3. Marvin Marcus, "The use of multilinear algebra for proving matrix inequalities," pp. 61–80.
4. A. M. Ostrowski, "Positive matrices and functional analysis," pp. 81–101.
5. H. J. Ryser, "Matrices of zeros and ones in combinatorial mathematics," pp. 103–124.
6. Olga Taussky, "On the variation of the characteristic roots of a finite matrix under various changes of its elements," pp. 125–138.

Briefly, each author makes a penetrating study of a particular facet of matrix theory, and each author unifies and summarizes the important results in his area. This book is, without question, a very valuable collection of results and references in modern matrix theory, and the editor, Hans Schneider, is to be congratulated for his successful efforts in bringing together such distinguished researchers and for editing the final results.

R. S. V.

78[G, X].—GERHARD SCHRÖDER, *Über die Konvergenz einiger Jacobi-Verfahren zur Bestimmung der Eigenwerte symmetrischer Matrizen*, Forschungsberichte des Landes Nordrhein-Westfalen, Nr. 1291, Westdeutscher Verlag, Opladen, 1964, 59 pp., 23 cm. Price DM 58.50 (paperback).

As the title implies, this report deals with the convergence of Jacobi methods for the determination of the eigenvalues (and eigenvectors) of real symmetric matrices. Specific methods considered are the classical Jacobi method, the cyclic-Jacobi method, and the threshold-cyclic-Jacobi method.

For a number of cyclic methods a new proof of convergence is given which indicates quadratic convergence for a matrix with distinct eigenvalues. In the case of multiple and close eigenvalues, the classical Jacobi method and the cyclic-threshold-Jacobi method are examined. It is shown, for these methods, that convergence is improved for matrices with multiple eigenvalues. Close eigenvalues also improve the convergence.

Some numerical examples are discussed. For matrices of low order, high-accuracy computations were performed and the results obtained confirm the theoretical results about the rates of convergence of the methods employed.

For matrices of higher order, computations were performed with ordinary accuracy. Results obtained permit a comparison of the methods, with regard to speed and accuracy, and thus permit an evaluation of the methods for the practical determination of all eigenvalues and eigenvectors of a real symmetric matrix.

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79[K, X].—ROBERT M. FANO, *Transmission of Information, A Statistical Theory of Communictions*, The Technology Press, M.I.T., and John Wiley & Sons, Inc., New York, New York, 1961, 389 pp., 24 cm. Price $7.50.

Professor Fano's valuable textbook on modern information theory (for, certainly, it is not a research monograph) is the considered outgrowth of nearly ten years' effort in teaching the subject at M.I.T. and of associating with the men who founded the physico-mathematical theory—notably, C. E. Shannon, N. Wiener, A. Feinstein, P. Elias, and J. M. Wozencraft. He follows Shannon's School [1], [2], [3], [4], [5], with its emphasis on reliable communication in the presence of noise, rather than Wiener's School [6], [7], [8], with its emphasis on the theory of extrapolation and prediction. Since the book is directed to graduate-level engineers, there is no pretension to the full rigor available in other, more mathematical, treatises, such as those by Khinchin [2], Feinstein [3], and Wolfowitz [4]. Frequently, the author uses refreshing physical insights to motivate the careful proofs of theorems.

The nine chapters of the work, which is reproduced by photo-offset, include such basic topics as: "a measure of information," where the functional form of the entropy function is obtained by using a geometrically oriented proof, in distinction to the arithmetical argument given in Feinstein [3], which uses the unique factorization into prime numbers; "the optimum encoding procedure of D. Huffman"; "the weak and strong laws of large numbers"; "the Sampling Theorem"; "Shannon's Coding Theorem and its weak converse" (Wolfowitz' results [4] are not given); and "various estimates for multinomial distributions" (previously unpublished results from Shannon's 1956 Seminar on Information Theory). Most results are stated for finite probability spaces, and Lebesgue integration is completely ignored even in the continuous cases.

The book terminates with a number of well-chosen problems, which will challenge most first-year graduate students in engineering. Further, it contains a storehouse of inequalities to be generalized.

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1. C. E. SHANNON, "A mathematical theory of communication," *Bell System Tech. J.*, v. 27, 1948, pp. 379 and 623.
2. A. I. KHINCHIN, *Mathematical Foundations of Information Theory*, Dover, New York, 1957.
3. A. FEINSTEIN, *Foundations of Information Theory*, McGraw-Hill, New York, 1957.
4. J. WOLFOWITZ, *Coding Theorems of Information Theory*, new edition, Springer-Verlag, Berlin, 1964.
5. J. M. WOZENCRAFT & B. REIFFEN, *Sequential Decoding*, The M.I.T. Press and Wiley, New York, 1961.
6. N. WIENER, *Extrapolation, Interpolation, and Smoothing of Stationary Time Series*, The M.I.T. Press and Wiley, New York, 1948.
7. N. WIENER, *Nonlinear Problems in Random Theory*, The M.I.T. Press and Wiley, New York, 1958.
8. Y. W. LEE, *Statistical Theory of Communication*, Wiley, New York, 1960.

80[L].—ROBERT SPIRA, *Coefficients for the Riemann-Siegel Formula*, Mathematics Research Center, United States Army, Madison, Wisconsin, ms. of 4 typewritten pages, $8\frac{1}{2} \times 11$ in., deposited in UMT file.

The first eight nonzero coefficients in the power-series expansion of

$$\phi(z) = \sec \pi z \sin \pi\{(1 - 4z^2)/8\}$$

are given (multiplied by a factorial) in the form of polynomials in π with integer coefficients, multiplying the numbers $\cos \pi/8$ and $\sin \pi/8$. Numerical values of these coefficients to 10D and 20D, respectively, have been given by Lehmer [1] and