15. Clifford E. Berry & J. C. Pemberton, "A twelve-equation computing instrument," *Instruments*, v. 19, 1946, p. 396–398.

See the article by Berry, Wilcox, Rock & Washburn, "A computer for solving linear simultaneous equations," reviewed by D. H. L., *MTAC*, v. 2, p. 222–223.

16. Ȋu. G. Tolstov, "Novyĭ elektricheskiĭ apparat dlîa harmonicheskogo analiza i sinteza" [A new electrical apparatus for harmonic analysis and synthesis], Akad. N., SSSR, *Izvestiîa*, *Otdelenie tekhnicheskikh N.*, Apr. 1946, no. 3, p. 389–400. See *Math. Rev.*, v. 8, 1947, p. 287, H. B. Curry.

17. I. S. Bruk, "A mechanical device for the approximate solution of the Poisson-Laplace equations," Akad. N., SSSR (*Dok.*) *C.R.*, v. 53, 1946, p. 311–312. See *Math. Rev.*, v. 8, 1947, p. 288, S. H. C.

18. I. S. Bruk, "A device for the solution of ordinary differential equations," Akad. N., SSSR (*Dok.*) *C.R.*, v. 53, 1946, p. 523–526. See *Math. Rev.*, v. 8, 1947, p. 288, S. H. C.

19. R. Fürth & R. W. Pringle, "A photo-electric Fourier transformer," *Phil. Mag.*, s. 7, v. 37, 1946, p. 1–13. See *Math. Rev.*, v. 8, 1947, p. 287–288, S. H. C. See also *MTAC*, v. 2, p. 89.

NOTES

80. Certain Gear-Ratio Tables.—We have previously referred to gear ratios in *MTAC*, v. 1, p. 21–23, 88, 92, 143, 324, 326–329, 430. In the tenth edition of their *Formulas in Gearing*, 1929, the Brown & Sharpe Mfg. Co. first published their 6D table, p. 239–243, Logarithm of Gear Ratios N/D, $N \leqslant 100$, $D \leqslant 100$, $\frac{24}{100} < N/D < \frac{100}{24}$. It was not until the eleventh edition, 1933, p. 227, that to the title of these tables is appended the footnote, "Wingquist's Tables (American Machinist)." This footnote is quoted by FMR, *Index*, p. 22. On appealing to Henry D. Sharpe, President of the Company, and Chancellor of Brown University, he kindly furnished the following details:

Erik Wingquist, in *American Machinist*, v. 43, 1915, p. 1080–1083, 1114–1118, published a 7D table of log N/D, for gear-ratios $\frac{30}{100} < N/D < \frac{100}{30}$. "Apparently we had used these tables in making hob-sheet calculations of the gearing for backing-off lathes. The tables, however, stopped at 30 teeth whereas we had to use change gears with as few as 24 teeth. When we decided to include a table of logarithms of gear ratios in the *Formulas*, it was also decided that the table should go down to 24:100. Accordingly our Mr. L. R. Mayo made the necessary revisions of Wingquist's tables to interpose and add all the new ratios involved with pinions having numbers of teeth between 24 and 30."

Hence the table in *Formulas*, by two authors, Wingquist & Mayo, is both an expansion and abridgment of Wingquist's table. Thus there is call for revision of the FMR entry in order accurately to present all that is here involved.

R. C. A.

81. Guide (*MTAC*, no. 7), Suppl. 6 (for Suppl. 1–5 see v. 1, p. 403, v. 2, p. 59, 92, 190f., 224).—S. P. Glazenap, *Matematicheskie i Astronomicheskie Tablit͡sy*, Leningrad, 1932, p. 103: 4D tables of $C[(2x/\pi)^{\frac{1}{2}}]$, and $S[(2x/\pi)^{\frac{1}{2}}]$, for $x = .04(.04)1, .5(.5)50$. There are two last-figure errors, namely: in S for $x = 1.5$, and in C for $x = 11.5$. These are corrected in Jahnke & Emde, *Tables of Functions*, 1945, p. 35.

N. R. Jørgensen, *Undersøgelser over Frequensflader og Korrelation*, Diss. Copenhagen, 1916. T. II, p. 153–156, $\log f_n(t) = \log [t^{-n}I_n(t)]$, for $n = 0(1)11$, $t = [0(.1)6; 7D]$, with first differences; the last figure is unreliable. This appears to be the only published table of this kind.

While it was noted in *MTAC*, v. 1, p. 253, 305, that B. A. Smith first tabulated and named Michell function in a paper on "Arched dams," a reference was given only to A.S.C.E., *Trans.*, v. 83 for years 1919–1920 (with title page dated 1921), p. 2027–2077, table on p. 2052–2055. The same table was, however, given in A.S.C.E., *Papers and Discussions*, v. 46, 1920, p. 400–403.

R. C. A. & Murlan S. Corrington

82. Herman Hollerith.—The American Council of Learned Societies and Charles Scribner's Sons have graciously granted us special permission to quote the following sketch of Hollerith written by the late Professor W. F. Willcox of Cornell University and published in *Dictionary of American Biography*, v. 21, New York, 1944, p. 415–416:

Hollerith, Herman (Feb. 29, 1860–Nov. 17, 1929), inventor of tabulating machines, was born in Buffalo, N. Y., the son of George and Franciska (Brunn) Hollerith. After preliminary schooling he attended the School of Mines of Columbia University and was graduated in 1879. Immediately thereafter he became an assistant to his teacher, William Petit Trowbridge [q.v.], in the Census of 1880. He worked on the statistics of manufacturers and prepared an article, "Report on the Statistics of Steam- and Water-Power Used in the Manufacture of Iron and Steel," for the *Report on Power and Machinery Employed in Manufactures* (Census Office, Department of the Interior, 1888). His work on the census brought him into contact with Dr. John Shaw Billings [q.v.], from whom came the suggestion of Hollerith's main invention. In a letter to a friend written nearly forty years later he described the origin of the idea: "One evening at Dr. B's tea table he said to me, 'There ought to be a machine for doing the purely mechanical work of tabulating population and similar statistics.' " Hollerith thought the problem could be solved and later offered Billings a share in the project.

In 1882 he went to the Massachusetts Institute of Technology, as instructor in mechanical engineering. He disliked teaching, however, and after a year moved to St. Louis, Mo., where he experimented on electromagnetically operated air-brakes and other types of brakes for railroads. From 1884 to 1890 he was attached to the Patent Office in Washington, D. C. During these years he worked on the problem of perfecting mechanical aids in tabulating statistical information. By the time the Census of 1890 was to be taken he had invented machines that would record statistical items, by a system of punched holes in a non-conducting material, and would also count those items by means of an electric current passed through the holes identically placed. The system was given trial in tabulating mortality statistics in Baltimore, and in compiling similar data in New Jersey and New York City. In competition with two alternative methods of tabulation, it was chosen for use in compiling the Census of 1890. It did a sample piece of work in less than half the time required by the other systems, and the commission estimated that in dealing with the returns expected at the approaching census the new machine would reduce the labor days by more than two-thirds. Subsequently the machines were improved by the addition of a mechanical feeding device. In 1890 the Franklin Institute of Philadelphia, reporting that Hollerith had made the outstanding invention of the year, gave him its highest award, the Elliott Cresson medal.

The Hollerith machines were used in 1891 in recording the census returns in Canada, Norway, and Austria. Although they revolutionized statistical technique, American scholars gave little attention to them at the outset, probably because statistical interpretation had not been carried as far in the United States as elsewhere. But in Europe technical articles about their value appeared in England, France, Germany, Austria, and Italy. Hollerith attended the Berne session of the International Statistical Institute in 1895 and commented upon a paper by an Austrian member. Between 1890 and 1900 the machines were successfully adapted to handle types of mass enquiries in which addition was an element, and thus they could be used in tabulating railroad freight statistics and the data assembled in the agricultural census.

In 1896 Hollerith organized the Tabulating Machine Company, incorporated in New York, to manufacture the machines and to sell the cards used with them. In 1911 that company was consolidated with the Computing Scale Company of America and the International Time Recording Company of New York to become the Computing-Tabulating-Recording Company, later known as the International Business Machines Corporation, of which Hollerith was retained as consulting engineer until 1921.

Hollerith died at his home in Washington, of heart disease, at the age of sixty-nine. . . . During his lifetime Hollerith received more than thirty patents from the United States Government, as well as many from foreign governments.

EDITORIAL NOTE: Hollerith received from Columbia University the E.M. degree in 1879 and the Ph.D. degree in 1890.

83. INTERPOLATION OF FUNCTIONS TABULATED AT FIXED POINTS.—In the recent note "The checking of functions tabulated at certain fractional points," the writer should have mentioned that those tabulated coefficients of f_k, say $A_k^{(n)}$, which give the $(n-1)$th divided difference for n particular points, $x_0, x_1, \cdots, x_{n-1}$ can also be used for interpolation according to a generalization of the scheme in W. J. TAYLOR, "Method of Lagrangian curvilinear interpolation," NBS, *Jn. Res.*, v. 35, 1945, RP 1667, p. 151–155. For, setting $a_k = A_k^{(n)}/(x - x_k)$, Taylor's scheme is essentially

$$f \sim \left(\sum_{k=0}^{n-1} a_k f_k\right) \Big/ \sum_{k=0}^{n-1} a_k.$$

This generalization of Taylor's scheme can always make use of the coefficients of the $(n-1)$th divided difference for any set of fixed irregularlyspaced points. In particular, the coefficients for the divided differences given in the author's "Coefficients for facilitating the use of the Gaussian quadrature formula," *Jn. Math. Phys.*, 1946, p. 246, and in "Tables for facilitating the use of Chebyshev's quadrature formula" (forthcoming), can also be used to interpolate for any function which is given at the zeros of either the Legendre or Chebyshev polynomials respectively.

HERBERT E. SALZER

NBSCL

84. THE NATIONAL APPLIED MATHEMATICS LABORATORIES.—After prolonged study and many conferences the National Bureau of Standards (NBS) started on July 1, 1947, to set up The National Applied Mathematics Laboratories (NAML) which, according to the plans set forth in *A Prospectus* (February, 1947, x, 46 p., with a Foreword by E. U. CONDON, Director of NBS), will not have its full initial personnel until 1949. We quote from this document. Applied mathematics is on the threshold of revolutionary developments which will permit numerical answers to physical problems to be obtained at hitherto undreamed of speeds. A strong, easily accessible, federal applied mathematics center, operating with low overhead costs, providing economical but competent computational and consulting services, and performing forward-looking research in the newer methods of applied mathematics, is a necessity in the national research program.

The work of the NAML, with Dr. JOHN H. CURTISS as Chief, is to be carried on with the guidance of a committee of representatives of interested outside groups, called the Applied Mathematics Executive Council. The NAML consists of four major units, as follows:

I. *The Institute for Numerical Analysis*, located at the University of California in Los Angeles, and starting operations in 1948. The present staff includes the following members: Mr. JOHN TODD, late of King's College, University of London; Dr. HARRY D. HUSKEY, recently of the National Physical Laboratory, Teddington; and Professor OTTO SZÁSZ, recently of the University of Cincinnati. Professor D. R. HARTREE of the University of Cambridge has been appointed Acting chief of the Institute for the duration of his stay in this country, June–September 1948.

II. *The Computation Laboratory*, located in New York or Washington; Dr. A. N. LOWAN is now Chief. In the future we shall refer to this group by the symbol NBSCL rather than NBSMTP.

III. *Statistical Engineering Laboratory* at the NBS, with Dr. CHURCHILL EISENHART as Chief. This is a statistical consulting service specializing in the application of modern statistical inference to the physical and engineering sciences.

IV. *Machine Development Laboratory*, Dr. E. W. CANNON, Chief, with A. Mathematics Group; B. Electronics Group, in the NBS. This is a Laboratory devoted to the development of automatic digital computing machinery, and its staff edits the department ACM in *MTAC*. Units II–IV are now functioning.

The general plan envisions a stabilization of operations within two years at a level of about 94 man-years and $532,000 annually. The estimated capital cost of automatic computing equipment, not included in these figures, is about $700,000.

The following NAML publication (Nov. 1947, 25p. 20.3 × 26.7 cm.) is an interesting one: *Activities in Applied Mathematics 1946–1947*.

85. NAML: THE COMPUTATION LABORATORY.—At this Laboratory there is now a staff of 60 people. The bound volumes of mathematical tables, issued from the NYMTP later NBSMTP, but now NBSCL, apart from those published by the Columbia University Press, are now distributed by the Superintendent of Documents, Washington, D. C. In the case of each of these volumes there were about 1500 copies in the edition. *Tables of the Exponential Function* e^x (1939) has long been out of print but a new edition is now in the press at the Government Printing Office. The edition of *Tables of Probability Functions* (2 v., 1941–1942) is nearly exhausted, but it is planned that these and other volumes shall be similarly reprinted.

Of volumes of the NBSCL published by the Columbia University Press the first editions consisted of approximately 800 copies. A second edition of *Table of The Bessel Functions* $J_0(z)$ *and* $J_1(z)$ (1943) is reviewed elsewhere in this issue, and a second edition of *Table of Circular and Hyperbolic Tangents and Cotangents for Radian Arguments* (1943) has been published.

The Superintendent of Documents, Washington, D. C., lists for sale 36 mathematical tables emanating from the NBSCL and its predecessors. Of these, 19, nos. M18–36, are shorter tables, mostly reprinted from the M. I. T. *Jn. Math. Physics*. This series is being continued, with a designation yet to be determined; its issues are not to be for sale. There is also a new publication of the NBS, *The Applied Mathematics Series*, containing mathematical tables, manuals and studies, by members of the mathematical laboratories of the NBS. More than 30,000 of the NBSCL tables are now in use, and the annual demand runs at the rate of about 3500 volumes.

86. RUSSIA AND MATHEMATICS.—In *Soviet News*, Soviet Embassy in London, no. 1542, Sept. 26, 1946 is an article by S. VAVILOV, president of the Soviet Academy of Sciences, entitled "Our five-year plan for science." The section on "Mathematics as a theoretical weapon" is as follows:

Mathematics, which is of vital importance to natural science, to technique, and to such social sciences as economics, is directly linked up with problems of philosophy and logic. Much of our five-year plan for mathematics is directed towards assisting other sciences. For example, we are stressing questions of the theory of probability—particularly those bearing on the interpretation of observations and research on partial differential equations, particularly those associated with what may be termed "machine mathematics," that is, the solution of mathematical problems with the help of calculating devices.

Calculating machines have been known for centuries. But never has "machine mathematics" reached such scope as at the present time. New calculators devised on electrical principles make it possible to solve extremely complex mathematical problems connected with technique and the various branches of natural science. So important do we think this side of mathematics, that we are proposing in the immediate future to devote to it a special institute.

However, machines can never displace mathematical thought. A characteristic of mathematical thought is its boldness, its imaginative power. Such creative mathematics, which at times finds no immediate application in technical science, has always found fertile ground in our Academy; and its development must continue on a broad scale. Such subjects as non-Euclidean geometry, the tensor calculus and the theory of groups, which seem to be abstract studies absolutely cut off from life and from reality, nevertheless suddenly assume a decisive significance at definite stages of scientific development.

This explains the inclusion in the Academy's plan of the problems of the theory of numbers, abstract algebra, topology and mathematical logic.

QUERIES

24. INTEGRAL OF A STRUVE FUNCTION.—In a problem of diffraction the following integral comes up: $\int_0^x H_0(t)dt$. Where may I find a published table of this integral for the range $x = [0(.1)10; 6D]$?

C. W. HORTON

Defense Research Laboratory
University of Texas

EDITORIAL NOTE: Since we received this Query for publication there came from Dr. JOHN W. WRENCH, JR., a copy of a table of $\int_0^x H_0(t)dt$, $x = [.1(.1)10; 8D]$. This was obtained by numerical integration of the values of $H_0(x)$ tabulated in G. N. WATSON, *A Treatise on the Theory of Bessel Functions*, second ed., Cambridge and New York, 1944, p. 666–684. For integral values of the upper limit the integral was calculated to about 15D by infinite series. This check on certain of the entries indicates that the maximum error in any entry should not exceed 0.6×10^{-8}.

25. RUSSIAN BESSEL FUNCTION TABLES.—According to an advertisement in *Matematicheskiĭ Sbornik*, v. 51, no. 3, 12 June 1941, the Mathematical Institute of the USSR Academy of Sciences was at this time in 1941 about to publish a volume entitled *Tablit͡sy Besselevykh Funkt͡siĭ Mnimogo Argumenta* [Tables of Bessel Functions with Complex Argument]. It was announced that the volume contained about 400 pages and was to cost 25 roubles. The Library of Brown University has long but vainly tried to procure a copy. Can any reader report on the ownership of this volume of tables by any individual or library, or on a copy for sale?

R. C. A.

QUERIES—REPLIES

33. PORTRAITS AND BIOGRAPHIES OF BRITISH MATHEMATICAL TABLE MAKERS (Q21, v. 2, p. 286).—Herewith are submitted references to biographical material concerning four of these table makers. (a) PETER BARLOW: Amer. Acad. Arts & Sci., *Proc.*, v. 6, 1866, p. 15–16; Inst. Civil Engin., *Proc.*, v. 22, 1863, p. 615–618; R.A.S., *Mo. Not.*, v. 23, 1863, p. 127–128; R. Soc. London, *Proc.*, v. 12, 1863, p. xxxiii–xxxiv. Sir HUMPHRY DAVY, *Six Discourses*, London, 1827, p. 111–115, also in H. DAVY, *Coll. Works*, v. 7, London, 1840, p. 76, 83–89. (b) RICHARD FARLEY: R.A.S., *Mo. Not.*, v. 40, 1880, p. 192–194. (c) HIRSCH FILIPOWSKI: *Jewish Encyclopedia*, v. 5, New York, 1903, p. 383 (M. BEER). (d) PETER GRAY: R.A.S., *Mo. Not.*, v. 48, 1888, p. 163–165.

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