REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

16[G H].—ÉMILE DURAND, *Solutions Numériques des Équations Algébriques*, Masson et Cie, Editeurs, Paris, 1961, viii + 445 p., 24.5 cm. Price 90 NF.

The second volume of Durand's work includes the following chapters: General Properties of Matrices; Discrete Methods for Linear Systems; Iterative Methods for Linear Systems; and Inversion of Matrices.

In these chapters, the author essentially considers problems related to the evaluation of small or medium systems of algebraic equations (iterative methods in the case of two variables).

The rest of the volume is devoted to methods for the determination of characteristic values of matrices by reduction to diagonal form, to triangular form, and to tridiagonal form. Other topics include deflation, solution of non-linear systems, and iterative methods applied to vectors.

The work includes numerous computational examples, as well as contributions of the school of Toulouse to the development and improvement of numerical methods.

The general impression that one obtains from the book is that it contains a series of methods rather than a unified theory. Particularly, the theory of errors is limited to consideration of common-sense methods and certain rules.

The book does not contain a bibliographic index, but only references in the course of the text and a brief list at the end.

The presentation is very clear, and the volume should have bright prospects as an instruction manual.

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17[I].—HERBERT E. SALZER, GENEVIEVE M. KIMBRO, & MARJORY M. THORN, *Tables for Complex Hyperosculatory Interpolation over a Cartesian Grid*, General Dynamics/Astronautics, San Diego, 1962, 71 p., 27.4 cm.

As stated in the introduction, these tables are designed to facilitate interpolation for analytic functions tabulated over a Cartesian grid in the complex plane, when the values of the first and second derivatives are known or readily obtainable at the tabular points. This "hyperosculatory" interpolation formula is thus a special case of the Hermite interpolation formula, as the authors note explicitly.

The hyperosculatory formula, with remainder term, is written in the form

$$f(z_0 + Ph) = \sum_j \{A_j^{(n)}(P)f(z_j) + hB_j^{(n)}(P)f'(z_j) \\ + h^2C_j^{(n)}(P)f''(z_j)\} + h^{3n}[\Pi_j(P-j)]^3\lambda f^{(3n)}\ (\alpha)/(3n)!$$

Here, $z = z_0 + Ph$ lies within or upon the side of a square Cartesian grid of length h in the complex plane. The fixed point z_0 constitutes the lower left corner of that square, and $z_j = z_0 + jh$, where j is a Gaussian integer. Furthermore, $P = p + iq$, where $0 \leqq p \leqq 1$, $0 \leqq q \leqq 1$. The polynomial coefficients $A_j^{(n)}(P)$, $B_j^{(n)}(P)$, and $C_j^{(n)}(P)$, are of degree $3n - 1$ in P. Explicit expressions for them are listed for

$n = 2, 3$, and 4, and for selected fixed points z_j. Exact decimal values of these coefficients are then tabulated for $p = 0\ (0.1)\ 1$ and $q = 0\ (0.1)\ 1$, corresponding to $n = 2, 3$, and 4.

To expedite the estimate of the remainder term, the function $F(n, P) \equiv |[\Pi_j(P - j)]^3|/(3n)!$ is separately tabulated to two significant figures, for every n and P occurring in the main tables.

Use of these tables is illustrated by an application of three-point hyperosculatory interpolation coefficients to the subtabulation of the modified Hankel function of the first kind and of order one-third, using selected entries from tables [1] of this function for a complex argument.

A reference list of fifteen publications is included.

J. W. W.

1. THE COMPUTATION LABORATORY OF HARVARD UNIVERSITY, *Annals*, Vol. II: *Tables of the Modified Hankel Functions of Order One-Third and of their Derivatives*, Harvard University Press, Cambridge, 1945.

18[J, L, M].—HAROLD JEFFREYS, *Asymptotic Approximations*, Oxford University Press, 1962, 144 p., 22 cm. Price $4.80.

This book treats, in a concise manner, modern work on asymptotic approximations to functions defined either by a definite integral or by a differential equation. The theory is illustrated by means of Bessel functions, the confluent hypergeometric function, and Mathieu functions. A brief discussion of Airey's convergence factor is given, and the book closes with a chapter devoted to the difficult problem of three-dimensional waves. We feel sure that the book will prove useful to students of problems that are attracting considerable attention, but the brevity of the treatment does not make its reading easy. However, ample references are given and difficulties encountered may be overcome by turning, if necessary, to Erdélyi's book [1] and to Langer's papers. The printing is of the high quality we have come to expect from the Oxford University Press.

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1. A. ERDÉLYI, *Asymptotic Expansions*, Dover Publications, Inc., New York, 1956.

19[K].—ANNA GLINSKI & JOHN VAN DYKE, *Tables for Significance Tests in a 2 × 2 Contingency Table (A Recomputation of the Finney and Latscha Tables)*, Statistical Engineering Laboratory, National Bureau of Standards, Washington 25, D.C., September 1962, 5 + 86 p. Deposited in UMT File.

These manuscript tables cover the same range as the original table of Finney [1] together with the extension by Latscha [2], namely, $A = 3(1)20$, $B \leqq A$. The format of these earlier tables is retained, except that the "tail probabilities" now appear to four decimal places instead of three. The authors state that these more precise values were obtained from the Lieberman-Owen tables [3] of the hypergeometric distribution. Errors in the tables of Finney and Latscha as revealed by this recomputation have been reported earlier (*Math. Comp.*, v. 16, 1962, p. 261–262).

In their introductory text the authors also refer to manuscript tables of Bennett and Hsu [4], and state that the present tables form the basis for 3D tables appearing in Section 5, by Mary G. Natrella, of Ordnance Corps Pamphlet ORDP 20-114, entitled *Experimental Statistics*.

J. W. W.

1. D. J. Finney, "The Fisher-Yates test of significance in 2 x 2 contingency tables," *Biometrika*, v. 35, Parts 1 and 2, May 1948, p. 145–156.
2. R. Latscha, "Tests of significance in a 2 x 2 contingency table: extension of Finney's table," *Biometrika*, v. 40, Parts 1 and 2, June 1953, p. 74–86.
3. G. J. Lieberman & D. B. Owen, *Tables of the Hypergeometric Probability Distribution*, Technical Report No. 50, Applied Mathematics and Statistics Laboratories, Stanford University, April 1961.
4. B. M. Bennett & P. Hsu, *Significance Tests in a 2 x 2 Contingency Table: Extension of Finney-Latscha Tables*, Review 9, *Math. Comp.*, v. 15, 1961, p. 88–89. See also *ibid.*, v. 16, 1962, p. 503.

20[K].—Zakkula Govindarajulu, *First Two Moments of the Reciprocal of a Positive Hypergeometric Variable*, Report No. 1061, Case Institute of Technology, Cleveland, Ohio, 1962, 16 + 28 p., 28 cm.

Starting from the definitions, the first two inverse moments of a positive hypergeometric variable have been computed accurate to five decimal places for: $N = 1(1)20$, $M = 1(1)N$, $n = 1(1)M$; $N = 25(5)50$, $M/N = 5\%\ (5\%)\ 100\%$, $n = 1(1)M$; $N = 55(5)100(10)140$, $M/N = 5\%\ (5\%)\ 100\%$, $n/N(\leqq M/N) = 5\%\ (5\%)\ 100\%$. Many theoretical results of interest, recurrence formulae among the inverse moments, and various approximations for the first two inverse moments have been obtained. The rounding error involved in using the formulae recurrently, in order to compute the moments, is at most 1 to 2 units in the last decimal place. The approximate values have been compared with the true values for some sets of values of N, M, and n. For large values of N and n, the Beta approximations are accurate up to 2 or 3 decimal places, provided they exist.

Author's Summary

21[K].—Frank L. Wolf, *Elements of Probability and Statistics*, McGraw-Hill Book Co., Inc., New York, 1962, xv + 322 p., 23.5 cm. Price $7.50.

Since the appearance of the "grey book" prepared by the Commission of Mathematics in 1957, at least a dozen or so textbooks have been published on probability and statistics at the elementary level, that is, requiring only "high school algebra". A number of these books are excellent. Nonetheless, the *Elements of Probability and Statistics* by Frank L. Wolf should prove to be a valuable addition to this collection.

This book is written in a style that is highly readable. The concepts are introduced one by one in a logical sequence and as a connected whole. The notations used are in accordance with the modern practice and would prepare the students for more advanced undertakings. In looking over the book, one is continually surprised and delighted with unexpected findings, such as the following, which are quoted.

"We say that we have a function defined on a set A if there is one and only one object paired with each element of A. The set on which a function is defined is said to be the domain of the function. The objects which are paired with elements of A are called values of the function, and the collection of all of them is called the range of the function." (Page 24.)

"In the general case, if x_0 is an observed value of the variable, we can consider the function

$$L(y) = P(X = x_0 | \theta = y).$$

This function is called the likelihood function for θ, given $X = x_0$. If $\hat{\theta} \epsilon A$ is a number with the property that

$$L(\hat{\theta}) = \max \{L(y) : y \epsilon A\} \tag{8-2}$$

then we say that $\hat{\theta}$ is a maximum likelihood estimate of (or for) θ. We read '$\hat{\theta}$' as 'theta hat' ". (Pages 138–139.)

"Since we shall so often be speaking of areas under curves, we now introduce an abbreviation.

$$\int_a^b f(x)\, dx \tag{9-7}$$

will stand for the area which lies under the curve $y = f(x)$ and over the interval from a to b. We read '$\int_a^b f(x)\, dx$' as 'the area under $f(x)$ from a to b', as 'the definite integral from a to b of $f(x)$', or (more simply) as 'the integral from a to b of $f(x)$' ". (Page 178.)

"Problem *9–27. To illustrate the fact that we have glossed over some logical difficulties in interpreting probabilities as areas for a continuous variable, let X be the result of a spin in Fig. 9-1 and consider the problem of finding the probabilities for the following 'events':
(a) $\{X: X$ is a rational number$\}$
(b) $\{X:$ in the decimal representation for X the digit 3 does not occur$\}$
(c) $\{X:$ the digits in the decimal representation of X are all even$\}$." (Page 183.)

As the author stated in the preface, the first eight chapters cover essentially the same material as does the experimental probability text prepared by the Commission on Mathematics of the College Entrance Examination Board. Chapter 9 jumps from discrete distributions to continuous probability distributions by the use of a "spinner", a rather useful device to introduce the concept of continuous variable to students who have not had calculus. Chapters 10, 11, 12, 13 introduce normal, chi-square, F, and Student's distributions, respectively, and Chapter 14, the bivariate distributions. Eight tables are included in the appendix, with their sources indicated in parentheses.

A-1	Tables of square roots	(Dixon and Massey)
A-2	Binomial distributions	(National Bureau of Standards, AMS-6)
A-3	Cumulative probabilities for binomial distributions	(National Bureau of Standards, AMS-6)
A-4	Random digits	(Interstate Commerce Comm., U.S. Bureau of Transport Economics and Statistics: *Table of 105000 Random Decimal Digits*)
A-5	Cumulative normal distributions	(Mood)

A-6	Chi-square distribution	(Fisher: *Statistical Methods for Research Workers*)
A-7	Critical values of F	(Wadsworth and Bryan)
A-8	Student's t distribution	(Fisher: *ibid.*)

Many problems are included between sections of each chapter; the ones marked with asterisks are the more difficult and more interesting, such as the one referred to above. A series of problems are included which give some idea of game theory.

Two review sections appear in this volume, one after Chapter 5 and another after Chapter 7. These reviews should be useful to both the teachers and students.

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22[L, M].—C. J. Ancker, Jr. & A. V. Gafarian, *The Function* $J(x, y) = \int_0^x \frac{\gamma(y, \xi)}{\xi} d\xi$*—Some Properties and a Table*, System Development Corporation Santa Monica, California, 1962, 36 p., 27.5 cm.

This report contains some analysis and a table of the function

$$J(x, y) = \int_0^x \frac{\gamma(y, \xi)}{\xi} d\xi, \qquad x \geqq 0, y > 0,$$

where

$$\gamma(y, \xi) = \int_0^\xi e^{-\eta} \eta^{y-1} d\eta$$

is the Incomplete Gamma-Function. The report is divided into four parts. The first part contains: (1) a recurrence relation in the variable y, (2) a closed expression for positive integer y, (3) definite integrals expressible in terms of the function, (4) some derivatives of the function, (5) a convergent power series expansion about $x = 0$, (6) an asymptotic expansion about infinity, (7) an approximation in closed form, and (8) the Laplace and Mellin transforms, treating y as a fixed parameter. The second part is a description of the computational technique used to obtain the table and a discussion of the accuracy of the table. The third part contains procedures for computing $J(x, y)$ outside the range of the table. Finally, in part four, there are some graphs and a table of $J(x, y)$ for x and $y = 0.1(0.1)10$ to six significant figures.

Author's Summary

23[L, M, X].—Wilfred Kaplan, *Operational Methods for Linear Systems*, Addison-Wesley Publishing Company, Inc., Reading, Massachusetts, 1962, xi + 577 p., 24 cm. Price \$10.75.

This book treats in a careful, detailed manner the subject usually known as operational calculus. A long introductory chapter is devoted to linear differential equations; this is followed by a chapter treating such matters as the superposition principle, the transfer and frequency response functions, and stability. Then come chapters on functions of a complex variable, Fourier series, the Fourier integral, the Laplace transform, and stability. The last chapter treats in an interesting manner time-variant linear systems, and there is an appendix on the operational calculus of Mikusiński. There are a great many exercises, with answers, and a conscientious student should be able to master the material even without the aid of a teacher. The printing is excellent.

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24[L].—WERNER E. KNOLLE & WILLIAM A. ALLEN, *Expansion of Elliptic Functions Tables*, 3 + 720 unnumbered sheets. Deposited in UMT File.

This large manuscript table of Jacobian elliptic functions constitutes an elaborate expansion of the first eight pages of the related Smithsonian tables [1]. The modular angle is now given over the range $\theta = 0(10'')2°$, in place of the original increment of 1°.

The format of the Smithsonian tables has been adopted for completeness, and the precision of 12D has been retained in the body of the tables.

In their explanatory text the authors state that each tabular value was computed independently on an IBM 7090 system. They claim that the existing computer program will suffice to produce results of comparable precision for values of the modular angle ranging up to 6°, and that further extension is possible through a slight modification of the program.

The original copy of these tables exists as an IBM listing on vellum paper, which can be reproduced inexpensively, according to the authors.

Comparison of the results of these new computations with the corresponding data in the Smithsonian tables revealed several serious errors in the latter; these are enumerated in the appropriate section of this issue.

J. W. W.

1. G. W. SPENCELEY & R. M. SPENCELEY, *Smithsonian Elliptic Functions Tables*, The Smithsonian Institution, Washington, D.C., 1947.

25[L, M].—A. V. H. MASKET & W. C. RODGERS, *Tables of Solid Angles:* I. *Solid Angle Subtended by a Circular Disc;* II. *Solid Angle Subtended by the Lateral Surface of a Right Circular Cylinder*, Office of Technical Services, Washington 25, D.C., July 1962, iii + 476 p., 26.5 cm. Price $5.00.

The two large tables comprising this publication contain, respectively, 125,000 and 112,500 values to 6 S (in floating-point form) of solid angles subtended by a circular disc and by the lateral surface of a right circular cylinder. The authors inform us that these tables are the result of a recalculation and enlargement, by use of a UNIVAC 1105 system, of *Tables of Solid Angles and Activations*, issued in November 1956 as a reproduction of Oak Ridge National Laboratory Report ORNL 2170.

All values in the tables are normalized to a unit radius of the disc or cylinder. The parameters are, then, the perpendicular distance z of the point above or below the plane of the disc, the distance ρ of the point from the axis of the disc or cylinder, and the height h of the cylinder. The solid angles in Table I are tabulated in steradians for $\rho = 0(0.05)6(0.25)16(0.5)35.5$ and $z = 0.02(0.02)5(0.04)10(0.2)20(0.4)100$; those in Table II, for $\rho = 1(0.05)6(0.25)16(0.5)35.5$ and $h = 0.02(0.02)5(0.04)10(0.2)20(0.4)100$.

A combination of Simpson's rule and four-point Gauss quadrature was used to obtain the data in Table I corresponding to the interval $0 \leqq \rho \leqq 0.95$; the remaining entries of Table I and all those in Table II were computed by 16-point Gauss quadrature. The authors state that the tabular data are accurate to within 1 or 2 units in the least significant place, except for those entries in Table I corresponding to $1 < \rho \leqq 35.5$, where the uncertainty ranges from 1 to 5 units in the last place.

Explanatory text consists of sections devoted to: computational procedures; solid angle contour integrals and related formulas, series, and approximations; illustrations of the use of these tables; and a list of 20 references supplementing those given in the Oak Ridge report.

J. W. W.

26[M, S].—V. Vanagas, J. Glembockij, & K. Ušpalis, *Tables of Radial Integrals of Atomic Spectra Theory*, Computing Centre, Academy of Science of the USSR, Moscow, 1960, xiii + 380 p., 26 cm.

The preface and the introduction to these extensive specialized tables are clearly written in Russian and English in parallel columns. Since it requires only seven pages of introductory text to describe the use of 380 pages of tables, the employment of two languages was only a minor burden on the editors, yet it opens the tables to a wide group of scientists. Other table-compilers should follow suit and also prepare bilingual introductory material.

The tables are designed to permit the numerical evaluation of the atomic radial integrals denoted by Slater [1] as $F^k(nl, n'l')$ and $G^k(nl, n'l')$ in cases where the individual electron radial integrals are approximated in the form:

$$R_{nl}(r) = \sum_i A_i \, r^{a_i} \, e^{-\alpha_i r}.$$

The functions actually tabulated are

$$V(ab; \gamma) = \log_{10}\left\{\int_0^\infty r^a e^{-\gamma r} \int_r^\infty r'^b \, e^{-r'} \, dr' \, dr\right\},$$

and

$$W(ab; \gamma) = \log_{10}\left\{\gamma^{b+1} \int_0^\infty r^a \, e^{-r} \int_r^\infty r'^b \, e^{-\gamma r'} \, dr' \, dr\right\},$$

from which the radial integrals in question can be calculated by methods described in the introduction. The functions V and W are tabulated for all nonnegative integer values of a and b in the range $0 \leqq a + b \leqq 16$, for $\gamma = 0.000(0.002)1.000$. The logarithms are given to six decimal places throughout.

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1. John C. Slater, *Quantum Theory of Atomic Structure*, McGraw-Hill, New York, 1960, v. 1, p. 311.

27[P, Z].—Mitchell P. Marcus, *Switching Circuits for Engineers*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1962, ix + 296 p., 23.5 cm. Price $12.00.

As the title indicates, this is a book on switching circuits written for engineers. In particular, it is written for engineers with little or no background in the subject or in mathematics. Thus, except for some elementary propositions of Boolean algebra, the book is essentially nonmathematical. Rather, the book is oriented toward the design of combinational and sequential circuits by simple hand methods. The reader is introduced both to the basic types of relay and electronic circuits, plus means for putting them together. Special subjects, such as tree circuits, symmetric functions, reiterative circuits, and error-correcting and error-detecting codes, are also surveyed.

The book covers a great many subjects, and the material is presented in a clear manner. The treatment, however, is rarely very deep. In particular, many of the given synthesis methods are quite unsophisticated, and the reader is not informed of the existence of more sophisticated ones. In the simplification of two-level AND-OR circuits, for example, the author starts his procedure from the expanded-sum-of-products form, and no mention is made of the numerous methods for getting from the prime implicants to a single minimal solution (say, in terms of number of literals) without first producing all irredundant forms. Thus, although the book will prepare the reader to solve simple practical problems, it will not serve to introduce him to the more mathematical portion of the literature, nor will it give him means to tackle complex problems either by hand or by machine.

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28[X].—Centre Belge de Recherches Mathématiques, *Colloque sur l'Analyse Numérique*, Gauthier-Villars, Paris, 1961, 214 p., 25 cm.

These are papers presented at a colloquium organized by the Centre Belge de Recherches Mathématiques and held at Mons in March 1961. In a foreword it is explained that "The object of the Centre is to pass in review the different chapters of mathematics in a manner to place at the disposition of our young research workers a precise documentation". Consequently, the papers are aimed more at exposition than at the reporting of new results. However, each paper treats a rather special subject, with one or two exceptions, and most of them presuppose a fair degree of sophistication on the part of the audience. The principal exception referred to is a paper by Forbat, entitled "Variational methods of determination of proper values" (in French), and a partial exception is a paper by Collatz (in German), describing various applications of the theory of monotonic operators. One of the more interesting papers is the one by Bauer (in French) on Romberg's method of numerical quadrature. This method was published by Romberg in 1955, and recently rediscovered; it is of special interest in that at this late date an important new development is possible in an area that has been worked so long and by so many of the masters.

Other papers that might be mentioned are one by Sauer, reporting work by Stetter in applying to certain hyperbolic systems Dahlquist's method of studying convergence for ordinary differential equations; a paper by Lanczos, dealing with the study of stability in solving systems of ordinary differential equations; and a paper by Stiefel on a problem arising in the design of electrical filters, which requires the construction of a rational fraction that is to be as large as possible over certain intervals and as small as possible over certain others. These papers are all in French.

The printing is not of the best, and in at least two places lines of type are missing.

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29[Z].—DANIEL D. MCCRACKEN, *A Guide to IBM 1401 Programming*, John Wiley & Sons, Inc., New York & London, 1962, viii + 199 p., 28 cm. Price $5.75.

This book on programming is addressed to the beginner in the field. The style is clear; the book is easily readable. The concepts treated are developed in an effective, pedagogical manner. An individual, desirous of learning how to program for the 1401, would do well to read this book before working with the IBM manual, which, like most manufacturers' manuals, is more a reference document than a learner's text. Though there is much to learn after Dr. McCracken's book is mastered, the reader is, by this time, off to a good start.

Dr. McCracken progresses from first principles about punched cards through the processes required to deal with some standard business data-handling problems. The use of cards, tapes, and disk storage is exemplified. Adequate examples are provided, in simplified form, but with the essential elements highlighted.

A useful feature is contained in the exercises at the end of most chapters. For selected exercises, solutions are provided in an appendix.

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30[Z].—RHEINISCH-WESTFÄLISCHES INSTITUT FÜR INSTRUMENTELLE MATHEMATIK, *International Series of Numerical Mathematics*, Vol. 3, Birkhäuser Verlag, Basel, Switzerland, 1961, 198 p., 24.5 cm. Price sFr. 20,00.

This book consists of ten papers presented at the Colloquium on Combinational and Sequential Switching Circuits, held at Bonn in October 1960. The colloquium was organized by the Rheinisch-Westfälische Institut für Instrumentelle Mathematik together with the Institut für Angewandte Mathematik der Universität Bonn. Their goal was to acquaint more German scientists with the basic ideas of switching theory and to help establish contacts among the various German researchers in the field, with the hope of stimulating more German work in this area. Thus, about half the papers are primarily tutorial and cover work done principally by Americans. The remaining papers cover original work by the authors. According to the forward, all the material is, or will be, available in more expanded form in other publications. The book, though, gives a fairly complete survey of the field and should help to further the goal of the colloquium. The brevity of some of the articles, however, plus a fair number of printing errors, may limit its usefulness to those with no prior knowledge of the field.

The titles, translated into English, and descriptive comments follow.

1. H. Rohleder, "On the synthesis of series-parallel switching circuits from

incompletely given work conditions," is a very brief sketch of a new minimization algorithm.

2. G. Häuslein, "J. P. Roth's method of cubical complexes for the minimization of switching functions," provides a good, concise outline of Roth's extraction algorithm.

3. G. Hotz, "On the reduction of systems of switching polynomials," describes original work on the synthesis of circuits, such as adders, by means of Boolean algebra; this is one of the few papers I have seen that employs the algebraic properties of Boolean algebra.

4. C. Hackel, "On the logic of NOR and NAND switching circuits," surveys the application of the Karnaugh map to NOR and NAND circuits.

5. J. Neander, "Fundamental ideas of Theodor Fromme's equivalence-calculus," outlines in some detail the basic ideas of the calculus developed by the late Theodor Fromme for the representation of combinational and sequential switching circuits.

6. K. H. Böhling, "On the reduction of sequential switching circuits," presents a survey of sequential switching circuit theory, with emphasis on state diagrams and Ginsburg's state reduction method.

7. P. Deussen, "On the synthesis of automata," is a survey of sequential circuit theory, with emphasis on feedback, Huffman's method, and transition matrices.

8. W. Zoberbier, "The practical application of minimization algorithms in the systems planning of combinational and sequential switching circuits," provides a discussion, by means of a completely worked out example, of the problems involved in applying minimization algorithms to real problems.

9. W. H. Rein, "A calculus for combinational and sequential switching circuits with many-valued signals," gives a formal and pictorial calculus for the description of switching circuits employing multi-level (many-valued) components.

10. W. Händler, "On the use of graphs in combinational and sequential switching theory," is a survey of graphical methods, such as Karnaugh maps, for circuit minimization; it includes the author's own work (M^n-graphs).

ERIC G. WAGNER

31[Z].—R. VICHNEVETSKY, Editor, *Analogue Computation Applied to the Study of Chemical Processes*, Gordon & Breach, New York, 1962, 170 p., 30 cm. Price $10.50.

This book contains articles presented at a seminar in Brussels, Belgium sponsored by the International Association for Analog Computation. The articles, with the discussion they evoked, survey the state of the art of analog computation in the Western European chemical industry at the time of the seminar in late 1960. To describe the book, we shall devote one sentence to each of the twenty-two contributions.

J. F. Coales (Computers in the design and control of chemical plants) suggests that "the most urgent requirement, if computers and self-optimising or learning systems are to be applied successfully to the control of complex plants, is for some workers in this field to acquire an understanding of the behavior of multivariable systems with random inputs and to develop reasonably simple methods for optimising them." B. Messikommer (Die Optimierung eines Halbkontinuierlichen

Chemischen Reaktors mittels Dynamischer Programmierung) uses Lagrange multipliers to reduce a two-dimensional dynamic programming problem to a unidimensional one, employing an analog computer for the calculations. J. Rissanen (Control system synthesis by analogue computer based on the "Generalized Linear Feedback" concept) extends the work of Kalman, and shows how to match actual to desired output, using an analog computer. G. Gau (Optimisation d'une unité de fabrication chimique par calculateur numérique industriel) reviews gradient methods for attaining an optimum in the presence of constraints. A. W. O. Firth (The use of an analogue computer for the solution of linear and non-linear programming problems and its further application as an automatic optimization system) discusses mechanical and electronic analogues to the Hitchcock-Koopmans transportation problem. J. K. Lubbock (Mathematical models of plants) surveys linear and nonlinear models with and without memory, automatically or manually adjusted to remove interaction between the input variables. R. Peretz (Asservissement conditionnel des processus industriels) asks why many controllers are bypassed in practice, and proposes a "conditional" controller whose behavior is altered automatically as disturbances change in character.

Shapiro, Harris, Lapidus, and Lee (Simulation of chemical processes on a combined analog-digital computer) and J. I. Archibald (Analogue-digital computing methods) describe their experiences with experimental hybrid computers. The articles of J. G. Thomason (Some analogue studies of boiler control system performance) and S. Wajc (Comportement transitoire d'un plateau de colonne de distillation) would be of more interest to chemical engineers than mathematicians.

A. M. Terlinden (Petits calculateurs analogiques en ligne introduits dans les processus industriels) describes four simple applications of on-line analogue computation in the process industries. T. B. Jawor (Estimation of error in on-line computing) gives a useful technique for estimating the propagation of errors in analogue systems, complete with table of errors encountered on conventional components. D. J. Wilde and A. Acrivos (Control of overdetermined systems) discuss the adjustment of many inventory variables simultaneously by manipulating only one parameter. M. James (Process control by computer) describes his company's on-line computer. J. P. Bromley and C. Storey (Some analogue studies of process control systems) discuss their experiences with simulation of control systems for a distillation column, a pressure electrolyser, and for concentration of acid in a liquid stream. D. S. Townsend (The application of an analogue computer to a stock control problem with discontinuous supply and continuous demand) describes the simulation of an inventory problem and its results.

Five papers on analog solution of partial differential equations (distributed parameter systems) should be of particular interest to applied mathematicians. T. Hennig and S. Naevdal (On errors due to lumping of a system with distributed parameters) shows how to use an analogue computer to calculate such errors in linear, steady-state problems. J. E. Rijnsdrop, R. Vichnevetsky, and J. G. van de Vusse (Application of the analogue computer in the study of the esterification of terephthalic acid) reduced the partial differential equations to ordinary ones by ignoring variations with respect to time; iterative computations are required. V. Broida (Mèthode simplifiée de simulation d'un échangeur de chaleur simple ou complexe; Extension possible aux problemes à deux variables et aux équations aux dérivées partielles) describes an analogue system with relays which approximates a distributed system by a lumped system. J. Girerd (L'analyseur différentiel à reseaux DELTA 600, son application à la résolution des équations aux dérivées partielles) discusses his company's resistance network differential analyzer. A Gadola, V. Gervasio, and C. Zaffiro (The use of standard analogue techniques in solving propagation problems) outlines two methods for handling a distributed system; first, by finite-difference approximation, and second, by expanding in a Fourier series with odd terms only, and then using analogue simulation on each mode.

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32[Z].—R. W. Williams, *Analogue Computation*, Academic Press, Inc., New York, 1962, 271 p., 21.5 cm. Price $9.50.

The scope of Dr. Williams' book is confined to the electronic and electromechanical techniques and components of analog computers instead of complete computers and their applications.

The book, written as an introduction to the subject, consists of nine chapters. Chapter 1 gives a brief account of historical points of interest in analog computers. Chapter 2 covers one of the important components, the potentiometer; the treatment is quite extensive. Chapter 3 deals with operational amplifiers. It presents both functional and design aspects, as well as automatic drift-correction. Chapter 4 is an interesting and unique chapter on a.c. analog technique. The subject of servomechanisms is treated in Chapter 5 for both position and rate servos. The treatment is concise and includes three a.c. components: tachometers, motors, and amplifiers. Chapter 6 covers another phase of a.c. analog technique: trigonometric functions and triangle solving, as well as the resolver component. Function generators and multipliers are presented, respectively, in Chapters 7 and 8. These include the function generator using non-ohmic resistor, the Hall multiplier, and the time division multiplier. The last chapter, on transistor application, mainly discusses d.c. transistor amplifiers and the problems of transistorizing operational amplifiers.

The reviewer has found that the book introduces much information available in British literature. This valuable book for students and designers interested in analog technique is quite readable and is illustrated with many figures.

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