Books

Digital Computer Programming. By D. D. McCracken. 253 pp. John Wiley & Sons, Inc., New York, 1957. $7.75. **Mathematics and Computers.** By George R. Stibitz and Jules A. Larrivee. 228 pp. McGraw-Hill Book Co., Inc., New York, 1957. $5.00. *Reviewed by Philip M. Morse, Massachusetts Institute of Technology.*

Most of the books published on computers, to date, have been descriptions of how computers operate, rather than on how to use computers. They are analogous to descriptions of the mechanical construction of an automobile. Such descriptions are useful to a person who wishes to drive a car, or use a computer, but they leave many things out which are necessary for the driver to know. A person driving a car needs to know the traffic laws and something about the art of driving, as well as the dynamical properties of the 200-odd horses he is supposed to be controlling. Similarly, the person wishing to use a modern high-speed computer should know roughly how the machine works but, more important for him, he must know how to program his problem so it can be put on the machine, and what to expect in the way of results.

Unfortunately, computing machines are not so standardized, in regard to operation, as are automobiles. Even digital machines of different makes have important differences in programming procedures and in what they can and cannot do easily. Consequently, to use a given computer effectively one must learn its particular language of command and its peculiarities of behavior. In the past three years, however, the newer machines have become much more standardized, so that now a person knowing how to program for an IBM 704, for example, can learn to use another digital computer, such as a Univac, fairly quickly. In other words, it is now possible to issue "driver's manuals" for digital computers, which will explain the general methods of putting a problem on any machine in enough detail so that the prospective user can, in a short time, use any of the large machines now being produced. To change metaphors, a machine code is a rudimentary language; present machines use about the same grammar and syntax; differences in vocabulary can be quickly learned.

This book of McCracken's is the first such "driver's manual" to have come to the attention of this reviewer. It describes the procedures of programming, coding, and checkout, which must be gone through to translate the equations of numerical analysis, representing the problem to be solved, into the specific coded instructions which tell the machine how to perform the numerical analysis. The various steps are illustrated, using a code for an imaginary machine, dubbed a TYDAC (TYpical Digital Automatic Computer), which has "grammar and syntax" similar to most present computers, though it is, of course, not identical with any one of them. (It is this reviewer's impression that TYDAC is somewhat closer to the properties of the IBM 704 than to Univac, but the differences are not serious.)

The process of laying out the program, of the various coding procedures, the use of loops or cycles, of subroutines, and of floating decimal point and the input-output methods are discussed and illustrated. The use of magnetic tape, methods of program checkout, and various specialized and generalized programming techniques are gone into.

Whether we like it or not, high-speed computers are now as necessary research tools for the theoretical physicist as are cyclotrons for the experimental physicist. Most of us should know enough about programming to ensure that our problems are solved effectively. With books like this one of McCracken's, it will not be difficult for us to do so. The learning of "computer language" is a much simpler task than the learning of German or Russian.

In contrast to *Digital Computer Programming*, reviewed above, *Mathematics and Computers* is a description of machines, their development and general properties, not a "driver's manual". It is written for the layman and not for the prospective user of a machine.

Within its self-imposed limits, the book is clearly and logically written. It begins with a well-written discussion of the difference between pure and applied mathematics, and what is meant by "solving a problem". It then goes on to a history of the development of analogue and digital computers, a very elementary discussion of the logical design of digital computers and of the various types of analogue machines, and finishes with chapters on Monte Carlo methods, computer errors, and special applications.

This is a useful book for the college freshman or for the nonprofessional who wishes to get a rough idea as to what computers do and how they came to be. It will not be of much help to physicists who want to learn how to put a problem on a computer. But then, it was intended for the former, not the latter.

Low Temperature Physics II. Vol. 15 of Handbuch der Physik. Edited by S. Flügge. 477 pp. Springer-Verlag, Berlin, Germany, 1956. DM 112.00 (if part of series DM 89.60). *Reviewed by Louis D. Roberts, Oak Ridge National Laboratory.*

In the past ten to fifteen years, the techniques of physical measurement in the temperature region 4.2 – 1°K and below have been much simplified, and correspondingly have been adopted in an increasing diversity of investigations. The growth is such that in another decade low-temperature physics may be so inclusive as

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.