90[G, X].—J. H. WILKINSON, *Rounding Errors in Algebraic Processes*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1964, vi + 161 p., 23 cm. Price $6.00.

The numerical solution of a mathematical problem, if not algebraic in form to begin with, requires at some point a reduction to algebraic form, implicitly or explicitly. The errors involved in the reduction are truncation errors, and these can be bounded by methods that are fairly standard and classical. The need for establishing rigorous bounds for the rounding errors that arise in the numerical evaluation of algebraic expressions, and in solving algebraic equations, became acute only with the advent of the electronic computer, and the techniques for doing so have developed only within the past two decades. In fact, the first systematic study to appear in the open literature was in the now classical paper by von Neumann and Goldstine, published in 1947, dealing with the inversion of positive-definite matrices by fixed-point computation. This paper led to a curious and fortuitous misconception on the part of many readers, that the positioning for size, which played so prominent a role, was essential for the control of error. It is indeed essential for the control of errors in the inversion of matrices that are not positive definite. For inverting matrices that are positive definite, it is essential only to permit the computations to be done in fixed point, and it has no bearing on the numerical stability of the process.

Probably no one has had more extensive practical experience than the author of this volume in computations of the type therein described and assessed, and no one has contributed more to an understanding of the subject. The appearance of the volume is, therefore, an event of major importance in the history of computing. There are three chapters. The first is on the fundamental arithmetic operations, both fixed-point and floating-point; the second on computations involving polynomials; and the third on matrix computations. This last includes both inversion and the evaluation of characteristic roots and vectors. Much progress has been made since the appearance of the paper by von Neumann and Goldstine. In particular, whereas in that paper it was suggested that the problem of solving $Ax = h$, with A other than positive definite, be replaced by $A^TAx = A^Th$, since the problem of finding error bounds seemed otherwise intractable, it turns out that the problem is in fact entirely manageable, and even fairly simple, when properly viewed.

This is not to imply that all the problems are trivial, or even completely solved. Faster machines and bigger memories will demand sharper results and more refined techniques. But much of the mystery is removed, and no practicing computationist can afford not to have this book within easy reach.

A. S. H.

91[H, M, W, X].—THOMAS L. SAATY & JOSEPH BRAM, *Nonlinear Mathematics*, McGraw-Hill Book Company, Inc., New York, 1964, xv + 381 p., 23 cm. Price $12.50.

This book consists of six chapters on various parts of analysis of contemporary interest where nonlinear functions and functionals enter in an essential fashion: linear and nonlinear transformations; nonlinear algebraic and transcendental functions; nonlinear optimization, nonlinear programming and systems of inequalities, nonlinear ordinary differential equations; introduction to automatic control; and linear and nonlinear prediction theory.

Of these chapters, only that on nonlinear optimization may be considered to be well enough organized and to contain enough material to represent a contribution to mathematical literature. The others show lack of understanding of the basic ideas and methods, lack of organization, or both. This is particularly true of the chapters on control theory and nonlinear differential equations.

The book is definitely not recommended for either students or teachers.

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92[K, O, X, Z].—JOHN PEMBERTON, *How to Find Out in Mathematics* (*A Guide to Sources of Mathematical Information Arranged According to the Dewey Decimal Classification*), Macmillan, New York, 1963, x + 158 p., 19 cm. Price $2.45 (paperbound).

This is a useful guide, not to the substance of mathematics, but more to its organizational set-up. It is written from the point of view of the librarian. The list of titles of the twelve chapters and three appendices that follows should indicate its scope:

Careers for Mathematicians; The Organization of Mathematical Information; Mathematical Dictionaries, Encyclopedias and Theses; Mathematical Periodicals and Abstracts; Mathematical Societies; Mathematical Education; Computers and Mathematical Tables; Mathematical History and Biography; Mathematical Books—Part 1: Bibliographies; Mathematical Books—Part 2: Evaluation and Acquisition; Probability and Statistics; Operational Research and Related Techniques; Sources of Russian Mathematical Information; Mathematics and the Government; Actuarial Science.

D. S.

93[I, M].—V. M. BELI͡AKOV, R. I. KRAVT͡SOVA & M. G. RAPPAPORT, *Tablit͡sy ellipt͡icheskikh integralov*, Tom I (*Tables of Elliptic Integrals*, v. I), Izdatel′stvo Akademie Nauk SSSR, Moscow, 1962, 656 p., 27 cm. Price 5 rubles 14 kopecks.

This is the third set of extensive tables of the elliptic integral of the third kind to appear within the last five years. The previous ones were prepared, respectively, by Selfridge and Maxfield [1] and by Paxton and Rollin [2].

In the present member of a two-volume set we find in Table I the values of

$$\Pi(n, k^2, \varphi) = \int_0^\varphi (1 + n \sin^2 \alpha)^{-1}(1 - k^2 \sin^2 \alpha)^{-1/2}\, d\alpha$$

to 7S for $-n = 0(0.05)0.85, 0.88(0.02)(0.94)(0.01)0.98(0.005)1$, $k^2 = 0(0.01)1$, and $\varphi = 0°(1°)90°$. Corresponding to $n = 0$, $\Pi(n, k^2, \varphi)$ reduces, of course, to $F(k^2, \varphi)$.

Table II gives $E(k^2, \varphi)$ to similar precision for the same range in k^2 and φ.

Approximations to 8D of $A_m(\varphi) = \int_0^\varphi \sin^{2m} \alpha\, d\alpha$ appear in Table III for $m = 1(1)10$

and $\varphi = 0°(10')90°$. These data were used in calculating the main table when $k^2 \leqq 0.7$ and $|n| \geqq 0.1$, by expanding the integral in powers of k^2, with coefficients involving $A_m(\varphi)$. When $k^2 \geqq 0.7$, the integral was expanded in powers of k'^2, and the coefficients depend on $R_m(\varphi) = \int_0^\varphi \tan^{2m} \alpha \sec \alpha \, d\alpha$, which is given in Table IV to 8D for $m = 1(1)8$, $\varphi = 0°(10')45°50'$.

Table V gives

$$R_0(\varphi) = \ln \tan \left(\frac{\varphi}{2} + \frac{\pi}{4}\right),$$

which is the inverse gudermannian (the equivalent of $\Pi(0, 1, \varphi)$ in the present notation), to 9D for $\varphi = 0°(1')5°43'$, and to 8S for $\varphi = 5°44'(1')89°59'$.

This volume closes with Table VI, listing $K(k^2)$ and $E(k^2)$ to 8S and $q(k^2)$ to 8D, for $k^2 = 0(0.001)1$.

The introductory text consists of four pages of definitions and explanatory remarks.

This reviewer has noted hand-corrections of typographical errors on a total of 21 pages in the copy he examined.

A spot check against corresponding entries in the Paxton-Rollin tables revealed discrepancies of at most a unit in the last decimal place. Direct comparison with the tables of Selfridge and Maxfield is not practicable because of the different subtabulation of k^2.

J. W. W.

1. R. G. Selfridge & J. E. Maxfield, *A Table of the Incomplete Elliptic Integral of the Third Kind*, Dover Publications, Inc., New York, 1959. (See *Math. Comp.*, v. 14, 1960, p. 302–304, RMT **65**.)

2. F. A. Paxton & J. E. Rollin, *Tables of the Incomplete Elliptic Integrals of the First and Third Kind*, Curtiss-Wright Corporation, Research Division, Quehanna, Pennsylvania, June 1959. (See *Math. Comp.*, v. 14, 1960, p. 209–210, RMT **33**.)

94[L, M].—L. N. Osipova & S. A. Tumarkin, *Tablitsy dlya rascheta toroobraznykh obolochek* (*Tables for the Calculation of Toroidal Shells*), Akad. Nauk SSSR, Moscow, 1963, xxvi + 94 p., 26 cm. Price 81 kopecks.

This publication of the Computational Center of the Academy of Sciences of the USSR includes tables computed on the electronic computer STRELA. The main table (pages 2–83) relates to the function

$$u = \pm \left| \frac{3}{2} \int_0^\theta \sqrt{\frac{|\sin \theta|}{1 + \alpha \sin \theta}} \, d\theta \right|^{2/3},$$

where $0 \leqq \alpha \leqq 1$, $-90° \leqq \theta \leqq 90°$, and u has the same sign as θ. Values of u are given to 5D for $\alpha = 0$, $\theta = 0(1°)90°$; $\alpha = 0.05(0.05)0.95$, $\theta = -90°(1°)90°$; $\alpha = 1$, $\theta = -70°(1°)90°$. For convenience in applications, ten related quantities (including $\partial u/\partial \theta$) are also tabulated. In the range of α from 0.05 through 0.95, there are four pages for each value of α.

Appendix 1 (pages 86–88) lists to 5D without differences the real and imaginary parts of $e_0(is)$, $e_1(is)$ and of their s-derivatives $e_0'(is)$, $e_1'(is)$ for $s = 0(0.05)6$. Here

$$e_0(is) = \int_0^\infty \exp\left(-\frac{1}{3}x^3 - isx\right) dx, \qquad e_1(is) = \int_0^\infty x^2 \exp\left(-\frac{1}{3}x^3 - isx\right) dx.$$

Appendix 2 (pages 90–91) lists to 6D without differences the real and imaginary parts of $h_1(is)$, $h_2(is)$ and of their s-derivatives $h_1'(is)$, $h_2'(is)$ for $s = 0(0.1)6$. Here h_1, h_2 are the same functions (related to the Airy integrals) as are tabulated for general complex arguments under the name of modified Hankel functions of order one-third in one of the Harvard volumes [1]. In the latter, however, $h_1'(iy)$, $h_2'(iy)$ denote derivatives with respect to iy (not y), so that the real and imaginary parts of the derivatives are interchanged, with one reversal of sign, compared with the Russian tables. Bearing this point in mind, all the values in Appendix 2 may be found (to two more decimals) in the Harvard volume; a single reading revealed no discrepancy. The Harvard values have to be picked from the top line ($x = 0$) of the Harvard table for each y, so that anyone computing with pure imaginary arguments only will find it convenient to have the values now set out at one opening.

In connection with the appendices, reference is made to earlier work (including tables) by Tumarkin and L. N. Nosova.

The introduction contains analytical details, a number of graphs of the various functions, and references. It also contains (page ix) a table of the integral of the real part of $e_0(is)$, namely

$$Q(s) = \int_0^s R[e_0(is)]\, ds,$$

to 4D without differences for $s = 0(0.1)8$.

A. F.

1. Harvard University Computation Laboratory, *Annals*, v. 2, *Tables of the Modified Hankel Functions of Order One-Third and of Their Derivatives*, Harvard University Press, Cambridge, Massachusetts, 1945. (See *MTAC*, v. 2, 1946, p. 176–177, RMT 335.)

95[L, M].—W. T. Pimbley & C. W. Nelson, *Table of Values of* $2\sqrt{x}F(\sqrt{x})$, IBM Engineering Publications Dept. No. PTP 773, 1964, Endicott, New York. Copy deposited in the UMT File.

Let $F(w)$ be Dawson's integral:

$$F(w) = e^{-w^2} \int_0^w e^{t^2}\, dt.$$

In connection with two different physical problems the authors had need of a table of $2\sqrt{x}F(\sqrt{x})$ and they have here computed two tables to 12D. Table 1 gives this function for $x = 0(0.1)9.9$ and Table 2 for $x = 1(1)100$. These were computed by known convergent and asymptotic series. A spot comparison with Rosser's 10D table of $F(w)$ [1] revealed no discrepancies.

A recent paper by Hummer [2] also discussed $F(w)$. In [3] the reviewer had occasion to investigate two functions of Ramanujan and Landau whose ratio, $r(x)/l(x)$, is the function given here with x replaced by $\log x$.

D. S.

1. J. Barkley Rosser, *Theory and Application of* $\int_0^z e^{-x^2}\, dx$ *and* $\int_0^z e^{-p^2y^2}\, dy \int_0^y e^{-x^2}\, dx$, Mapleton House, Brooklyn, New York, 1948, p. 190–191.

2. David G. Hummer, "Expansion of Dawson's function in a series of Chebyshev polynomials," *Math. Comp.*, v. 18, 1964, p. 317–319.

3. Daniel Shanks, "The second-order term in the asymptotic expansion of $B(x)$," *Math. Comp.*, v. 18, 1964, p. 79–80, 85–86.

96[P, X].—J. M. Alexander, et al., *Progress in Applied Mechanics*, The Macmillan Company, New York, 1963, xii + 384 p., 24 cm. Price $12.50.

This volume contains twenty-eight papers on applied mechanics, and is dedicated to Professor William Prager of Brown University on the occasion of his sixtieth birthday, May 23, 1963. The authors of the papers are colleagues, friends or former students of Professor Prager. The papers thus reflect Professor Prager's interests, and it is not surprising that most of them are on some phase of elasticity or plasticity.

It is impossible to give detailed reviews of each of the papers here. Those papers on subjects which the reviewer feels competent to judge are substantial contributions to the field. A list of titles and their authors is given below:

Fluid Dynamics

Studies of the Inviscid Boundary Layer of Magnetohydrodynamics. W. R. Sears & Y. Mori

On the Interaction of Solitary Waves. R E. Meyer

Numerical Methods

Extended Initial-Value Problems and Their Numerical Solution. H. J. Greenberg

Dynamics of Solids

Surface Waves Over a Slightly Curved Elastic Half-Space. G. H. Handelman

Non-Linear Stress-Wave Propagation in Metals. H. G. Hopkins

High Frequency Vibrations of Plated, Crystal Plates. R. D. Mindlin

Elementary Theory for the Vibration of a Beam of a Special Linear Viscoelastic Material. L. N. Persen

General Theorems of Elasticity

New Derivations of Some Elastic Extremum Principles. R. Hill

Extremum Principles in the Theory of Small Elastic Deformations Superposed on Large Elastic Deformations. R. T. Shield & R. L. Fosdick

Elastic Membranes and Shells

On the "Best" First-Order Linear Shell Theory. B. Budiansky & J. L. Sanders, Jr.

The Deformation of an Inflated Circular Cylindrical Membrane by a Uniform Radial Line Load. N. J. Hoff & W. Nachbar

A Spherical Shell Under Point Loads at Its Poles. W. T. Koiter

On the Equations for Finite Symmetrical Deflections of Thin Shells of Revolution. E. Reissner

Elastic Deformations of Thin Cylindrical Sheets. J. J. Stoker

Plasticity and Soil Mechanics

On the Limit Analysis of Hot Rolling. J. M. Alexander & H. Ford

An Experimental Study of Cylindrical Shells Under Ring Loading. H. H. Demir & D. C. Drucker

Instabilities of Plastic Solids in Sustained Flow. J. N. Goodier

The Kinematics of Soils. R. M. Haythornthwaite

On the Soap-Film Sand-Hill Analogy for Elastic-Plastic Torsion. P. G. Hodge, Jr.

STRUCTURAL DESIGN

The Calculation of Steel Frames. J. Heyman

Optimum Design of Beams and Frames in Reinforced Concrete. Ch. Massonnet and M. Save

TIME DEPENDENT BEHAVIOR (CREEP, VISCOELASTICITY)

Influence of Redistribution of Stress on Brittle Creep Rupture of Thick-Walled Tubes Under Internal Pressure. F. K. G. Odquist and J. Erikson

On the Equations of State for Creep. Y. N. Rabotnov

Some Limiting Cases of Non-Newtonian Fluids. H. Ziegler

On Critical States in Viscoelasticity. W. Olszak

On Uniqueness in Linear Viscoelasticity. E. T. Onat and S. Breuer

Thermo-Viscoelastic Stresses in a Sphere with an Ablating Cavity. T. G. Rogers & E. H. Lee

Uniqueness in the Theory of Thermo-Rheologically Simple Ablating Viscoelastic Solids. E. Sternberg and M. E. Gurtin

The volume represents an interesting and valuable collection. The title *Progress in Applied Mechanics* is well chosen.

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97[S, X].—R. COURANT & D. HILBERT, *Methods of Mathematical Physics*, volume II by R. COURANT, Interscience Publishers, New York, 1962, xxii + 830 p. Price $17.50.

The two volumes of Courant and Hilbert's *Methoden der mathematischen Physik* have been regarded, since their appearance, as standard source books for applied mathematicians. And this is the second volume of the English version, contributing to "breaking through the language barrier," so to speak.

The preface, by Professor Courant, explains the genesis of the book; this English version is said to have been in preparation ever since the appearance during the last war (1943) of the Interscience Publishers reprint of volume II of the German edition, under license of the United States Government. It also explains the dedication of the book to Kurt Otto Friedrichs as "a natural acknowledgment of a lasting scientific and personal friendship." The polycephalic character of the authorship of the book is also explained (one is reminded here of the skiing picture which was distributed along with many copies of Courant and Friedrichs' book, *Supersonic Flow and Shock Waves*, showing Courant leading a crowd of readily identifiable skiers down a slope, and the resulting shock wave): "The present publication would have been impossible without the sustained unselfish cooperation given to me by friends. Throughout all my career I have had the rare fortune to work with younger people who were successively my students, scientific companions and instructors. Many of them have long since attained high prominence and yet have continued their helpful attitude. Kurt O. Friedrichs and Fritz John, whose scientific association with me began more than thirty years ago, are still actively interested in this work on mathematical physics. . . . To the cooperation of Peter D. Lax and Louis Nirenberg I owe much more than can be expressed by quoting specific details.

Peter Ungar has greatly helped me with productive suggestions and criticisms. Also, Lipman Bers has rendered most valuable help and, moreover, has contributed an important appendix to Chapter IV. . . . Among younger assistants I must particularly mention Donald Ludwig whose active and spontaneous participation has led to a number of significant contributions."

It would be an impossibility to try to mention, even briefly, all the topics which are discussed within the covers of this large volume. Chapter I, entitled Introductory Remarks, describes basic concepts, problems and general lines of approach to their solution. One finds here, in particular, the Cauchy-Kowalewsky existence proof, for analytic solutions of the Cauchy problem, by the method of "majorants." There are two appendices to the chapter, the first on the equation of a minimal surface and the second on the relationship between systems of first-order equations and single differential equations of higher order. Chapter II, bearing the title General Theory of Partial Differential Equations of First Order, centers around the *im kleinen* equivalence of a first-order partial differential equation and a certain system of ordinary differential equations. The Hamilton-Jacobi theory, Hilbert's invariant integral, and contact transformations, are included. There are two appendices to the chapter, the first one on characteristic manifolds, and Haar's uniqueness proof, and the second on the theory of conservation laws, leading to not necessarily smooth, *im grossen* solutions. Chapter III carries the title Differential Equations of Higher Order, and opens with the normal forms for linear and quasi-linear differential operators of second order in two independent variables, followed by a classification of general equations, characteristics. An interesting section contains a lively enumeration and discussion of the chief typical problems of mathematical physics: initial-value problems (Cauchy), boundary-value problems (Dirichlet), mixed problems, Riemann's mapping problem, Plateau's problem for the equation of minimal surfaces, and the jet problem of plane hydrodynamics. It is to be noticed that the formulation of the jet, or Helmholtz problem, a problem whose solution was given by A. Weinstein, is improved over that in the German edition, while an extensive section (in the German edition) on minimal surfaces, a theory to which Courant himself has made outstanding contributions, has been omitted in the present edition. There are two appendices to the chapter, the first on S. L. Sobolev's lemma for estimating a function by means of L_2-bounds of its derivatives, and the second on the uniqueness theorem of Holmgren for analytic equations with arbitrary, not necessarily analytic, Cauchy data. Chapter IV, headed Potential Theory and Elliptic Differential Equations, begins with a rather systematic treatment of potential theory and concludes with a less elementary part, where one finds, among other subjects, Sommerfeld's radiation condition for the reduced wave equation, E. Hopf's maximum principle for elliptic equations, a priori estimates of Schauder, and the solution of elliptic differential equations by means of integral equations (E. E. Levi and D. Hilbert). There is an appendix on boundary-value problems for nonlinear differential equations in several variables, and a supplement (written by L. Bers) on function-theoretic aspects of the theory of elliptic partial differential equations, in particular, the theory of pseudoanalytic functions of L. Bers and I. N. Vekua. This supplement ends with a proof of the Schauder fixed-point theorem. The concluding two chapters are concerned with hyperbolic equations of wave propagation. Chapter V: Hyperbolic Differential

Equations in Two Independent Variables, starts with a review of the basic concept of characteristics, which is then applied to the treatment of the initial-value problems. Among other items, one finds: characteristics and normal forms for hyperbolic systems of first order in two variables; application to the dynamics of compressible fluids; domains of dependence, influence and determinacy; Riemann's method of solution; Cauchy's problem for quasi-linear systems, and for single hyperbolic equations of higher order; and discontinuities of solutions, shocks. There are two appendices to Chapter V, the first is devoted to the application of characteristics as coordinates (in particular, the transition from the hyperbolic to the elliptic case through complex domains, due to H. Lewy, P. Garabedian and H. M. Lieberstein), while the second appendix treats transient problems and the Heaviside operational calculus. Chapter VI: Hyperbolic Differential Equations in More than Two Independent Variables, deals primarily with Cauchy's problem for a single equation of arbitrary order, and with systems of such equations in several unknown functions. The first part of the chapter handles questions of uniqueness, existence, construction, and geometry of solutions, while the second part concentrates on the representation of solutions in terms of the given data, and related questions. In part I one finds: the geometry of characteristics for second- and higher-order operators; applications to hydrodynamics, crystal optics, and magnetohydrodynamics; propagation of discontinuities and Cauchy's problem; oscillatory initial values and asymptotic expansion of the solution; energy integrals and uniqueness for linear symmetric hyperbolic systems and for higher-order equations; and ends with the existence theorem, proved by means of energy inequalities, for symmetric hyperbolic systems. In part II, some of the topics covered are: Cauchy's problem for equations of second order with constant coefficients, the method of spherical means, the method of plane mean values, solution of Cauchy's problem as a linear functional of the data (R. Courant and P. D. Lax), ultrahyperbolic differential equations (Asgeirsson's mean-value theorem), transmission of signals and progressing waves, and Huyghens' principle. It is to be observed that the original chapter, in the German edition, on the classical wave equation in n dimensions, has been reviewed in the present edition, paralleling the recent work of A. Weinstein. The authors retain the original terminology of the German edition in referring to a certain equation as the Darboux equation, while today a great number of mathematicians refer to it as the Euler-Poisson-Darboux equation, in view of the fact that Darboux only considered the one space variable case, whereas Poisson has already considered this equation in three-dimensional space, in his famous investigation of spherical mean values in connection with the wave equation. There is a timely appendix to Chapter VI, dedicated to the theory of ideal functions (S. L. Sobolev) or distributions (L. Schwartz).

It would be easy, as in the case of any book, to mention interesting and important topics which have not been included in the presentation. However, the reader will find plenty to occupy him in this volume. And, as if that were not enough, he can still look forward to the third volume of the series, which is already announced on page one of the present book, as follows: "The present volume, essentially independent of the first, treats the theory of partial differential equations from the point of view of mathematical physics. A shorter third volume will be concerned with existence proofs and with the construction of solutions by finite-difference methods and other procedures."

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98[V, Z].—K. N. DODD, *Mathematics in Aeronautical Research*, Oxford University Press, New York, 1964, xiii + 130 p., 21 cm. Price $3.40.

Teachers of calculus and elementary differential equations frequently feel the need for fresh, up-to-date applications of the mathematics which they are presenting to the students. Many good textbooks either ignore applications altogether or give a rather bloodless treatment to a succession of stock problems. The present book is designed to supplement these texts by presenting a collection of real problems taken from aeronautical research.

The book was designed for use in the British school systems, but there should be no trouble in using it in first or second year college programs in the United States. The book could also be used by advanced high school students who have had some calculus and a smattering of differential equations.

The book has two strong points: (1) it is directed toward digital computing, and (2) the variety and novelty of the applications is excellent. The chapter titles illustrate these points. They are: 1. Mathematical Concepts, 2. Electronic Computers, 3. Air Composition in an Ascending Fuel Tank, 4. Atmospheric Scattering of a Searchlight Beam, 5. A Computer-Controlled Milling Machine, 6. Accurate Position Determination Using the Gee System, 7. Dynamics of an Ejection Seat Sled, 8. Charge on a Transmission Line, 9. Radiation Doses from Nuclear Attacks, 10. Shattering of Raindrops by Aircraft, 11. More about Raindrops, 12. A Computer Aid to Air Traffic Control, and 13. Supersonic Flow Calculations in Gases.

The reviewer has two criticisms: (1) the treatment of the material, including the introductory chapters, is sometimes overly sketchy even for a book of this type; and (2) there are no references to sources where more information could be found. This latter deficiency limits the use of the book for self-study. A great many teachers should welcome the fresh examples and should find little difficulty in using the book as a supplement to their courses.

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99[X].—EDWARD OTTO, *Nomography*, Pergamon Press, Ltd., Oxford, England, distributed by The Macmillan Co., New York, 1963, 313 p., 21 cm. Price $10.00.

This book is intended as a text and is not a collection of nomograms. The mathematical level required for an understanding of the subject is quite low (a good high school student should have no difficulty). There are five chapters. Chapter I, as an introduction, deals with analytic geometry and related considerations. Chapters II, III, and IV take up equations with two, three, and many variables, respectively. Chapter V discusses some problems of theoretical nomography.

Y. L. L.

100[X].—EDWARD L. STIEFEL, *An Introduction to Numerical Mathematics*, Academic Press, Inc., New York, 1963, x + 286 p., 24 cm. Price $6.75.

This book tends to treat many of the newer aspects of computing to the neglect of a balanced presentation such as is apt to be required in American schools where the beginner is almost totally ignorant of all of computing. The author also tends to give an algorithmic approach to many topics to the exclusion of "why." Since he seldom tells the reader where he is going, the reader is apt not to know where he has been when he reaches the end of a section.

Among the better points of the book is the treatment of simultaneous linear algebraic equations so that linear programming fits neatly into the scheme. He follows this with some game theory, but, as is often the case, the treatment is so rapid and scanty that the student is not likely to retain much.

The author is clearly oriented towards the treatment of each individual problem and away from the mass production of many answers to many problems (which can, of course, be dangerous but is a fact of life, nevertheless). Finally, the author makes a number of small slips which reveal that he was occasionally "nodding" when he wrote the book, especially when it comes to the treatment and effect of roundoff errors.

All in all, however, it is an interesting book and one that many experts could profit from reading.

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101[Z].—MICHAEL A. ARBIB, *Brains, Machines, and Mathematics*, McGraw-Hill Book Co., New York, 1964, xiv + 152 p., 20 cm. Price $6.95.

This book is intended to be a readable introduction to the relatively new and fashionable subject of modeling of mental or nerve activity by mathematical or machine systems. Rather than trying to say a little about every aspect of this rather sprawling subject, the author has chosen to go fairly deeply into one particularly nice piece of work in each of several areas, with passing mention of a few others. Mathematics, in the form of finite automata theory and computability theory, gets some fifty pages, with communication theory and related work on reliable structures taking up another thirty. The remainder of the book is devoted to a summary of the work of Lettvin and others on the visual system of the frog, the vaguely similar Perceptron, and a brief discussion of Cybernetics. The book has, in fact, a good bit of the flavor of a collection of research papers, since many of the sections follow some standard presentation quite closely, though usually with a good bit of compression obtained by omission of detail and some reduction in generality. These omissions are usually well indicated, and the interested reader is referred to one or more sources for a fuller treatment. A particularly pleasant feature is the presence of frequent comments pointing out the often gross approximations involved in associating the various models with actual neurological structures, and making explicit the assumptions which have been made and the limitations which they imply.

One can, of course, quarrel with some of the choices in emphasis that have been made. In particular, the form of Gödel's Theorem which is given (and proved) claims only the incompleteness of an "adequate, ω-consistent logic," without any indication that in any such logic an undecidable sentence can be effectively found, or that the hypothesis of ω-consistency can be reduced to simple consistency. These features, along with the proof, evidently resulted from a condensation of the discussion in Davis [1], where the creativity of the set of theorems of an adequate logic is discussed, but not emphasized.

In summary, this book can be recommended as an exploration in depth of a selection of the more scientifically respectable attempts at constructing models of the brain, laced together with enough commentary and indication of context to give the reader a reasonably fair notion of what has been done.

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1. Martin Davis, *Computability and Unsolvability*, McGraw-Hill Book Co., Inc., New York, 1958.

102[Z].—F. J. Corbato, J. W. Poduska & J. H. Salzer, *Advanced Computer Programming*, M. I. T. Press, Cambridge, Massachusetts, 1963, vi + 192 p., 29 cm. Price $5.00.

In contrast to most of the books on digital computer programming which have been published (in increasing numbers) in the last two or three years, this short text deals exclusively with systems programming. It does this very competently by setting up a prototype system, called Classroom Assembly Program (CAP), and showing how to design an assembler and compiler to translate from CAP language to machine language. The translator program is described in the FAP language of the IBM 7090. The reader is assumed to be sufficiently familiar with FAP so that he can understand the IBM reference manuals on FAP and the 7090 without guidance from the present text. In particular, he is supposed to be familiar with the Binary Symbolic Subroutine (BSS) linkage and relocation techniques used in the IBM Fortran Monitor System, as described in the FAP Reference Manual (IBM Publication C28-6235, September 1962).

The text consists of five chapters and three appendices. The five chapters describe: (1) the CAP language (it is similar to FAP); (2) the CAP assembler (in general terms and using flow charts); (3) the CAP compiler (e.g., what does a compiler do?; precedence of operations; temporary storage); and finally (4) an execution-monitor system which allows the student to perform laboratory exercises on CAP (e.g., modifications and additions suggested in Appendix C).

Appendix A contains a FAP listing of the assembler-compiler program of CAP. Appendix B contains a FAP listing of the execution-monitor program.

Although the authors have based their exposition on a particular programming system, they succeed in explaining many of the general ideas and problems underlying the design of assemblers and compilers. The text is a useful addition to the literature on programming technology.

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103[Z].—Allen Kent, *Textbook on Mechanized Information Retrieval*, John Wiley & Sons, Inc., New York, 1962, xii + 268 p., 23 cm. Price $9.50.

The purpose of this book is to offer a systematic introduction to the basic principles and techniques of machine literature searching. In the words of the publishers, it is designed both for classroom use and for those who wish to master the subject through self-study.

After a brief introduction in Chapter 1, the author jumps very quickly into a discussion of the physical tools or equipment used in information retrieval. Succeeding chapters cover, in turn: (a) principles of analysis for machine literature searching; (b) principles of searching; (c) manipulation of searching devices; (d) words, language, and meaning in retrieval systems; (e) codes and notations; and (f) systems design criteria.

It is always difficult in writing a text on a subject as broad as this to decide what is significant and should be included or, if space limitations prevail, what should be omitted and referenced for outside reading. Another difficult problem, which the author acknowledges, is where to start when introducing the technical aspects of the field. The author has chosen to start with a discussion of the hardware, or physical tools available for mechanizing information retrieval. Moreover, he describes the hardware in terms of its application to information retrieval functions, which are not discussed until later sections. It would seem more desirable to start with the discussion of system design criteria, rather than making it the last chapter in the text, in order to establish the proper framework for the remainder of the text. The analysis of data for machine literature searching should be discussed initially in terms of its fundamental elements. Once the basic principles of information storage and retrieval systems have been established, then the effects of equipment selection and the design changes which may have to be made to exploit the characteristics can be more meaningfully discussed. The discussion of equipment could best be presented at the end of the text with more emphasis on the general characteristics of classes of equipment, and more emphasis on the role of computers as opposed to punched cards and key-sort cards.

This book, in the hands of a competent instructor and supplemented by appropriate references from current literature to provide deeper coverage of the basic elements involved in the mechanization of an information retrieval system, would be adequate for a first course in information retrieval for library scientists. The author has provided in the appendix a good collection of supplemental material for classroom use. The reader interested in the role of computers in the mechanization of information retrieval systems is apt to be disappointed in this text if he is reading it for self-study.

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