volume of this series. It should be read by all persons aspiring to become experts in the fields of numerical analysis and computer programming, and it certainly can be studied with profit by students in both pure mathematics and statistics.

J. W. W.

1. DONALD E. KNUTH, *The Art of Computer Programming*, Vol. I: *Fundamental Algorithms*, Addison-Wesley Publishing Co., Reading, Mass., 1968. (See *Math. Comp.*, v. 23, 1969, pp. 447–450, RMT **18.**)

27[3].—GEORGE E. FORSYTHE & CLEVE B. MOLER, *Computer Solution of Linear Algebraic Systems*, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1967, xi + 148 pp., 24 cm. Price $6.75.

This is an excellent brief introduction to the subject, written by two experts with considerable experience. The senior author, in fact, is one of the pioneers.

Very little is presupposed on the part of the reader. The necessary theoretical background is developed in an elementary fashion, and detailed algorithms are spelled out and analyzed. For the beginner, and even for those who already have some experience, this book is a must.

A. S. H.

28[3, 10].—MORRIS NEWMAN, *Matrix Representations of Groups*, Applied Mathematics Series No. 60, National Bureau of Standards, Washington, D. C., 1968, 79 pp., 26 cm. Price $0.60.

This monograph develops the theory of representations of groups in terms of finite dimensional matrices over the field of complex numbers, with strong emphasis on the representation theory of finite groups. It avoids algebraic machinery outside of matrix theory as far as possible, trying successfully to give proofs which are both elementary and simple. Appendices deal with the elements of the theory of algebraic numbers (needed, e.g., for proving the solvability of groups whose order is divisible by not more than two distinct prime numbers) and specifically with the roots of unity. An interesting proof of the irreducibility of the cyclotomic polynomials is included.

Except for the monograph by Martin Burrow [*Representation Theory of Finite Groups*, 185 pp., Academic Press, New York, 1965] (which goes farther and develops and uses more advanced algebraic tools), there seems to exist no book of comparable size in English which gives the same amount of information; the book by Curtis and Reiner [*Representation Theory of Finite Groups and Associative Algebras*, 685 pp., Interscience, New York, 1962] is much larger, and the book by Marshall Hall [*The Theory of Groups*, 434 pp., Macmillan, New York, 1959], which contains representation theory as a chapter, covers many other parts of group theory as well.

There is no doubt that the present monograph will be useful for many purposes and to many readers. In particular, the explicit construction of a full set of irreducible representations for some finite groups may be welcome to many users.

The reviewer found the book very clear locally, but less so globally. It follows, of course, from the proved results, that all finite dimensional representations of a finite group are equivalent to a matrix representation which is composed in an obvious manner of a finite number of irreducible representations, and that a knowledge of the character function of any representation describes its composition completely. But statements of this and of a similar type (e.g., concerning the importance of the regular representation) which could serve as landmarks for the reader, in what amounts to a very wide range of facts, are not, or certainly not conspicuously, displayed.

There are, of course, the nearly unavoidable small inaccuracies. Theorem 12, p. 68 uses the term "algebraically closed" for the ring of algebraic integers—whereas not even all linear equations with coefficients in this ring have a solution that is in the ring.

Also, on p. 4, it would be better to say that there are groups without finite dimensional representations (in spite of the author's definition of a representation at the top of p. 4 which excludes infinite dimensional representations if n is tacitly assumed to be finite). After all, there exists a large and growing literature on infinite dimensional representations of some groups. On p. 12, a reference [G. Higman, B. H. Neumann, H. Neumann, *J. London Math. Soc.*, v. 24, 1949, pp. 247–254] could be given for the construction of infinite groups with two conjugacy classes.

Finally, there are some questions of method. In proving Theorem 3, p. 64, the author refers to van der Waerden for the theory of symmetric functions. But the proof given in van der Waerden for the same theorem just uses a little linear algebra—and would have fitted nicely into the text. Also, it is not clear to the reviewer why the author, after abstaining from using ideals (and, e.g., Wedderburn's Theorem) in the main part of the text, proves the unique factorization into prime ideals for the integers of algebraic number fields in the Appendix.

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29[3, 12].—T. J. DEKKER & W. HOFFMAN, *ALGOL* 60 *Procedures in Numerical Algebra*, *Part* II, Mathematical Centre Tracts 23, Mathematisch Centrum, Amsterdam, 1968, 95 pp., 24 cm. Price $3.00.

The authors present the programs which they have developed at the Mathematical Center in Amsterdam for calculating eigenvalues and eigenvectors of real matrices which may be stored in high speed memory. Their procedures make use of the basic subroutines for matrix and vector operations which the authors presented in Part I.

This is an excellent collection of programs developed with understanding and loving care, fully comparable with the Handbook series of Numerische Mathematik. Documentation is thorough. To each page of code, there is at least a page of description. However, this book does not claim to be a textbook on these numerical methods. Familiarity with the subject matter is assumed in the descriptions, whose purpose is to present the all important programming details which can make or break a procedure.

Each chapter begins with a survey of its subdivisions. Each subdivision corresponds to a particular procedure, explains the numerical method and gives the necessary details.

The first chapter (Chapter 23 of the series) concerns symmetric matrices. These are reduced to tridiagonal form by Householder's method. The pth step introduces