clear. The study of man differs from the study of physical phenomena in that the aim must not be manipulation but self-control. It is concerned not merely with knowledge, which is external, but with "understanding" as well. But is this altogether capable of being organized scientifically, indeed can it ever be so organized? Or, as a good many of the most able physical scientists today would probably surmise, are these areas of understanding and of self-control essentially areas of experience rather than of knowledge —that is, are they the domains of poet, artist, and saint rather than of researcher and professor? Matson does not raise these questions, but he makes it clear that these are the real issues and that so far no scientific approach has been found to the understanding and self-control of man, of his society, his behavior, and his values.

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Crystallography

Crystallography and Crystal Perfection. Proceedings of a symposium held in Madras, 14–18 January 1963, and organized by the University of Madras. G. N. Ramachandran, Ed. Academic Press, New York, 1963. x + 374 pp. $12.

It is obvious that the editor must have been hard put to find a suitable title: a glance at this book will show the magnitude of his predicament. Thirty mostly unrelated papers, by 55 authors representing about 30 institutions, were presented at a symposium on crystallography. (Another symposium—on protein structure—held at the same time, is presented in a companion volume.) These activities testify to the vitality of Indian crystallographers: about one-third of the contributions come from Indian research centers. The list of authors contains many names famous among crystallographers. In Section 1, Phase Problem, are papers by M. J. Buerger (image functions), Dan McLachlan, Jr., (optical devices for phase determination), G. N. Ramachandran and R. Ramachandra Ayyar (Fourier series for isomorphous crystals and anomalous dispersion), I. Nitta *et al.* (sign determination by statistical method), W. Hoppe *et al.* (the "shift product method" and structure-factor signs by Sayre's relations), S. Raman and W. N. Lipscomb (the Patterson approach), R. Srinivasan *et al.* (tests for isomorphism), and W. Cochran *et al.* (EDSAC program).

Section 2, Crystal Perfection, contains papers by G. Borrmann, L. V. Azároff, S. Chandrasekhar, R. Parthasarathy *et al.*, M. Renninger, and N. Kato, who contributes a unified treatment entitled "Wave-optical theory of diffraction in single crystals." Section 3, Crystal Disorder, contains four papers: H. Jagodzinski (disorder phenomena), I. Waller (effect of impurities on neutron scattering), P. Krishna and A. R. Verma (silicon-carbon polytypes), J. I. Langford and A. J. C. Wilson (variance and line broadening). In section 4, Anomalous Dispersion, J. M. Bijvoet *et al.* take a second look at sodium chlorate and sodium bromate antipodes of the same sign and find that they have opposite configurations; D. Dale, D. C. Hodgkin, and K. Venkatesan report the structure of Factor V 1a, which is an aquocyanide of natural vitamin B_{12} nucleus (containing Co); S. N. Vaidya and S. Ramaseshan comment on procedures used in the Bijvoet method. A paper on electron diffraction by S. Miyake *et al.* and two papers on neutron diffraction, by J. Shankar and V. M. Padmanabhan and by P. K. Iyengar (from the Atomic Energy Establishment at Trombay, India), constitute section 5.

The Wooster family describe their automatic x-ray diffractometer in section 6, Instrumentation; an integrating Weissenberg camera for low and high temperatures is also described, by A. K. Singh and S. Ramaseshan, in this section. Four miscellaneous papers are collected in a last section: elasticity of cubic crystals (by J. Laval); infrared and Raman spectra of glycine and its addition compounds (R. S. Krishnan and P. S. Narayanan); infrared absorption in ionic crystals (S. S. Mitra); antitensors of first and second kinds and their symmetries—ten groups for each kind (I. S. Zheludev). Each contribution is accompanied by a summary of the oral discussion that followed it. A 5-page index lists the names of over 400 authors whose works are cited. The volume is beautifully printed, illustrated, and bound. A crystallographer can hardly afford not to buy it.

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Russian Translation

The Theory of Mathematical Machines. Yu. Ya. Bazilevskii, Ed. Translated from the Russian edition (Moscow, 1958) by C. A. Hoare. J. M. Jackson, Ed. Pergamon, London; Macmillan, New York, 1963. xii + 264 pp. Illus. $10.

This is a translation of a book published in Russia in 1958. It is comprised of a preface and eight papers. The principal contributors are the editor who wrote two papers and participated in one other, I. Ya. Akushskii who wrote two papers, and Yu. A. Schreider who wrote one paper and shared one with the editor. As is customary with symposia, the papers are to some extent expository. It is my impression that the last four papers are mainly of the expository category. The first four, however, have more claims to originality.

In the preface the editor presents an outline of the theory of mathematical machines. According to him this theory consists of three parts. The first part consists of the study of the logical structure of mathematical machines. The second is the theory of programming, and the third is the study of the means of physical implementation of a given logical structure. He says that "The first and second parts may be considered as a branch of cybernetics which deals with methods of implementing algorisms as distinct from such branches as, for instance, mathematical linguistics and biology, which are concerned with the creation or the discovery of algorisms. The content of the third part lies outside the framework of cybernetics." This statement, granted accurate translation, is rather stunning, but perhaps this is because I have been much more concerned with numerical methods than with logic. It seems to me that an almost automatic consequence of implementing algorisms is the creation of new ones. Moreover, in this we see that the interpretation given cybernetics in Russia is broader than that accorded it in the United States.

The distinctive features of the first paper, "The theory of sequential logical functions," by Bazilevskii, seem to be in the methods of introducing sequences (that is, time lags and feedback) and in the study of reductions of sequential logical functions through use of periodicities as well as other devices. Although I have not attempted to construct a symbolism for a comparable purpose, I find the choices made rather unwieldly for purposes of initial study and use. Using $\dot{x}$ for the *value* of a logical variable x obscures the fact that a function is involved. Similarly, the negation of x, written $\bar{x}$ has little to recommend it.

Instead of using the symbol "Λ", which has already been introduced for logical conjunction, for the conjunction of two words of the same length, the symbol "∩" is used. This change, while justifiable on grounds of rigor, is merely a nuisance here since "∩" will be used for set intersection, also in the usual nonrigorous fashion. For the most part the choice of symbols does not originate with Bazilevskii of course. It is illuminating to see the inconsistencies that arise in notational usage, even in a logical presentation. Thus, $\dot{X}$ is used to indicate the value of a word X which should be a finite chain comprised of 0's and 1's; this is immediately interpreted as a integer expressed in binary form, but X is not an integer without some rather careful discussion since initial 0's then must be inserted. There is no logical reason for ignoring 0's at the beginning of a word.

Aside from these niceties, Bazilevskii makes a contribution in considering problems related to mathematical machines. His discussion of the solution of equations (section 6) sheds some light on the objectives and methods of analyzing a sequential function which describes the behavior of some discrete system and which is generally given in the form of a system of implicit equations. The relationship between periodic functions and stationary states is discussed.

In his second paper, Bazilevskii proceeds to apply some of the formalism developed in the first to the structure of memory systems. Here he introduces weight functions which may assign to a word X other numerical values than the binary number indicated above. He uses his derived Boolean expressions to obtain circuits of various types of accumulators.

The paper entitled "Some general questions on programming," by I. Ya. Akushskii, contains an important contribution to the orderly treatment of program operators. In his work during the preceding several years, Akushskii found that he could obtain general facts about programming additive machines by treating the machine operations as linear transformations in n-dimensional space. This changes these problems to a discussion of the matrices of program operators. I found his paper most interesting.

In the fourth paper, "Programming and recursive functions," Yu. A. Shreider discusses a systematic approach to forming programs that contain cycles. His method is illustrated for a three-address system. In particular, he records a set of instructions that calculates the Gauss-Seidel solution of a linear equation system. The objectives are similar to those of Algol and Fortran, both of which appeared after this paper was written.

The remaining papers are rather routine discussions of various topics. The efficiency of computers, a Monte Carlo method for solving linear equations, the efficient number of addresses per word, and multiregisters in arithmetical operations indicate the topics treated.

With respect to the translation itself, I encountered no particular difficulties. In one place, "not" seems to have been replaced by "to"—the statement reads as follows: "The field of application of such mathematical methods need *to* be confined solely to programming" (p. 86). On page 26, in Eq. 5.1, the first two expressions, linked by an identity symbol, are, as far as I can tell, completely identical.

The lag between the original publication and the publication of the translation (some 5 years) appreciably decreased the value of this book. In contrast, the book by R. C. Richards, *Arithmetical Operations in Digital Computers* appeared in Russian translation in 1957, 2 years after its original publication. Strangely, the contributors to this volume are identified by name only. Surely a little information about their locations and positions would be useful, but this is not provided in the editor's preface or in footnotes.

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Mathematical Information

How To Find Out in Mathematics. John E. Pemberton. Pergamon, London; Macmillan, New York, 1963. x + 158 pp. Paper, $2.45.

This is volume 2 in the "Libraries and Technical Information Division" series. It is "a guide to sources of mathematical information arranged according to the Dewey Decimal Classification." Besides being a valuable reference work, this carefully organized book affords an interesting insight into some of the extensive ramifications of mathematics in the modern world.

Chapter 1, "Careers for mathematicians," gives information of practical value on opportunities in teaching, research, statistics, operational research, and actuarial science.

The next six chapters are devoted to the organization of mathematical information, with the Dewey Decimal Classification used as a guiding principle. Specific mention is made of the most useful dictionaries, encyclopedias, periodicals, and journals devoted to abstracting or reviewing. Mathematical societies are listed and mathematical education discussed. Sources of further information are cited for mathematical tables.

Chapters 9 and 10 treat mathematical books—part 1, "Bibliographies," and part 2, "Evaluation and acquisition."

By way of specific subject matter, separate chapters are devoted to probability and statistics and to operational research. There are three appendices: (i) Sources of Russian Mathematical Information; (ii) Mathematics and the Government (United States and United Kingdom); and (iii) Actuarial Science.

The emphasis throughout is on practical applications, professional uses of mathematics, and utilization of library facilities. Much of the information is at a level appropriate to undergraduate students, and a few exercises are included.

The book, which is both thorough and as up-to-date as possible, includes a number of references to items which have appeared in the last 2 years.

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Organic Chemistry

Reactions of Organic Compounds. A textbook for the advanced student. Reynold C. Fuson. Wiley, New York, 1962. viii + 765 pp. Illus. $12.95.

The principal topic of this book is, as the title indicates, the reactions of organic compounds. Mechanisms receive frequent mention but are not of primary concern. The amount of in-