to lose its identity as a field, attaining the same degree of distinctiveness as, say, "liquid air temperature" physics. For the present, however, there are several areas of investigation which fall predominantly in the low-temperature region. Outstanding among these are the fields of superconductivity, superfluidity in liquid helium, and the study of low-temperature magnetism, including its application to magnetic cooling.

*Kältephysik II* is a treatment of these uniquely low-temperature fields. There is a chapter dealing with low-temperature magnetism by J. van den Handel, one on magnetic cooling by D. deKlerk, a chapter on the experimental aspects of superconductivity by B. Serin, one on the present state of the theory of superconductivity by J. Bardeen, and a final chapter on liquid helium phenomena by K. Mendelssohn. The text reflects the enthusiasm of the writers for their subjects and makes interesting, informative reading. The treatment of superconductivity is particularly effective in that both the experimental and theoretical aspects are presented in detail. The other three chapters reflect predominantly the measurement aspects of their subject. The relevant interpretive concepts are well discussed but the approach tends to be more descriptive than mathematically formal. As the text indicates, recent progress in the understanding of low-temperature magnetism and magnetic cooling rests, to a large degree, on paramagnetic resonance results and the related spin Hamiltonian theory. Few reviews of this important theory exist, and, thus, a detailed discussion of at least the theoretical aspects of crystal field and nuclear effects in magnetism would have made an additional useful chapter. Perhaps this is to appear in another volume of the *Handbuch.*

In recent years, several other good reviews of superconductivity, superfluidity, and low-temperature magnetism have appeared. *Kältephysik II* makes an important contribution to this literature. Possibly the most important gain lies in the fact that much of this subject material is controversial and it is useful to have this documented presentation of the viewpoint of these authors. Additionally we note that the summary of magnetic cooling results is impressively thorough. With the currently increasing interest in low-temperature physics, the book should find application both as an up-to-date introduction to the subjects discussed and for reference.

**Electrical Conductivity II.** Vol. 20 of Handbuch der Physik. Edited by S. Flügge. 491 pp. Springer-Verlag, Berlin, Germany, 1957. DM 112.00 (if part of series DM 89.60). *Reviewed by H. P. R. Frederikse, National Bureau of Standards.*

While the first volume on electrical conductivity was devoted largely to metallic conduction and electronic structure, this second book deals with semiconduction, ionic conduction, and electrolytes. This volume expresses clearly the international nature of the *Handbuch;* of the four articles, one is written in German, two in English, and one in French. Madelung's contribution ("Halbleiter") opens with a very comprehensive and thorough treatment of the physics of homogeneous semiconductors. The second part discusses the nonhomogeneous effects (*p-n* junctions, transistors, surface and contact phenomena). Two short chapters on optical and magnetic properties and a survey of the properties of semiconducting materials conclude the article. The author has devoted quite a few pages to a listing of expressions for transport parameters in their most general form. This reviewer would have preferred a somewhat more extensive treatment of a few other aspects, e.g., cyclotron resonance. He was impressed, on the other hand, by the completeness of the literature references.

The second contribution, by A. B. Lidiard, surveys the ionic conductivity of crystals (mainly alkali halides, silver halides, and several fluorites). The intrinsic and extrinsic conduction mechanisms are discussed in terms of the formation and the mobilities of Schottky and Frenkel defects. A chapter on ac conductivity is concerned with dielectric losses due to defects and polarization phenomena. The last chapter of this article presents an excellent treatment of diffusion in ionic crystals and its relation to electrical conductivity.

A special article is devoted to the "Electrical Properties of Glass" written by J. M. Stevels. In 41 pages the author has compiled a considerable amount of data on the dc and ac conductivity of many glasses. The scattered nature of the information and the vagueness of the conclusions reached (if any) demonstrate again that glass is still one of the least understood solids. The final contribution to this volume entitled "Electrochimie", by E. Darmois, deals with the properties of electrolytic solutions and molten electrolytes. The author reviews a large variety of topics in this field: ion mobility, emf of electrolytic cells, association of ions, Debye-Hückel theory, electro-osmosis, electrophoresis, pH, etc. The very direct style in which this article is written makes it a pleasure to read. It is perhaps unfortunate that so many tables contain numerical values of parameters without any indication of the units.

**System Engineering:** An Introduction to the Design of Large-Scale Systems. By Harry H. Goode and Robert E. Machol. 551 pp. McGraw-Hill Book Co., Inc., New York, 1957. $10.00. *Reviewed by T. Teichmann, Lockheed Missile Systems Division.*

The combination of the intricate new devices of modern technology into ever more complex systems has in recent years called forth a more disciplined and well defined approach to the design of such systems. In essence, of course, this approach is not new, for without it none of the great large-scale engineering (and military) programs of the past could have succeeded. Until recent times, however, it was not necessary to so specifically articulate the comprehensive nature of this approach, nor did it need to embrace such a variety of separate disciplines as are now required. But it now has become necessary to make a more conscious and systematic effort to combine them smoothly in any complex program.

In the absence of both a reasonable definition of the "systems approach" and an outline of the basic disciplines which its practitioners should have at their command, it has, unfortunately, become possible for jargon peddlers to assume a significant role in the direction of major projects, and, in some cases, to relegate to positions of tooth-gnashing impotence the specialists who produce the crucial components as well as the manufacturers of the ultimate product. Such a vast and amorphous field cannot, of course, be simply delineated in a single volume, but this work by Goode and Machol serves as an excellent first step and includes much that a good *system* engineer should be expected to know.

The authors begin by a general discussion of complex systems and then give qualitative descriptions of examples, such as Teleran, Reservisor, and the Number 5 crossbar in telephone dial exchanges. It is emphasized that in system engineering the accent is on equipment rather than procedure, as in operations research; but it is made clear that much of the fundamental analysis is similar in nature. This is followed by a series of chapters on the fundamentals of probability and statistics, the text of which includes a variety of simple but illuminating worked-out examples. These are terminated by a set of examples which stress understanding rather than computational ability. The next section deals with problem formulation, mathematical models, the design and analysis of experiments, and concludes with an excellent example: the paper by W. O. Turner, describing the analysis which supports the change to the number 5 crossbar equipment, together with some additional discussion. Part 4 includes a summary of computers, both analog and digital, together with their input-output devices, and a comparison of their capabilities in various applications. The remainder of the book is substantially devoted to interior system design, viz., the solution of the system design problem. The main problems discussed here are system logic, traffic questions (i.e., waiting time theory), and competitive aspects (game theory). Other topics included are linear programming, group dynamics, cybernetics, system simulation, important types of components, information theory, servomechanism theory, human factors (so unfortunately known as human engineering), and, finally, managerial problems, including economics, organization, and evaluation. There are brief bibliographical notes after each chapter and a good bibliography of expository material, if not of original sources.

In attacking such an enormous and heterogeneous subject in a volume of finite size, the authors have of necessity limited their discussions and their topics. For example, their section on interior system design would have much greater impact and educational value if a large-scale example involving a number of the topics discussed could have been included (like the number 5 crossbar system earlier in the book). It is also unfortunate that the book is so completely concerned with electronic systems (though there is some verbal obeisance toward other types). Many of the large systems under development today have significant nonelectronic por-

tions and it would have been most valuable to illustrate some of *their* system engineering problems. However, Goode and Machol have made a good start, and have produced an interesting book to boot. It is to be hoped that the books which will undoubtedly follow and extend their exposition will be able to maintain a similar degree of interest.

**Physics in Meteorology.** By A. C. Best. 159 pp. Pitman Publishing Corporation, New York, 1957. $3.75. *Reviewed by S. F. Singer, University of Maryland.*

This little volume is written at a very simple level and serves as a fine introduction for physicists to meteorological problems. The author, who is Deputy Director of the British Meteorological Office, starts with a short discussion of meteorological instruments and then treats various special aspects of meteorology: the microphysics of clouds; radiation problems within the atmosphere, between the ground and the atmosphere, and into space; and the general question of the heat balance of the earth. A descriptive approach is given on the subject of atmospheric electricity, the production of thunderstorms and lightning. Dynamical meteorology as such is not discussed, but there is a brief treatment of large-scale winds and of the turbulence in the atmosphere, again on quite a descriptive level. Meteorological optics and acoustics and radiometeorology complete the treatment of physical problems. The latter chapter is quite detailed; it takes up propagation of radio waves and the effects of fog and precipitation. Finally, there is a brief account of the present state of work on weather control. The reviewer notes a lack of references to recent papers, or even to recent books, such as the *Compendium of Meteorology,* or to texts on physical meteorology.

**Nuclear Reactor Physics.** By Raymond L. Murray. 317 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1957. $7.50. *Reviewed by R. Hobart Ellis, Jr., New York City.*

In the rapidly developing field of reactor physics there are remarkably few books. Designers are basing calculations on journal articles, class notes, AEC documents, and personal communications. Students study the classic Glasstone and Edlund and engineering texts like Richard Stevenson's *Introduction to Nuclear Engineering.* In Professor Murray's new book they will now have their second-course text—a presentation of the more subtle aspects of reactor behavior previously to be learned only from original sources.

The author introduces his subject briefly in his first two chapters. Basic equations are stated with little or no derivation. Then come computations of critical masses, transient analysis, temperature effects, and one-, two-, and multigroup computations of neutron behavior.

The novice will find the book difficult and will do well to understand his basic concepts well before attempting this text. When average logarithmic energy decrement is derived, for example, the uninitiated may not notice that it is independent of energy and may miss the significance of this important fact. He is not told about it. It will be difficult for him to get much feel for diffusion length when he suddenly comes upon a definition of its square in terms of other parameters with no discussion of its physical significance.

Even the better informed reader may object to a poor job on the part of the editor. He has not contributed to the ease of reading and understanding as he should have. The distinction between "may" and "can", for example, has disappeared. Hyphens do not connect the parts of compound modifiers in order to make quickly recognizable such distinctions as that between "fast reactor control" and "fast-reactor control". His hyphens stand instead where they don't belong as in "slowly-varying". But these are quibbles to most physicists, who will not mind re-reading many of the sentences in a short book to see just what they mean.

Let us differ, then, with the man who wrote the jacket blurb and thinks that this is "a logical and straightforward presentation of theory". It is rather an adventure into the presentation of material that is newer and more advanced than is to be found in most of the existing texts. It is concise rather than logical. Explanations and derivations have been omitted or abbreviated to make room for a wealth of material. The man who is designing reactors, however, will find at his fingertips the numbers, formulas, and concepts of his business in a compact package.

**Proceedings of Symp. on Astronomical Optics and Related Subjects** (U. of Manchester, Apr. 1955). Edited by Zdeněk Kopal. 428 pp. (North-Holland, Holland) Interscience Publishers, Inc., New York, 1956. $12.50. *Reviewed by V. Twersky, Sylvania Electronic Defense Laboratory.*

The forty-six papers of this volume and the historical introduction by the editor are essentially the proceedings of a symposium held at the University of Manchester, April 19–22, 1955.

The first chapter consists of five papers on information theory and optics. These include general extensions of the theory to spatially extended "messages", as well as specific problems. For example, Gabor's work indicates that broadening the diffraction pattern of a double star improves the accuracy of measuring the separation at the expense of position: "spoiling the instrument" is an aid in collecting additional information on partially known objects.

The ten papers on optical images and diffraction of Chapter 2 range from Linfoot's paper on optical image assessment to Spencer's survey of radio antennas. Wolf's survey of partially coherent fields is the first of the four papers on interferometry and coherence problems of the following chapter. Chapter 4 contains seven papers dealing primarily with photo-electronic devices for obtaining pictures of star fields and for recording very faint spectra; these devices may lead to increased sensitivity (so