I believe that there is no need for this series of volumes entitled *Progress in Solid State Chemistry*. Indeed, examination of the Table of Contents reveals no subject which does not already fall into the domain of the Seitz-Turnbull solid-state physics series or the older review series in inorganic chemistry. I do not believe that a publisher is justified in bringing forth a new series of review volumes when there is no direct need for that series.

If we avoid the problem of whether or not this volume is needed, we may answer the second question cited above in the affirmative, i.e., the editor has done a good job in providing a broad survey of many topics in solid-state science. Unfortunately, it is obvious that the editor has been done in by the publisher. Although the Preface is dated February 6, 1963, the volume has just appeared [in June 1964. ED.]. But even worse than that, examination of the individual articles reveals uniformly that the articles were submitted to the publisher some time in 1961 or at the latest early in 1962. As a result, several articles are so far out of date as to be hardly worth the paper on which they are printed. I refer in particular to the article on organic semiconductors which, through no fault of the author or the editor, no longer contributes anything to the field.

On other occasions I have made comments about the rate of publication of review volumes. In the particular case under review there seems to have been an inexcusably long delay which, coupled with the lack of need for the series to begin with, reflects very poorly on the publisher.

In view of the preceding remarks it seems pointless to comment about the individual articles. I can only say that I am sorry that the editor and the individual authors have seen so much effort go for naught.

Microwave Solid-state Masers. By A. E. Siegman. 583 pp. McGraw-Hill, New York, 1964. $18.50.
Reviewed by H. J. Hagger, Albiswerk Zurich, Switzerland.

Most books on masers aim to cover the problem generally and do not concern themselves with only one type of device. Professor Siegman's book, however, is an exception. It concentrates on the solid-state version and supplies both the theoretical background of the physical principles the devices are based on and a disclosure of practical possibilities and limitations.

After a brief introduction to maser theory and some magnetic relations in a medium, the author starts with a quantum-mechanical description of the internal structure and the magnetic properties of atoms. He then concentrates on paramagnetic maser materials. Chapter 5 is a well-written survey of paramagnetic resonance using both the relaxation of the spin-lattice system and Bloch's approach (dynamic behavior of macroscopic magnetization in a nuclear paramagnetic material). In the next chapter Bloembergen's three-level solid-state maser is dealt with, both as an amplifier and as an oscillator. The author also considers briefly the problem of harmonic pumping. Further on he discusses the traveling-wave maser, considering first the amplification mechanism and then passing on to bandwidth and tuning considerations and to properties of the interaction structure. This section also has a concise discussion of traveling-wave tube problems. In Chapter 8 noise generation in maser spin systems is considered, and here the author uses the well-suited wave approach. The sources of these perturbations and their measurement are dealt with, and some discussion is added on the quantum aspect of amplification and noise. The last chapter considers a number of practical maser devices, their performance figures and important experimental techniques involved. A very useful table of properties and suppliers of maser materials is included. In an appendix the ruby energy level and transition-probability matrix elements are given. An index and a bibliography containing about 350 references on solid-state maser problems and about 280 references on paramagnetic resonance and relevant topics are attached.

Siegman's book is an excellent handbook on microwave solid-state masers, both as a detailed and concise introduction leading the student and research worker to a very high level of understanding and as a reference book for the scientist working in the field. It is quite certain that this book will very soon belong to every library, private or public, containing books on masers and paramagnetic resonance. It may be highly recommended to every scientist in the field and to people having both a deep interest in maser problems and a good physical knowledge. The book is worth the price and will not be out-dated for quite a long time.

The Chemistry of Imperfect Crystals. By F. A. Kröger. 1039 pp. North-Holland, Amsterdam, 1964. $30.80.
Reviewed by Norman H. Nachtrieb, University of Chicago.

This book is significant as a comprehensive treatment of the defect crystalline state, insofar as imperfections are responsible for the chemical behavior of solids. Its author is a staff member of the Philips' Research Laboratories in Eindhoven, Holland, long distinguished for contributions to the research literature on the luminescence of solids.

Crystalline solids would be chemically uninteresting substances were it not for the imperfections they possess. Even the most superficial tarnishing reaction would not proceed much beyond the depth of a single lattice spacing in their absence. Broadly speaking, imperfections fall into one of two categories: lattice defects and electronic defects. Much has been learned during the past two decades about their properties, and techniques have been devised to regulate and control them for useful purposes. Kröger's monograph is an effort to summarize most of what is important in the thermodynamic and kinetic behavior of crystal imperfections. On the whole, this has been accomplished in a very successful manner. It is highly readable, up to date, and critical.

The first of its twenty-five chapters is devoted to the principles of purification of materials, the growth of single crystals, and doping. Succeeding chapters are concerned with the thermodynamics of phase diagrams and a survey of the laws of dilute solutions, with particular reference to solid solutions. The detailed discussion of lattice imperfections (vacancies and interstitial atoms) and of electronic defects (electrons and holes) is particularly well done. The simple law of mass action and the principle of electroneutrality suffice for the description of most of the chemical equilibria encountered at low-defect concentrations. Imperfections may interact with one another, of course, forming ion pairs and higher associates when they are charged, and requiring a Debye-Hückel kind of correction when their concentration becomes appreciable. They may also interact with impurity atoms and modify solubility relations, or alter the stoichiometry of the host substance. Kröger carefully points out that although electronic defects are usually in equilibrium with a crystal, it is often the case that lattice imperfections are not; the thermal history and ambient gas composition during the growth and annealing of crystals are often dominant factors in the reactivities of solids. In a systematic manner, separate chapters deal with imperfection equilibria in pure elemental substances, and with the effects of one and two kinds of foreign atoms on these equilibria. Similar considerations are then given to compounds (oxides, sulfides, alkali halides, and to such complex systems as spinels, perovskites, and ice). Relaxation effects in solids, including the kinetics of clustering and precipitation reactions, the diffusion of color centers, and the migration of charged imperfections are considered in one chapter.

The last five chapters represent the application of the principles of crystal-defect chemistry to particular problems, notably sintering, tarnishing reactions, solid-state batteries, fuel cells, electrolytic capacitors, and the photographic process. Particularly interesting, although admittedly still speculative, is a discussion of the heterogeneous catalysis of charge-transfer gas reactions by semiconductor surfaces. The over-all process involves adsorption, surface reaction, and desorption when donor and acceptor molecules combine with one another to form a product molecule. The slow step is presumed to be the charge-transfer reaction, in which ionized