closed with this information or mailed directly to the Treasurer, Mr. ROBERT V. D. CAMPBELL, Raytheon Manufacturing Company, Waltham, Mass.

American Statistical Association.—"High-speed automatic computing machinery" was the discussion topic at a meeting of the local chapter of the American Statistical Association in Washington, D. C., on October 27, 1947, at 8:00 p.m. A survey of the national machine development program was presented by Dr. J. H. CURTISS, Chief of the National Applied Mathematics Laboratories, National Bureau of Standards. This was followed by a talk by Mr. J. L. MCPHERSON of the Census Bureau on "The application of high-speed automatic digital computing machinery to statistical tabulation" (see DISCUSSIONS).

On the evening of November 10, 1947, the chapter presented talks on "The solution of statistical problems for automatic computing machines." In keeping with this topic, Dr. E. W. CANNON, Chief of the Machine Development Laboratory of the National Bureau of Standards, discussed "Instruction codes for high-speed automatic computing machines," and Mrs. IDA RHODES, also of the Bureau, in a talk on "Programming problems for solution," presented the coding sequence to be used on the new machines for several problems of a statistical nature.

National Electronics Conference.—On Tuesday, November 4, 1947, a meeting on electronic computers was held at Chicago, Illinois. Dr. J. W. MAUCHLY of the Electronic Control Company, Philadelphia, Pa., discussed computers from the block diagram, or functional, standpoint. This was followed by a talk by Mr. J. M. COOMBS of Engineering Research Associates, St. Paul, Minnesota, on the development of magnetic disc memory devices. Mr. O. H. SCHUCK, of the Minneapolis-Honeywell Company, also spoke on analogue potentiometer-type computers for aeronautical navigation. Most of the discussion at the meeting centered around the computing ability, reliability, and time required for construction of the proposed machines.

OTHER AIDS TO COMPUTATION

BIBLIOGRAPHY Z–III

1. LEE JOHNSON, "How to speed up slide-rule work," *Engineering News-Record*, v. 139, July 24, 1947, p. 112–114. 21 × 28.6 cm.

2. "Kinks and short-cuts—Winder production aided by slide-rule calipers," *Textile World*, v. 97, no. 10, Oct. 1897, p. 154–156. 21 × 28.6 cm.

"Loss of production time can be avoided in the winder room by using this slide-rule caliper for estimating the amount of yarn on unfinished cones at shift-changing time. Instead of allowing the machine to remain idle while a part of a set could be run, the operator can run the part set with assurance that piece-rate pay for the number of pounds run will be equitably apportioned. The calipers indicate the number of pounds run according to package diameter and spindle assignment."

3. R. G. MANLEY, "Computer for principal stresses," *Engineering*, v. 164, Oct. 10, 1947, p. 340–341. 26.4 × 36.1 cm.

An instrument consisting essentially of two horizontal slides, one vertical slide and three cursors, one of which carries a radius arm and protractor.

4. L. E. WADDINGTON, "A slide rule for the study of music and musical acoustics," Acoustical Soc. Amer., *Jn.*, v. 19, Sept. 1947, p. 878–885. 20 × 26.6 cm.

"Musicians are seldom concerned with the mathematical background of their art, but an understanding of the underlying physical principles of music can be helpful in the study of music and in the considerations of problems related to musical instrument design. Musical data and numerical standards of the physics of music are readily adaptable to slide-rule presentation, since they involve relationships which are the same for any key. This rule adjusts relative vibration rates, degrees of scale, intervals, chord structures, scale indications, and transposition data, against a base of the piano keyboard. It employs and relates several standard systems of frequency level specification."

5. A. J. BARACKET, "Square-wave response," *Electronics*, v. 20, no. 8, Aug. 1947, p. 130. 21 × 28.5 cm.

"Nomograph correlates tilt of square wave after passage through uncompensated RC-coupled video or audio amplifier with low-frequency response of amplifier and time constant of coupling circuit."

6. IRA J. HOOKS, "Nomograph aids use of Boussinesq equation," *Civil Engineering*, v. 17, June 1947, p. 46–47. 21 × 28.6 cm.

Boussinesq's equation is $y = 3Pz^3/[2\pi(r^2 + z^2)^{5/2}]$.

7. R. E. LAFFERTY, "Voltmeter loading," *Electronics*, v. 20, no. 10, Nov. 1947, p. 132–133. 21 × 28.5 cm.

"Simple nomograph $[SE_L(E - E_H) = E_H(E - E_L)]$ gives true voltage in high-impedance circuit when measurements are made with two different voltage ranges of an ordinary low-sensitivity voltmeter. Underlying equations for voltmeter error are given, with examples of use."

8. KURT BENJAMIN, "Problems of multiple-punching with Hollerith machines," Amer. Statist. Assoc., *Jn.*, v. 42, Mar. 1947, p. 46–71.

9. BERTRAM J. BLACK & EDWARD B. OLDS, "A punched card method for presenting, analyzing, and comparing many series of statistics for areas," Amer. Statist. Assoc., *Jn.*, v. 41, 1946, p. 347–355.

10. PSYCHOMETRIC SOC. & IBM, *Proceedings of the Research Forum, Endicott, New York, August 26–30, 1946.* IBM, New York, 1947. 94 p., 21.6 × 28 cm.

CONTENTS: LEDYARD TUCKER, "Simplified punched card methods in factor analysis," p. 9–19; PAUL S. DWYER, "Simultaneous computation of correlation coefficients with missing variates," p. 20–27; ALBERT K. KURTZ, "Scoring rating scales after the responses are punched on IBM cards," p. 28–34; CHARLES I. MOSIER, "Machine methods of scaling by reciprocal averages," p. 35–39; W. G. COCHRAN, "Use of IBM equipment in an Investigation of the 'truncated normal' problem," p. 40–44; JOHN C. FLANAGAN, "Use of IBM equipment in obtaining stanines in the AAF," p. 45–51; JOHN V. MCQUITTY, "Maximum use of mechanical aids in handling test results," p. 52–55; H. S. DYER, "Making test score data effective in admission and course placement of Harvard freshmen," p. 56–62; ERWIN K. TAYLOR, "The use of a single card column for recording variables with a range of 30 or fewer units," p. 63–67; HERBERT A. TOOPS, "The research possibilities of addends," p. 68–74; W. J. ECKERT, "Facilities of the Watson Scientific Computing Laboratory," p. 75–80; H. R. J. GROSCH, "Harmonic analysis by the use of progressive digiting," p. 81–84; WARREN G. FINDLEY, "The use of the IBM test-scoring machine in the N. Y. State scholarship programs," p. 85–88; ARTHUR E. TRAXLER, "Accuracy of machine scoring of answer sheets marked with different degrees of excellence," p. 89–94.

11. A. D. BOOTH, "Two calculating machines for X-ray crystal structure analysis," *Jn. Appl. Physics*, v. 18, July, 1947, p. 664–666.

First two paragraphs: "Apart from large and expensive machines for performing automatically the whole range of crystallographic calculation, there remains a need for simple *ad hoc* devices to deal with particular aspects of the problem. If the current schemes for centralizing the latter stages of Fourier refinement come to fruition, this demand for the 'home made' and simple type of calculator is likely to be increased.

"It is the purpose of this paper to describe two such arrangements which the author designed and found useful in practical structure analysis. The first is especially valuable in the case of tetragonal space groups and found extensive application during the determination of the structure of pentaerythritol tetranitrate. The second is considerably simpler in principle and in design, and has been in constant and satisfactory use in structure analysis for the past four years." (See G. A. JEFFREY, R. Soc. London, *Proc.*, v. 183A, 1945, p. 388 and v. 188A, 1947, p. 222. Also *Math. Rev.*, v. 8, 1947, p. 606, S. H. C.)

12. GREAT BRITAIN, MINISTRY OF SUPPLY, Aeronautical Research Council, *Reports and Memoranda* no. 2144, Aug. 1944: R. A. FAIRTHORNE, *Mechanical Instruments for Solving Linear Simultaneous Equations.* London, His Majesty's Stationery Office, July 1947, 7 p. 23 × 30.4 cm. 1 shilling and 6 pence.

"*Summary:* The solution of linear simultaneous equations is necessary for the investigation of many important aeronautical problems, such as those of flutter, stability and vibration.

"Some mechanical instruments for the direct solution of these equations are reviewed, the principles used ranging from nomography to hydrostatics. It is concluded that, while almost any mechanical principle can be employed, the instrument can be successful only if carried out as a major engineering project.

"A practical limit to the value of any instrument is the time taken to set up the coefficients. A mechanical device would seem always to be inferior to an electrical in this respect.

"It is suggested that attention might be given to mechanical nomograms, such as Torres' Arithmophores, and, in the light of contemporary projection and motion picture technique, to extension of the principles of multiplane nomography."

For Arithmophores of LEONARDO TORRÈS QUEVEDO, see M. D'OCAGNE, *Le Calcul Simplifié*, third ed., Paris, 1928, p. 80–81, 158–167.

13. EGBERT HARBERT, *Vermessungskunde.* V. 1, third ed., Berlin, Verlag der deutschen Arbeitsfront, 1943. "Rechenhilfsmittel," p. 275–304.

The pages are pleasantly discursive. On p. 275–283 are discussed tables of NAPIER, BÜRGI, BRIGGS, F. G. GAUSS & GOBBIN, BREMIKER, VEGA, JORDAN, CRELLE, H. ZIMMERMANN and L. ZIMMERMANN; and then, p. 303–304, trigonometric tables of PETERS, F. G. GAUSS, BRANDENBURG, JORDAN, STEINBRENNER, BALZER & DETTWILER, LEUPIN. In all this, more space is devoted to various tables of Gauss than of any other author.

Slide rules, and in particular those of GUNTER, OUGHTRED, and SCHERER, are discussed, p. 283–289.

Pages 290–303 are devoted to Calculating machines with references to PASCAL, LEIBNIZ, HAHN, POLENI, THOMAS, ODHNER (always misspelled by Harbert), BRUNSVIGA, HAMANN, MERCEDES-EUKLID, and MILLIONAIRE.

14. W. MEYER ZUR CAPELLEN, *Mathematische Instrumente* (*Mathematik und ihre Anwendungen in Physik und Technik*, ed. by E. KAMKE & A. KRATZER, series B, v. 1). Second enlarged ed., Leipzig, Akademische Verlagsgesellschaft, 1944. x, 313 p., 250 figures and illustrations. Offset print, without correction of errors. Ann Arbor, Mich., Edwards Bros., 1947. Published and distributed in the public interest by authority of the Alien Property Custodian under License no. A1064. $10.50.

The present book of which the first edition appeared in 1941, describes a wide range of mathematical devices, mainly of German or continental origin. There is considerable emphasis on constructional detail and the actual use of the instruments.

The major part of the book is divided into five sections: Calculating Devices, p. 4–142; Geometrical Devices, p. 143–169; Differentiators, p. 170–178; Integrators and Harmonic Analyzers, p. 179–289. There is a bibliography, p. 290–305, listing 310 references, an excellent coverage of such material appearing during the past 20 years; 174 of these items were published 1936–1943.

The calculating device section begins with a description of various addition and multiplication devices. Specifically, the various differentials are described as well as similar triangle multipliers, the disc integrator as a multiplier, the three-dimensional cam, a WHEATSTONE Bridge multiplier and various mechanisms involving sliding rods, mounted in revolvable collars, which are used for multiplication, division and various trigonometric purposes. A device of this type for the solution of nomograms is described (p. 31–32).

The next portion of this section (p. 32–53) is mainly devoted to the slide rule. A slide rule of the "System Darmstadt" pattern is described in detail. The various scales and their uses are indicated and a table describing 89 formulae which can be almost immediately evaluated by means of the slide rule is given. There is also a description of certain more complicated logarithmic devices.

A detailed and exceedingly interesting description of desk type calculating machines of German manufacture follows (p. 53–131). The exterior of the machines is first described and the exact significance of the various operational cranks and auxiliary keys is given. Then the interior mechanisms are described with proper emphasis on the tens transmission. The verbal descriptions are clear but some of the photographs seem to have suffered from this offset reproduction and are too dark to be of effective assistance. The uses of these machines, and the usual, very useful, precisely stated procedures, are given in the final section of this chapter.

The following machines are described in detail: 1. A LEIBNIZ wheel machine made by "Rheinmetall," 2. Two-sprocket wheel (ODHNER) types, see *MTAC*, v. 2, p. 149, "Brunsviga" and "WALTHER," 3. A proportional lever type "Mercedes-Euclid," 4. The "Hamann," which has its own characteristic feed, the "Schaltklinken" (switching catch?) arrangement. There are briefer descriptions of the "Millionär," which splits the multiplication table, and of the "Continental" which uses a key stop or Comptometer principle.

The author seems to favor the handdriven machines and the smaller electrical devices and it may be that if a scientist uses a calculating machine only during a small part of his time, he may find these smaller machines just as effective for his purposes. However, among those who spend a good deal of time on calculations, there is certainly a demand for the maximum mechanization possible. For the desk machine, the dividing line seems to be at the automatic multiplication point. Machines with this additional ability cost more but in many cases the time saved, when computed in terms of salary, easily justifies the additional expense. And certainly in this country, the use of automatic punched card computing has made it possible to consider scientific questions which would be far beyond the capacity of desk type machines.

The calculating devices section ends with a chapter which considers devices for the solution of equations. The WILBUR and MALLOCK linear equation solvers (see *MTAC*, v. 1, p. 350; v. 2, p. 158) are described and also an electrical machine due to BODE, which uses reactances. There is an adjusting type of device due to RECK but the convergence question is not considered. For a polynomial equation, the HART-TRAVIS machine (see *MTAC*, v. 1, p. 350) is described and also T. C. FRY's isograph (see *MTAC*, v. 1, p. 167), with which only the names DIETZOLD-MERCNER are associated by the author.

The geometrical devices part of the book contains chapters on various instruments for the accurate graphing of functions in cartesian or polar coordinates, changing scale and various graphical transformations as well as one on the instruments for drawing conic sections and the more general curves like the cycloids and spirals. Instruments for measuring arc lengths are also given here. In the next part on Differentiators, optical methods for determining tangents are described.

The Integrator part contains a description of the various planimeters, integraphs and integrometers. This part also contains a section on the differential analyzer. The precise procedure for the use of the PRYTZ planimeter is also given and also for certain related devices. The concluding part on the Harmonic Analyzers (p. 273–290) seems rather brief.

The reviewer feels that a German-English glossary of technical terms would be very helpful for reprints of this type.

The book is a valuable contribution to the literature. Its general plan is well conceived, and the various detailed descriptions and many of the photographs are excellent. It certainly should be available to those who own or operate one of the German machines, both to utilize the device with maximum effectiveness and in case of needed repair.

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15. S. VAJDA, "Shortcutting in multiplication on a calculating machine," *Math. Gazette*, v. 31, July 1947, p. 172–173.

16. HENRY G. WEISSENSTEIN, "Calculating machine furnishes shortcut method of computing P.I. of two lines," *Civil Engineering*, v. 17, Sept. 1947, p. 545. 21 × 28.6 cm.

"Computing the coordinates of the point of intersection of two lines is a rather tedious process if done the conventional way using the law of sines. With the help of a calculating machine considerable time can be saved using the method shown in this article."

NOTES

87. GERMAN ALTITUDE AND AZIMUTH TABLES.—DEUTSCHE SEEWARTE, (**a**) *Höhen und Azimute der Gestirne, deren Abweichung zwischen 30°S und 30°N liegt, für 50° Breite.* (**b**) *Höhen und Azimute der hellen Fixsterne bis zur dritte Grösse deren Abweichung grösser als 30°N ist, für 50° Breite.* Herausgegeben vom Reichs-Marine-Amt. Berlin, 1916, (**a**) xxiii, 377 p., (**b**) xii, 88 p. 20.5 × 30 cm.

(**a**) This volume is clearly one of a series, but neither the introduction nor preface gives any indication of the extent of that series. The preface of the particular volume under review is dated July, 1916, and that of the exactly similar volume for latitude 70°, September, 1917; there also exists a volume for latitude 55°, preface dated June 1916, which is printed by a photo-lithographic process from manuscript figures. Although the ms. is very good it cannot compare in legibility with printed figures; surprisingly the format is smaller than for the printed volumes, the overall size being 20.5 × 27.5 cm. The preface hints that the manuscript has been reproduced by photography to lessen the chance of errors occurring in the process of letterpress printing; presumably, experience rapidly led to placing legibility higher than freedom from error! In all the volumes users are begged to communicate errors to the compilers.

The main tables comprise the most extensive tables of altitude and azimuth for a given