whole area of interest. . . ." He also intended the monograph to be "useful for engineers as a reference." Indeed engineers and scientists who are familiar with the concept of boundary layers will find this monumental, well-organized guide to the mushrooming literature very useful as a handbook reference of low-speed and high-speed separated flows with varied geometries of technological interest. The special strength of the book lies in the more than 550 figures and photographs illustrating the basic features of the flows and reporting typical experimental results.

Had Chang had the opportunity to include more than just a few pages of post-1964 research, he would have probably been more circumspect in a number of his assessments (for example of acoustic theory of cylinder wakes, prediction methods for turbulent boundary layers, vortex bursting, and the significance of protruding probes placed in front of blunt bodies, to which 57 pages are allotted). It is, however, a surprise that Navier-Stokes equations go unmentioned, as do the concepts of matched asymptotic approximations. Exclusive reliance on the (parabolic) asymptotic boundary-layer theory (usually coupled with ad hoc empiricism) tends to obscure the essential feedback (elliptic) nature of separated flows. Deeper exploitation of this nature may well hold the key to further progress whether experimental, theoretical, or numerical. In the meantime evaluating the flow and forces associated with a "curve" thrown by a pitcher will remain more of an art than throwing one. And P. K. Chang's book will be used as a handy reference.

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Radiation Effects

Fission Damage in Crystals. Lewis T. Chadderton and Ian McC. Torrens. Methuen, London, 1969 (U.S. distributor, Barnes and Noble, New York). xii, 268 pp., illus. $13.50.

Ever since atomic power became generally available much technological and scientific effort has been directed toward understanding the interaction of various radiations with solids. Nuclear engineers have had to cope with difficulties arising from a gradual change of properties of materials exposed to radiation (Wigner effect) while research chemists, physicists, and metallurgists acquired a magnificent tool (some say toy) for studying a multitude of defects produced in solids by radiation. Chadderton and Torrens's book is an excellent up-to-date introduction to and survey of a particular class of these phenomena: the interaction of uranium fission fragments with crystalline solids. Since fission fragments produce secondary radiations such as electrons (which the authors call for some reason "delta rays") these are also considered in some detail. The book gives much theoretical background concerning fundamentals of the pertinent phenomena: fission, mechanisms of energy loss, collision cross section, several kinds of spikes (thermal, displacement, plasticity), focusing, and others. Much space is also devoted to the experimental methods of irradiation, to direct and indirect observation (electron microscope) of the bombarded solids, to imaging techniques, to tracks in heat-sensitive crystals, to effects in lead iodide and alkali halides, and to other relevant topics.

Considerable space is also occupied by discussion of results obtained, mostly by the authors, on computer-simulated irradiation processes. These computer "experiments" stimulate imagination and provide many fascinating illustrations in the book. The reviewer is, however, skeptical about the degree of significance attached to some of these results, which of necessity sometimes are obtained with drastically simplified pairwise interatomic interactions, in small volumes or in less than in three dimensions. It is only recently that such computer "experiments" are emerging from the convenient but not very realistic pair formalism and other limitations, and attempts are being made to include such factors as noncentral forces and polarization sums (matrix method). It suffices to point out that there is, as yet, no satisfactory estimate of the threshold energy for vacancy formation in alkali halides or of energy losses during the linear propagation of the ensuing neutral interstitial [110] configuration as first suggested by Vosko *et al.* Various mechanisms of defect formation in these crystals have been proposed, and some of them have found support, although a generalization to all alkali halides is still lacking.

One of the fundamental questions in the theory of fission damage is the problem of the effective charge of the fission fragments moving through a solid and of the associated energy loss. The usual Bohr-Linhard theory, referred to in the book, has been very recently modified by Betz and Grodzins, and it will be interesting to see to what extent this will alter the quantitative interpretation of the effects of fission on solids.

The book is very clearly written, is well printed, and has a fair index and a number of references at the end of each chapter. It is a most useful addition to the solid state literature.

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Crystallization Method

Crystal Growth in Gels. Heinz K. Henisch. Pennsylvania State University Press, University Park, 1970. 112 pp., illus. $6.95.

Only recently has there been a surge of interest in the growth of crystals in gels, though this method has a history beginning at the close of the last century with the study of Liesegang rings. Henisch has combined the extensive literature on the subject with his own investigations to produce a concise and readable book on this potentially fruitful area of investigation.

This method for growing crystals is relatively simple, and no elaborate equipment is needed. The basic procedure involves crystallization within a gel by chemical reactions between reagents in the gel and liquids or gases that diffuse through it. Variations in growth procedures are illustrated by discussions of compounds such as calcium tartrate, cuprous chloride, and silver iodide. The crystals considered were grown in silica gel. Several other gels such as agar, gelatin, and soft soaps are mentioned, but unfortunately a discussion of crystal growth in them is not developed. The effects of *p*H and aluminum impurities on gelling are considered, and excellent electron micrographs show silica gel structures with interconnected cells of sheetlike form.

Much attention is given to the subject of nucleation. Though foreign nuclei undoubtedly play a role in crystallizing in gels, Henisch develops a good argument to show that homogeneous nucleation is probably more important. The effects of silica gel on suppressing nucleation as well as controlling diffusion rates of reagents are emphasized. Other topics considered include crystal size and perfection, crystal doping, silica gel inclusions (especially in calcium carbonate), and the reimplanting of crystals. Henisch further outlines research based on gel-grown crystals (for example, calcium tartrate, lead iodide) and reviews unsolved theoretical problems regarding the growth of crystals by this method.

The book is well illustrated, but unfortunately magnification factors for several photographs are lacking. Since Liesegang rings are mentioned several times, the book would have been strengthened by a short discussion of the theory of this phenomenon as it relates to the current work.

Everyone interested in crystals, ranging from those who are only impressed by their beauty to researchers concerned with their structures and properties, would benefit from reading this relatively short book.

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