

presenting so much criticism on special topics, the authors really owe the reader some sort of general tying together of the pieces.

It is customary in these reviews to give a list of typographical errors as evidence of the conscientiousness of the reviewer. Let it be reported therefore that on page 315, line 2, the authors inadvertently toss a coil instead of a coin.

For our own concluding remark we return to our initial observation. The authors have made available and understandable a great mass of interesting material in a new field, an achievement that will surely earn them the admiration and gratitude of all who read their book.

DAVID GALE

*Variational methods for eigenvalue problems.* By S. H. Gould. Mathematical Expositions, no. 10, University of Toronto Press, Toronto, 1957. 14+179 pp. \$8.75.

Until the publication of this book there had been no monograph at all on the study of variational eigenvalue problems, and it has always been hard for the student to get a suitable introduction to the subject. Hitherto, he has had to rely on expositions having the character of an engineering textbook and these have always been mathematically unsatisfactory.

In conformity with the other books of the Toronto series, the author does not presuppose much mathematical knowledge on the part of the reader and gives lengthy and detailed explanations whenever they seem desirable. The nature of his subject, however, compels him to make use of the methods and fundamental concepts of Lebesgue integration and of the theory of linear transformations in Hilbert space, and it is therefore necessary for him to develop parts of these theories in very little space. These brief developments are satisfactory for the purpose of the book, but are of necessity incomplete.

In the introductory chapters, the author considers eigenvalue problems in finite dimensional space using such problems as that of the vibrating string as examples. The equivalence between the eigenvalue problem and the variational problem is carefully established and the Monotony principle on which the Rayleigh-Ritz and Weinstein methods depend is explained in detail. It is now necessary to develop the theory of Lebesgue integration and to construct the space  $L^2$ . The classical eigenvalue problems for membranes, plates, and rods are considered in a further chapter and another describes most of the Weinstein method in its original form as applied to the problem of the

vibrations of a clamped plate, a numerical example being given as an illustration. The author next develops what he needs of the theory of completely continuous operators on a Hilbert space and the spectral theorem for self-adjoint operators of that class. A further chapter is devoted to the Weinstein-Aronszajn method of approximating eigenvalues of completely continuous self-adjoint operators, the passage from the spectrum of one intermediary problem to the next being given in some detail. A short chapter on the problem of the vibrating plate illustrates the method. The book ends with a rather difficult chapter on the application of the method to general differential problems.

Although no special preparation is needed for the reading of the book, a mediocre student will find it quite difficult. He is required to absorb the fundamental concepts of the theory of Lebesgue integration, Hilbert spaces, completely continuous operators, Hilbert-Schmidt operators, reproducing kernels, functional and pseudo-functional completions, and systems of stable and unstable boundary conditions for differential problems. It is an ideal book to put in the hands of the graduate student whose interest in applied mathematics has led him to believe that mathematics itself (i.e. real variables, linear spaces etc.) is of no use to him. Besides providing an excellent introduction to the subject at the level where such an introduction is most needed, the book will also be useful as a readable survey of the study of eigenvalue problems for all who are unfamiliar with the subject.

Since this is a first printing, there are a number of rather obvious misprints which will not impede the reader; at two or three places in the text there are certain oversights in the arguments themselves which may delay a student somewhat, but in no case are these very serious.

WILLIAM F. DONOGHUE, JR.

*Numerical analysis.* By K. S. Kunz. New York, McGraw-Hill, 1957. 15+381 pp. \$8.00.

This fine text book should be useful in a first course in numerical analysis given to students with backgrounds of calculus and elementary differential equations.

The first seven chapters cover the ABC's: Finite Differences, Interpolation, Differentiation and Integration, Roots of Equations. Included here is an interesting and useful chapter on summation of series, Euler's transformation, and various summation formulae. Then follow several long chapters devoted principally to three topics: