. It is indeed narrow, but this book and earlier accounts with a similar basis make clear that it is adequate to handle a large number of significant ideas and quantities. The book itself would appear to give the best available account of the subject. It would have been a better one but for some of the omissions.

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Symmetry Violations

The CP Puzzle. Strange Decays of the Neutral Kaon. P. K. KABIR. Academic Press, New York, 1968. x + 138 pp., illus. $6.

In 1964 an experiment was performed which indicated that the symmetry *CP* was violated. By inference from the universally accepted *CPT* theorem, a violation of symmetry under reversal of time was also indicated. Since so much of the progress in elementary particle physics has centered around questions of symmetry, a tremendous surge of theoretical and experimental activity was generated. Since 1964 fully 20 percent of the activity of every major high energy physics laboratory in the world has been devoted to experimental investigations searching for *CP* violation or time-reversal violation. A violation of *CP* symmetry would be indicated if the laws of physics in a mirror-reflected antiworld were different from ours. A time-reversal violation would be indicated if the microscopic laws of physics changed when the sign of the time was reversed in all the equations.

The new discovery, in which long-lived neutral mesons were found to have decays to two π-mesons, reminded one of the discovery of parity violation in 1957. That discovery led rapidly to a deeper understanding of β-decay and the weak interactions. Sadly, the similar vigorous pursuit of the *CP* violation has not led to any deeper understanding at all, and the phenomenon nags one to the point where one wishes that it had never appeared. Nevertheless, the phenomenon does exist, and we must face up to it. An absolute distinction can be made between matter and antimatter.

Kabir's book deals with the first few years of research following the original discovery. The beginning chapter reviews the fundamentals of the strangeness concept and the bizarre nature of the two-component *K*-meson system. The second chapter gives a detailed discussion of the two-pion decays of the long-lived *K*-meson. The third chapter discusses the possible origins of *CP*-noninvariance. Subsequent chapters discuss regeneration and interference phenomena. A final chapter provides a summary of conclusions that can be drawn from the experiments. More technical discussions such as the basis for the Wigner-Weisskopf description of decaying states are placed in appendices. The book is carefully written and contains the best descriptions of the early experiments to be found outside the original papers.

The existence of a *CP* violation or a time-reversal violation has consequences that reach far beyond the neutral *K*-meson system, and it is unfortunate that the author did not spend more time on these topics. Experimentalists have met the challenge by performing many beautiful experiments searching for *CP* or *T* violations. Up to the present there have been a few hints but no hard evidence of any violations outside of the *K*-meson system. The lack of experimental progress outside the *K*-meson system may justify the author's faith that important understanding of the effect will come from the *K*-meson system itself.

It is usual to criticize a book in a rapidly moving field for being out of date before it is published. The reviewer cannot refrain from remarking on this point, for the entire thrust of the experimental results has changed since the book went to press. That the book is thus dated is no fault of the author but is rather due to the fact that some of the early experiments were either incorrect or incorrectly interpreted. Evidence is accumulating that the *CP* effect either is due to a very weak microscopic interaction which contains the violation or is related in some way to the total environment. It may be a problem for the cosmologists. In either case it is unlikely that fruitful experimentation in this field will continue many more years. We must await some other related discovery or brilliant insight before the significance of the *CP* effect will be fully appreciated.

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The Solid State

Excitons, Magnons and Phonons in Molecular Crystals. Proceedings of a symposium, Beirut, 1968. A. B. ZAHLAN, Ed. Cambridge University Press, New York, 1968. xii + 224 pp., illus. $11.50.

As the editor of these proceedings points out, the purpose of the meeting was to help break down barriers in related fields and provide a learning experience. Indeed, six introductory talks were given the group, but are not included in the book; thus, the participants in the symposium received a background to the detailed lectures that the reader will not.

The symposium spanned a wide range of topics from infrared absorption to spin lattice relaxation, from the simpler aspect of vibrating lattices to exciton propagators and second quantization formalism. The book is divided into three sections: Phonons: Spectra and Density of States; Phonons in Combination with Electronic Transitions; and Excitons: Coupling to Phonon and Radiation Fields.

There are several articles that bear special mention because of their clarity of presentation and their educational

value to the nonexpert. These are the articles on neutron-scattering spectroscopy by J. W. White, the pair potential function approach to the properties of molecular crystals by S. H. Walmsley, spin polarization and spin-lattice relaxation in lowest triplet state of pyrazine by M. A. El-Sayed, L. Hall, A. Armstrong, and W. R. Moomaw, and a discussion of excitons and magnons in antiferromagnetic crystals by D. S. McClure. Many of the remaining articles are also well written but will be comprehensible and of value only to those close to the particular subject they cover.

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Immunity and Development

In Vitro. Vol. 3, Differentiation and Defense Mechanisms in Lower Organisms. A Tissue Culture Association symposium, Philadelphia, 1967. M. MICHAEL SIGEL, Ed. Williams and Wilkins, Baltimore, 1968. xii + 212 pp., illus. $11.50.

Immune responses may have evolved to control mutated cells that might become neoplastic. This book considers immune systems and therefore may be indirectly concerned with control of abnormal differentiation. Thus, some relevant questions are: Do invertebrates have immune responses and, if so, are the parameters the same as those in vertebrates? Can we observe true neoplasms in invertebrates? On the other hand, in the absence of true neoplasms, can we infer the existence of immune systems functionally equivalent to vertebrate types? Results from several laboratories have shown that immune responses undoubtedly occur in lower species, but we await more convincing demonstrations of specificity and anamnesis in invertebrates, particularly.

This book should appeal to two main audiences, developmental biologists and comparative immunologists. To provide evolutionary perspective, it is divided into three sections, dealing with cell aggregations, methods of culturing tissues from lower invertebrates and plants in vitro, and primitive mechanisms of resistance to infection in invertebrates and poikilotherms (fishes).

Much emphasis is placed on *Hydra* as an experimental animal; yet representative work involving other invertebrates could well have been included. The *Hydra* grafting studies reported deal with cell movements; tissue incompatibilities should also be considered. Since cell affinities and disaffinities are real in numerous other phyla, they may be demonstrable in the Coelenterata as well, and if present could well suggest a type of primitive immune response.

Cell aggregation has been crucial in understanding differentiation. In this symposium it was appropriately presented, for what may have been the first time, as an all-important preface to the understanding of primitive mechanisms of resistance (treated in the last section of the volume). Undoubtedly, recognition of the difference between self and not-self was manifested early in ontogeny and phylogeny in the manner in which single, disaggregated cells respond to each other; patterns form as a result of this kind of recognition, which is thus germane to development. Yet, when considered from the viewpoint of immunological competence, specific recognition lies at the foundation of defense reactions. When cells react to surface differences and fail to aggregate, this kind of specificity insures precise morphogenetic interactions in development or antigenic recognition in immunity.

The most important section of the book deals with primitive mechanisms of resistance to infection, evidenced, for example, in the work on cellular immunity in oysters. Rather than specific immunity, nonspecific host-parasite relationships are stressed. Cellular immunity at this level suggests that antigen processing by vertebrate macrophages may have come about early in phylogeny. Using the oyster to search for evidence of humoral immunity, the contributors pose the provocative and basic question of the origin of immunoglobulin chains among the invertebrates. With regard to primary clearance, oysters can, like sharks, clear bacteriophage at the same rate in 24 hours, but after secondary injection no phage was detected in shark serum, which generally was found to contain neutralizing antibody. The enhanced clearance of phage probably occurred via a cell-mediated mechanism. In the oyster a naturally occurring hemagglutinin exists which has physical and chemical properties analogous to molecules in higher forms.

With regard to immune-like phenomena, it is noteworthy that some fishes usually do not synthesize immunoglobulin A or G in response to certain antigens. The capacity to produce interferon as a means of recovery from viral attack may have evolved as an alternative to the ability to synthesize certain classes of immunoglobulins. The gene (or genes) that code for several of the immunoglobulins apparently did not differentiate until later in phylogeny.

Aggregation, cell and tissue culture of plant and animal cells, and evidence of immune phenomena are subjects that have been treated separately elsewhere. This volume fills the great need of uniting the superficially different disciplines of immunology and development. Both can profit by exchange of technical and conceptual approaches, since the disciplines cannot be strictly delineated. Many comparative immunologists were once and maybe still are concerned principally with answering questions in developmental biology.

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Books Received

Abstracts of Theses 1964–1965. Accepted in Partial Fulfillment of the Requirements for the Degrees of Doctor of Philosophy and Doctor of Science during the Academic Year 1964–1965. Prepared by Eleanor L. Bartlett and M.I.T. Press. M.I.T. Press, Cambridge, 1969. viii + 328 pp. Paper, $6.95.

Advances in Ecological Research. Vol. 5. J. B. Cragg, Ed. Academic Press, New York, 1968. xii + 284 pp., illus. $13.

Advances in Insect Physiology. Vol. 5. J. W. L. Beament, J. E. Treherne, and V. B. Wigglesworth, Eds. Academic Press, New York, 1968. x + 362 pp., illus. $15.

Analytical Applications of 1,10-Phenanthroline and Related Compounds. Alfred A. Schilt. Pergamon, New York, 1969. viii + 196 pp., illus. $9. International Series of Monographs in Analytical Chemistry, vol. 32.

Bighorn Canyon Archeology. Wilfred M. Husted. Jerome E. Petsche, Ed. Museum of Natural History, Smithsonian Institution, Washington, D.C., 1969. vi + 138 pp., illus. Paper. Smithsonian Institution-River Basin Surveys Publications in Salvage Archeology, No. 12.

Biochemical Methods in Red Cell Genetics. Jorge J. Yunis, Ed. Academic Press, New York, 1969. xiv + 530 pp., illus. $25.

Biologische Onderzoekingen op Pathologische Prostaatweefsels. En Hun Betekenis Voor de Differentiele Diagnose der Prostaataandoeningen. K. van Camp. Arscia Uitgaven, Brussels; Presses Académiques Européennes, Brussels, 1968. 272 pp., illus. Paper, 540 F.

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