

those techniques which are directly applicable to computers. Thus an introductory chapter is devoted to computers (including a brief description of FORTRAN), and in two succeeding chapters the necessary concepts of linear algebra are developed. The remainder of the book emphasizes matrix methods along with various techniques of solution and can best be described by simply listing the chapter headings: Computers—Fundamental Concepts, Structures—Fundamental Concepts, Characteristics of Structures—Stiffness and Flexibility, Determinants and Matrices, Solution of Linear Equations, Energy Concepts in Structures, Transformation of Information in Structures, The Flexibility Method, The Stiffness Method, Analysis by Substructures and by Recursion, Analysis by Iteration, Analysis of Plates and Shells—Introduction. Each chapter contains a selection of problems with answers given at the back of the text. The book is clearly written, and can be recommended for use in a computer-oriented course in structural analysis.

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97[Q].—MILTON P. JARNAGIN, JR., *Expansions in Elliptic Motion*, constituting Volume XVIII of *Astronomical Papers prepared for the use of the American Ephemeris and Nautical Almanac*, U. S. Government Printing Office, Washington, D. C., 1965, xxxvi + 659 pp., 29 cm. Price \$4.50 (paperbound).

This volume is, in effect, a repetition and extension of Cayley's classical tables [1], giving the literal expansions as harmonic series, in the mean anomaly, of such functions as $(r/a)^n \exp(imf)$, $\log(r/a)$, and the equation of the center. These expansions are carried to the 20th power of the eccentricity, and all the numerical coefficients are rational fractions.

The Introduction is a model both of clarity of exposition and of probity in the care with which this large computing project was planned and programmed. There is no evidence of any hammer-and-tongs approach, even though the most powerful electronic computer of its day, the NORC, was available for the work, performed at irregular intervals in 1961 and 1962.

For the record, the Introduction should have included an explanation of the printing process. Both for reliability and economy, the computer output was recorded on microfilm by means of the NORC cathode ray tube. Judicious programming provided a compact, self-explanatory format. Owing to the extremely high reliability of the NORC, it may be assumed that probably not a single digit in the 659 pages of tables is in error. Unfortunately (and as a sad commentary on these times) the review copy has 16 pages of one whole signature completely illegible, because of careless printing-press workmanship.

The personnel of the Naval Weapons Laboratory and the Nautical Almanac Office are to be commended for their excellent collaboration in producing and publishing this volume. As a desk-type reference for workers in celestial mechanics, it may be expected to serve all needs during the second century of existence of Cayley's Tables.

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1. ARTHUR CAYLEY, "Tables of the developments of functions in the theory of elliptic motion," *Memoirs of the Royal Astronomical Society*, v. 29, 1861, pp. 191-306.

98[W].—MARTIN SHUBIK, Editor, *Essays in Mathematical Economics*, Princeton University Press, Princeton, N. J., 1967, xx + 475 pp., 24 cm. Price \$12.50.

This tribute to Oskar Morgenstern by his friends (both old and young) is remarkable for the high level of its articles. A brief biography and a bibliography of Morgenstern, which explains his impact on economics, are presented at the beginning of the volume. The twenty-seven technical articles are grouped into seven areas in which Morgenstern has worked and made his influence felt. To do more than merely list the titles and authors, would take up too much space:

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