REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

34[A, B, C, D].—L. FLAVIEN, *Nouvelles Tables Numériques pour les Fonctions Usuelles de l'Analyse*, Gauthier-Villars, Paris, 1958, 63 p., 21 cm. Price $0.85.

This little volume has been compiled for students who are preparing "aux grands écoles scientifiques." It has been edited to conform with the 1956 program published by the *ministère de l'Education Nationale.* Tables included are:

I. Avertissement.
II. Values of n^2, n^3, and n^{-1}, n^{-2}, n^{-3}, $\sqrt{n}$ $\sqrt[3]{n}$ to 4D, for $n = 1(1)1000$.
III. Mantissa of $\log_{10} x$ to 4D for $x = 1(1)999$.
IV. $\text{Log}_e\, x$ to 4D for $x = 1(1)1000$.
V. 10^x to 4D for $x = 0(.01)1$.
VI. Sin x, tan x, ctn x, cos x to 4D, in degrees for $x = 0(0°.1)90°$.
VII. Sin x, tan x, ctn x, cos x to 4D, in grades for $x = 0(0^g.1)100^g$.
VIII. Arc sin x in radians to 5D for $x = 0(0.01)1$. Arc tan x in radians to 5D for $x = 0(0.01)1$ (var.)100.
IX. Radians r: to degrees (decimal), to grades (decimal), to 4D for $r = 1(1)10$, Radians to degrees, minutes, and seconds for $r = 0.1(0.1)0.9, 0.01(0.01)0.09.$ $0.001(0.001)0.009, 0.0001(0.0001)0.0009$.
X. Degrees d, minutes m, seconds s: to grades (4D), to radians (5D) for $d = 1(1°)90°$, $m = 1(1')60'$, $s = 1(1'')60''$.
XI. Grades G: to radians (4D), to (decimal) degrees (1D), to degrees, minutes, for $G = 1(1^g)100^g$. Centigrades C to minutes, seconds, (1D), for $C = 1(1^c)100^c$.
XII. "Remarkable" numbers (e.g., π, e, $n!$) and their common logarithms.

The Tables are well designed and easy to read.

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35[A, B, I, N].—P. MONTAGNE, *Tables abrègées de puissances entières*, Dunod, Paris, 1958, xv + 411 p. + loose appendix 32 p., 28 cm. Price 5600 francs.

These extensive tables are designed to facilitate the evaluation of x^n, where n is a positive integer, more accurately than is possible with eight-place logarithmic tables. The main tables are divided into three sections comprising tables referred to as small, medium and large. The values of x^n are given in the small and medium tables to 15S, and in the large tables to 10–11S. Numerous special signs attached to the last figure give some information about the next place. There are no differences. The values of the arguments are:

Small tables (a), pages 3–17: $x = .2(.1)2$, $n = 0(1)m$, where m depends on x in the following way:

x	.2	.3	.4	.5(.1).9	1.1(.1)2
m	600	400	250	200	150

Small tables (b), pages 18-62: $x = .1(.01)1.53$, $n = 2(1)78$.

Medium tables, pages 64–157: $x = .097(.001)1.263$, $n = 2(1)26$.

Large tables, pages 160–411: $x = 0(.0001)1.2603$, $n = 2(1)10$.

In all tables except small (a), x is the vertical argument, and there is an overlap of about 7 lines between pages, instead of the usual one line or even none. This accounts for initial and terminal arguments ending in 7 and 3; thus, the medium tables are basically for $x = .1(.001)1.26$, the three extra arguments at each end being added for convenience in interpolation and so forth. The tables are photographically reproduced from manuscript written by professional calligraphers.

A loose appendix contains 29 pages of *Tables annexes* and 3 pages reserved for notes. The varied contents defy brief description in full. About half the pages contain matter relating primarily to the main tables, such as illustrative diagrams, indexes, and tables indicating the number of differences needed in interpolation. The remaining pages contain matter of more general applicability. Outstanding are two tables of Everett interpolation coefficients, one giving exact coefficients of second and fourth differences at interval 0.002, and the other, phenomenally extensive, giving at interval 0.01 coefficients to 12–13D of all even differences up to the sixteenth; except in the case of coefficients of the 14th and 16th differences, even differences (up to the second or fourth) of the interpolation coefficients are also given. There are also rather extensive tables of factorials, reciprocals of factorials, binomial coefficients, and useful constants (including Bernoulli and Euler numbers).

There are few references; it seems a pity not to mention the important British Association tables of powers [1]. The tables of x^n will certainly be found useful for tabular arguments, but when much interpolation would be needed, the use of logarithms as an alternative may still appeal on occasion. Obviously much work has gone into checking the tables, but a copious page of errata is pasted in, and it is stated that the last check revealed less than one error per ten pages. There do exist, however, radix and similar special logarithmic tables which are slim, simple, and of absolute accuracy. Nevertheless, anyone much concerned with integral powers should consider what possibilities this volume may have for his purpose. An excellent feature of that part of the large tables which relates to the range $0 \leqq x \leqq 1$ is that, for given x, all the powers of x and $1 - x$ are contained on one line running right across two pages visible at an opening; this facilitates the solution of equations of the form $x^\alpha(1 - x)^\beta = k$, which occur in connection with chemical equilibria. The extensions for $x > 1$ may be found useful in connection with problems on compound interest.

Editions in English and several other languages are in preparation, as also is a table of fourth powers.

A.F.

1. British Association for the Advancement of Science, *Mathematical Tables, vol. IX: Table of Powers giving Integral Powers of Integers*, Cambridge University Press, 1940. See MTAC, Review **169**, v. 1, 1945, p. 355–356.

36[G].—L. Lunelli & M. Sce, "Sulla ricerca dei k-archi completi mediante una calcolatrice elettronics," *Atti Convegno Intern. Reticoli e Geometrie Proiettive*, Palermo-Messina, 1957 (Roma 1958), p. 81–86.

[G].—L. Lunelli & M. Sce, *k-archi completi nei piani proiettivi desarguesiani di rango 8 e 16*, Politecnico di Milano, Centro di Calcolo Numerici, Milano 1958, 11 p.

The authors have programmed a CRC 102 A/P to search for complete k-arcs in a finite projective plane coordinatized by a Galois field. A k-arc is a set of k points such that no three lie on a line. It is complete if it is not contained in a $(k + 1)$-arc. To eliminate the most obvious duplications, only k-arcs through the four fundamental points (0, 0, 1), (0, 1, 0), (1, 0, 0), (1, 1, 1) were considered, but the authors regard as distinct k-arcs those which result from one another under collineations permuting the four points.

The procedures in the first paper are limited to planes of prime order. A description of the program is given and the results of a complete search of the plane of order seven are announced. Examples of complete k-arcs are given for planes of orders 11, 13, and 17.

In the case of the plane of order seven, 40 6-arcs are tabulated.

In the second paper, the program is extended to utilize the irreducible polynomials $x^3 + x + 1$ and $x^4 + x + 1$ to calculate in terms of the coordinatization by GF(8) and GF(16) for planes of these orders. (A misapprehension as to the general suitability of polynomials $x^n + x + 1$ does not affect the results in these cases.) Ten 10-arcs are listed for the plane of order eight, and 45 6-arcs. If permutations were considered, the authors could have reduced the tabulation to three 10-arcs and fifteen 6-arcs. Indeed, as they point out, the case of the 6-arcs can be reduced to the statement: any 5-arc can be completed to a complete 6-arc in precisely three ways. For the case 16 no exhaustive tabulation is given. Some 18 10-arcs, one 11-arc, two 12-arcs and three 18-arcs are listed. The last do not contain conics (ovals); this answers a question of B. Segre as to the existence of such arcs.

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37[H, I, S].—R. L. Chambers & E. V. Somers, *Solution of a radiation type non-linear differential equation*, Scientific Paper 8-0529-P6, Westinghouse Research Laboratories, Pittsburgh, Pennsylvania, October 1958.

The treatment of a heat transfer problem [1, 2] dealing with radiation from a cooling fin gives rise to a second order non-linear differential equation

$$\frac{d^2\theta}{dr^2} + \frac{1}{r + 1/(\rho - 1)} \frac{d\theta}{dr} - \gamma\theta^4 = 0;$$

with boundary conditions $\theta = 0$ at $r = 0$, $d\theta/dr = 0$ at $r = 1$. Tabulated results are presented from the numerical solution of the above equation over a range of values of r from 0 to 1.0, for the parametric values of $\rho = 1.001, 1.1, 1.25, 1.5, 2.0$, and 3.0 and $\gamma = 0$ to 4. The tables were computed on an IBM 704 digital computer by a finite-difference method. A copy has been deposited in the UMT file.

H.P.

1. Robert L. Chambers, *The determination of radiation fin efficiency and temperature distribution for one-dimensional heat flow in a circular fin*, University of Pittsburgh thesis, 1958.
2. Robert L. Chambers & E. V. Somers, *Radiation fin efficiency for one-dimensional heat flow in a circular fin*, Westinghouse Scientific Paper 8-0529-P4, 1958.

38[I, X, Z].—R. M. Pearce, *Digital Computer Solution of the Two Group Diffusion Equations in Cartesian or Cylindrical Geometry with Application to the Datatron*, Report AECL No. 487, 1957, 27 p., 27 c.m. Available from Scientific Document Distribution Office, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. Price $1.00.

This report derives a set of difference equations for use in solving the two-group diffusion equations in XY or RZ geometries, and describes a Datatron program to solve the difference equations. The Datatron program and the output from a sample problem are included.

The Datatron program can handle problems with a maximum of 324 mesh points. This is less than some other currently available programs can handle.

The boundaries may be black (the value of the flux is forced to zero) lines of symmetry, or what is referred to in the report as reflector termination. In the case of reflector termination, an attempt is made to simulate the effects of a partially reflecting material bounding the cell.

The iteration scheme uses point relaxation. The latest values are used except in one case where their use would require extra machine time per iteration. No attempt is made to accelerate the convergence of the iteration scheme, even though there are several methods available which have been used successfully in similar programs.

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39[L].—H. V. McIntosh, A. Kleppner & D. F. Minner, *Tables of the Herglotz Polynomials of Orders* $\frac{3}{2}$–$\frac{8}{2}$ *Transformation Coefficients for Spherical Harmonics*, Ballistic Research Laboratories, Memorandum Report No. 1097, Aberdeen Proving Ground, Maryland, 1957, 162 p., 28 cm.

The Herglotz polynomials H^n_{jk} (R) are the matrix elements of the unitary irreducible representations of the three-dimensional rotation group and are defined by:

$$H^n_{jk}(\alpha, \phi, \gamma) = (-1)^{j-k} e^{ij\gamma} e^{ik\alpha} (\cos \phi/2)^{2n-j+k} (\sin \phi/2)^{j-k} \cdot \sum_s \frac{(-1)^s \tan^{2s} \phi/2}{(n+k-s)!(j-k+s)!(n-j-s)!\, s!},$$

where α, ϕ, γ are the Euler angles of the rotation R. These polynomials have the useful property that if R takes the coordinate system r, θ, ξ into r, θ', ξ', then

$$P_n{}^j (\cos \theta') e^{ij\xi'} = \sum_{k=-n}^{n} H^n_{jk}(R) P_n{}^k (\cos \theta) e^{ik\xi}$$

where $P_n{}^j$ $(\cos \theta)$ $e^{ij\xi}$ are the normalized spherical harmonics.

In this table the values of H^n_{jk} $(0, \phi, 0)$ are given for $n = \frac{3}{2}(\frac{1}{2})\frac{8}{2}$ and $\phi = 0°$ $(1°)$ $90°$.

Authors' Summary

40[I, M, P].—R. L. Murray & L. A. Mink, *Tables of* $\overline{\phi^n}$ *for Reactor Slabs, Cylinders, and Spheres*, $n = 1$ *to* $n = 20$, Department of Engineering Research, North

Carolina State College, Raleigh, North Carolina, Bulletin No. 70, 1958, 56 p., 28 cm. Price $1.50.

This paper contains a tabulation of average neutron fluxes for slab, cylindrical and spherical reactors. Specifically, the following functions are tabulated to 8 decimal places:

$$\text{Slab} \quad \overline{\phi^n}(z) = \frac{1}{(\delta\pi/2)} \int_0^{\delta\pi/2} [\text{Cos } x]^n \, dx \quad \text{with} \quad x = \pi z/H$$

$$\text{Cylinder} \quad \overline{\phi^n}(r) = \frac{z}{(\delta j_0)^2} \int_0^{\delta j_0} [J_0(x)]^n x^2 \, dx \quad \text{with} \quad x = j_0 \, r/R_{\delta\pi}$$

$$\text{Sphere} \quad \overline{\phi^n}(r) = \frac{3}{(\delta\pi)^3} \int_0^{\delta\pi} \left[\frac{\text{Sin } x}{x}\right]^n x^2 \, dx \quad \text{with} \quad x = \pi r/R.$$

R and H represent the extrapolated boundries of the reactor.

δ, the fraction of the total dimension over which the average is performed, is given from 0 to 1 in steps of .01, and n assumes integer values from 1 to 20. The above values of $\overline{\phi^n}$ actually represent $\overline{\phi^n}/\phi_c{}^n$, where $\phi_c{}^n$ is the central flux normalized to unity.

These tables were calculated on an IBM 650. Details of the methods used are presented, as well as a method for interpolating for values not tabulated.

The paper illustrates the application of these flux averages by means of a few worked examples.

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41[P, T, Z].—Ernest F. Johnson, "Automatic Process Control"—Chapter II, *Advances in Chemical Engineering*, Thomas B. Drew & John W. Hoopes, Jr., Editors, Academic Press Inc., New York, 1958, x + 338 p., 23 cm. Price $9.50.

This chapter should be a convenient primer for those to whom this subject is new. Terms are defined clearly, equations given and the bibliography is excellent. Some of the more advanced notions such as "three-mode control" are discussed adequately. It is unfortunate that the topic of "sampled-data systems" is no more than mentioned, as this is an area of equal importance functionally, and will be of much greater importance in the future when chemical engineers finally appreciate that digital computers are much more powerful and flexible than analog systems.

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42[W, X, Z].—Armour Research Foundation, *Proceedings of the Fifth Annual Computer Applications Symposium*, 1958, Sponsored by the Armour Research Foundation of Illinois Institute of Technology, x + 153 p., 23 cm. Price $3.00.

This small volume contains copies of the papers presented at the 1958 Computer Applications Symposium held on 29 October in Chicago and sponsored by the

Armour Research Foundation. A list of papers presented at this meeting is given below.

1. Operations Research and the Automation of Banking Procedures—R. A. Byerly
2. Information Systems Modernization in the Air Materiel Command—D. E. Ellett
3. Utilization of Computers for Information Retrieval—A. Opler
4. Problems and Prospects of Data-processing for Defense—C. A. Phillips
5. An Integrated Data-processing System with Remote Input and Output—R. D. Whisler
6. The Role of Character-Recognition Devices in Data-processing Systems—R. L. Harrell
7. Input-Output—Key or Bottleneck?—R. D. Elbourn
8. Scientific Uses of a Medium-Scale Computer with Extensive Accessory Features—R. A. Haertle
9. The Design of Optimum Systems—R. R. Brown
10. Computer Applications in the Numerical Control of Machine Tools—R. B. Clegg
11. Frontiers in Computer Technology—R. W. Hamming
12. Computer Sharing by a Group of Consulting Engineering Firms—E. M. Chastain and J. C. McCall
13. Current Developments in Computer Programming Techniques—F. Way, III
14. The Future of Automatic Programming—W. F. Bauer

H. P.

43[X].—Vera Riley & Saul I. Gass, *Linear Programming and Associated Techniques*, Bibliographic Reference Series No. 5, Published for the Operations Research Office, The Johns Hopkins University, The Johns Hopkins Press, Baltimore, 1958, x + 613 p., 23 cm. Price $6.00.

This bibliography, a revised edition of BRS-2, *Programming for Policy Decision*, March 1954, includes over 1000 abstracts of articles, books, monographs, theses, conference proceedings, etc., dealing with linear programming and related topics such as nonlinear programming, dynamic programming, and game theory. The comprehensive work embraces references on the history, progress, and application of mathematical programming. It is divided into four sections: Part I, "Introduction," covers the early development and basic concepts of linear programming; Part II, "General Theory," embraces a wide range of topics such as advanced mathematical aspects of linear programming, computational methods and machine techniques, linear inequalities and convex sets, and theory of games; Part III, "Applications," presents applications to industrial, agricultural, and military problems, and contains a basic bibliography of material related to the field of production scheduling and inventory control; Part IV, "Nonlinear and Dynamic Programming," covers the mathematical and computational aspects of nonlinear and dynamic programming. Each section is prefaced by an expository discussion of the scope and contents of the material listed.

Notwithstanding the spate of impressive publications on the applications of linear programming, its record of accomplishment does not support the glowing advocacy of it as a practical tool in management science; its contribution has been marginal at best. The lack of efficient computational techniques and machine methods precludes the use of mathematical programming as an effective vehicle in solving the multifarious and vexing problems inherent in many large-scale industrial, governmental, and military operations. The reviewer does not discount the progress already made, but wishes to stress the fact that extensive research is still required to effectively solve the complex and formidable problems of management.

In the opinion of the reviewer, the bibliography will serve as an invaluable aid and guide for obtaining a detailed account of the current mathematical techniques and applications. The broad spectrum of references describing the work in the field of linear programming makes the subject accessible even to readers without advanced training in mathematics.

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44[X, Z].—R. W. METZGER, *Elementary Mathematical Programming*, John Wiley & Sons, Inc., New York, 1958, ix + 246 p., 22.5 cm. Price $5.95.

This book was written as an attempt to fill a gap which exists in the literature concerning mathematical programming. The author tries with singular success to hit the middle ground between purely literary discussions for the layman, which are of no technical value, and highly technical papers, which are incomprehensible to all except professional mathematicians. Mr. Metzger assumes his reader has a limited background in mathematics but wishes to understand the basic techniques and applications of mathematical programming.

In Chapters 2, 3, and 4 Mr. Metzger gives an excellent exposition of the distribution, simplex and approximation methods. The techniques are worked out by use of sample problems which are well chosen for their simplicity and applicability. The mathematics of the analysis and solution is complete, accurate, and understandable. Mr. Metzger goes to considerable lengths to keep the reader from getting lost in unfamiliar mathematics. At no time is the reader informed that "it is not difficult to show that . . ." Each step is carefully explained. No proofs are given for any of the methods. However, intuitive explanations keep the reader from feeling that the mathematics involved is a kind of "black box" which magically produces the right answer. Adequate references are given for those who wish to verify the proofs. Each method of solution is summarized in a step by step listing of the procedure for easy reference.

Chapter 6 is a short discussion of computers and their applications in this field. Existing programs for various computers are mentioned and some indications given as to size limitations and time required for computation.

The remaining chapters are concerned with various applications of mathematical programming to industrial and business problems. The analysis preceding and following the mathematical computation are emphasized and illustrated with somewhat simplified but practical problems.

The book is well documented, and contains a fairly good bibliography. It is best suited for individual study but could be used as a text or supplementary text in a course. The only fault lies in the scarcity of practice problems other than those worked out in full in the text.

This book will be extremely valuable to any person who wishes an introduction to mathematical programming, whether or not he is a mathematician. Mr. Metzger should be commended for fulfilling a real need.

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45[Z].—NED CHAPIN, *An Introduction to Automatic Computers*, D. Van Nostrand Company, Inc., Princeton, New Jersey, 1957, viii + 525 p., 25 cm. Price $8.75.

The stated objective of this revised edition of a 1955 book is to present computers from the business systems point of view. This is developed through two subbooks, one set of chapters dealing with the logical and engineering nature of a computer and with structural and operating characteristics of a large number of commercial devices and computers, and another set of chapters dealing with the applications of computers in business operations. The programming chapters are related to computers, not to application.

The style and depth are largely that of the numerous popularizations in business, systems and accounting periodicals. There is prevalence of many of the common clichés and generalizations, preoccupation with explaining or destroying "popular misconceptions", and some narrowness of viewpoint about the nature of business management and the role of computers in it. Many managers are still seeking conceptual simplification and education about computers and their relation to management. It is doubtful that they approach this search as less than serious students, students hoping to find scientific classification and orderly development rather than demeaning and patronizing popularization.

To its credit, this book touches on several very important aspects of computers in business—the control features of systems, operations research and management science related to system definition, organization and administration of computer activity, company planning for computers, etc. There is, however, no originality, no profundity, no sureness of touch, no indication of "battle action" with these matters. Instead, there is a hollow reflection of culled magazines. There is, for example, a dearth of case history presented from the author's vast experience, the experience which qualified him to write this book.

Because there is as yet an extremely limited literature dealing with business systems design in general and with principles of the use of computers in such systems in particular, this text should prove useful, say, at the level of undergraduate students in business administration or of the high-speed orientation courses contained in the "management development programs" of many large companies. Better to serve this purpose, there are a sizeable glossary, an extensive collection (already badly out of date) of data on commercially available computers after the manner of the ONR and BRL surveys, historical material, bibliographic references partitioned by chapter content, and even related homework assignments. The popular style should contribute to the book's palatability as an undergraduate text.

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46[Z].—LOUIS COUFFIGNAL, *Les Notions de Base*, Gauthier-Villars, Paris, 1958, 60 p., 24 cm. Price $1.55.

The title of this little pamphlet needs to be interpreted. At the top of the title page is Information et Cybernetique, Collection Internationale.

On a fly leaf are the names of three projected items of the Collection: Boulanger, *L'Automation*; Prudhomme, *Construction des machines automatiques*; and Ducasse, *L'expression des connaissances techniques.*

In the light of these the title of this pamphlet becomes clear, namely, "the basic notions of information theory and cybernetics."

Monsieur Couffignal merely lists and comments on the basic notions; there is nothing original. In fact, a fair part of the text consists of quotations from M. Couffignal's other publications.

Wiener first published the doctrine of cybernetics in 1948. The term comes from the Greek word for pilot. Aboard ship the captain decides where to go and the helmsman works the mechanism of the ship, but the pilot between them contrives that the work of the helmsman shall achieve the object of the captain. Cybernetics is the study of means—principally feed-back—of reaching prescribed goals. Subsequently Wiener published *The Human Use of Human Beings* about the social implications of cybernetics.

Couffignal contests the scientific character of these two books. It is in the analysis of human action that Couffignal hopes to find essential principles. Man lives in an environment. His actions have an object, to affect the environment. Each action is preceded by preparation for the action, a program. Preceding the program is a decision to act, based on judgements of values. Thus a definite structure appears.

Having acted, there are three possibilities. First and simplest, the environment is affected as foreseen in the program. Or, second, the environment reacts in an unforeseeable fashion, but according to known laws. A simple example is the temperature regulation of a building; because of unknowns such as the number of times doors will open or the number and activity of the occupants, it is not possible to prescribe directly how to regulate the furnace. But a simple feed-back makes possible a program that accomplishes the desired objective. Third, the environment reacts according to unknown laws in an unforeseeable way, as a pursued butterfly.

Each of the situations above requires information about the environment; the less the reaction of the environment is understood, the more information is needed to build an effective program. Thus information is seen to be an essential of cybernetics.

The word "information" comes from the French, and originally designated the action of giving a form; it still has this connotation in its legal usage. The concept "quantity of information" is new. A specific occurrence of information has a physical form which is irrelevant to its meaning. For instance, a television program is fed over a microwave network as modulation of super-high-frequency radio waves, at a transmitting station it may be remodulated onto ultra-high-frequency or very-high-frequency waves, or recorded on magnetic tape. At a receiver it is viewed as a picture on a kinescope and it may be photographed. Each of these physical forms is different and is called a "support" by Couffignal. The common property of all the possible forms of an information he calls its "semantic."

Couffignal argues that cybernetics is not a science. Neither is it a technology nor an applied science. He concludes that it is an art, the art of insuring effectiveness of action. The material with which it works is information.

He conceives for each technique a set of systems in which the technique is effective. This set of systems is called the "domain of effectiveness" of the technique. It is intended that subsequent works in the series of which this is the first will report progress in exploring these domains. Some possibilities are: "subjective man", who reacts to his concept of his environment instead of the environment itself; "social man", who reacts to a social environment, or who reacts en mass as a social unit. The theory of governors may yet apply to Governors with a capital G. There is the domain of machines, especially information machines. A parallel domain is that of automation, the replacing of human beings by machines. There is the domain of models and simulation, which includes mathematical models (such as the Maxwell equations) of the physical world. And then there is the domain of knowledge. This is clearly basic. In fact, it is overwhelming that Couffignal stakes out such a broad claim.

The last chapter is a bald list of concepts. It is in six categories: human beings; human actions; information; mechanisms; analogues; and mentality.

Evidently M. Couffignal believes that he is starting something that will have far-reaching consequences. He has mapped out a broad outline that will take a generation to fill in. But he has only outlined broad areas with vague boundaries; subsequent items in this collection will need to be much more precise if they are to have scientific value.

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47[Z].—J. von Neumann, *The Computer and the Brain*, Yale University Press, New Haven, Conn., 1958, xiv + 82 p., 21 cm. Price $3.00.

This small volume constitutes the last contribution of one of the great scientists of our time, John von Neumann. The material was prepared for delivery at Yale University during the spring of 1956 in the Silliman Lectures series. However, the lectures were never given, owing to the increasing severity of the illness which finally took von Neumann's life on February 8, 1957. The subject is one which attracted his interest for a number of years. It is a subject in which he was eminently qualified, by virtue of his great genius and his contributions in the fields of high-speed calculators and the logic of automata. In spite of the preliminary nature of this work, it is destined to become the nucleus of a new field of research which will challenge the minds of men for many years to come—the comparative study of the human brain and man-made automata.

The book is divided in two parts. In the first part von Neumann discusses the basic principles underlying the design of modern computing machines, both analog and digital. Some of the properties of analog computers receiving special attention are: (1) their continuous but approximate method for representing quantitative information; (2) their capacity to obtain valid solutions to many classes of mathematical problems in spite of their limited accuracy, which is, at best, 0.01%; and (3) the use of basic operations more advanced than the four arithmetic operations in some analog calculators such as the "Stieltjes" integral in the differential analyzer. The characteristics of modern electronic digital calculators are discussed in somewhat greater detail. Of special interest for comparison with the human brain are: (1) the quantized or "marker" method for representation of information; (2) the conventional basic arithmetic and logical operations used; (3) the organization of the controls of digital calculators, which is governed by strict logical rules and prescribed sequences; (4) the high precision available in these computers, which is approximately 10^{-11} in large-scale computers currently in operation; (5) the organization and capacity of the memory components; (6) the great arithmetic and logical "depth" required for the solution of most problems on digital computers (i.e. the very large number of operations used in sequence); (7) the use of the memory for storing instructions as well as other information, resulting in the capability of digital computers to modify or operate on instructions; and (8) the use of interpretive subroutines or "short codes" for carrying out functions more advanced than the basic operations built into the hardware of a computer. One of the key points made by von Neumann is that the very high precision requirement of digital computers is dictated by the inherent deterioration of accuracy resulting from the very large number, or great "depth," of the mathematical and logical operations used in sequence.

In the second part von Neumann compares the functioning of the human brain with the operation of a modern computer, bringing out the areas of "similarity and dissimilarity between these two kinds of automata." He begins by describing the known properties of a neuron and the apparent digital character of its mechanism for receiving and transmitting pulses. Some of the more superficial comparisons between the human brain and its man-made counterpart are: (1) *speed*—there is a factor of about 10^4 to 10^5 in favor of the man-made components; (2) *size*—there is a factor of about 10^8 to 10^9 in favor of the human brain (the number of neurons estimated in the central nervous system is of the order of 10^{10}); (3) *energy dissipation*—there is a factor of 10^8 to 10^9 in favor of the human components; and (4) *accuracy*—there is a factor about 10^8 in favor of the artificial componentry.

Looking deeper into the more intrinsic areas of comparison, von Neumann is led to the conclusion that the basic internal language used by the brain is undoubtedly quite different from the mathematical language with which we are acquainted. He arrives at this conclusion primarily on the basis of the argument that the information stored in the brain lacks sufficient accuracy to enable it to carry out mathematical and logical processes in such "depth" as would be required if the language used were based on conventional mathematical symbols. Von Neumann conjectures that the language used by the brain is probably statistical in nature in which correlation processes play an important role. (See *The Perceptron—A theory of statistical separability in cognitive systems*, Cornell Aero. Lab. Inc., Report Nos. VG 1196 G-1, 1958 and 1196 G-2, by F. Rosenblatt.) He concludes the book with the remark: "Thus logics and mathematics in the central nervous system, when received as languages, must structurally be essentially different from those languages to which our common experience refers.

"It also ought to be noted that the language here involved may well correspond to a short code in the sense described earlier, rather than to a complete code: when we talk mathematics, we may be discussing a *secondary* language, built on the *primary* language truly used by the central nervous system. Thus the outward forms of *our* mathematics are not absolutely relevant from the point of view of evaluating what the mathematical or logical language *truly* used by the central nervous system is. However, the above remarks about reliability and logical and arithmetical depth prove that whatever the system is, it cannot fail to differ considerably from what we consciously and explicitly consider as mathematics."

(Courtesy of *Applied Mechanics Reviews*) H.P.

48[Z].—CHARLES V. L. SMITH, *Electronic Digital Computers*, McGraw-Hill, New York, 1959, xi + 443 p., 24 cm. Price $12.00.

In the preface the author states: "This is not a treatise on digital computer engineering, nor on the other hand an exhaustive treatise on logical design. The reader will find considerable discussion of circuits and components—enough, I hope, to give him a reasonably complete understanding of various ways in which the usual functions of a computer, such as memory, control, the performance of arithmetic, and input and output, can be realized physically. But I have not attempted a treatment sufficiently detailed to provide design information. The reader will also find sufficient information on computer arithmetic and instruction codes to provide him with a basic understanding of these matters, but here again I have not attempted the detailed treatment that a logical designer would demand, and I have for brevity considered only machines using binary arithmetic. My purpose has been to provide the reader with sufficient information to understand how digital computers function."

No book of this size could possibly cover every phase of computers; however, for the numerous topics chosen, the author's objective has been met. Mathematicians, programmers, and engineers who have limited knowledge of the basic principles should find this volume especially useful in extending their understandings. As stated previously, this is not a treatise, and its organization is such that it is probably most useful as a reference text. There are many additional references footnoted throughout the book for those desiring additional details. The usefulness of the subject index, however, suffers somewhat because of its brevity. The bulk of the material has been written about computers and techniques of 1956 and earlier, but this need not detract in any way from the value of the material.

Chapter titles are:

1. Digital-computer Arithmetic (Number Systems and Their Machine Representation)
2. Instruction Codes

3. Some General Considerations on Systems (Basic Functions and Inner Structure)
4. Basic Logic Circuits and Their Representation (Logic or Switching Circuits)
5. Static Memory Cells (Circuits and Devices Having Two Stable States)
6. Dynamic Memory Cells (Circuits and Devices Which Require Recirculation or Regeneration)
7. Higher-order Logic Circuits (Boolean Algebra, Switching Matrices)
8. Shifting Registers (Basic Storage Combined into Complex Structures)
9. Counters
10. Adders and Accumulators
11. Large-scale Memory Devices I (Magnetic Drums, Ultrasonic and Magnetostrictive Delay Lines)
12. Large-scale Memory Devices II (Electrostatic Tubes and Magnetic Cores)
13. The Arithmetic Unit
14. The Memory
15. The Central Control
16. Input and Output
17. Superspeed Computers (NBS, LARC, STRETCH, ILLIAC II).

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