

Conference on Advanced Computation Techniques

During the recent war there was tremendous development of certain types of computing devices. The big Harvard-IBM machine indicates the way in which a whole battery of IBM equipment can be brought under automatic electric control. Electronic devices have been constructed, or are under development, which promise astronomical speeds for numerical processes. At the Bell Laboratories there has been important development of automatic relay computing. Thus, with war's end these and other similar developments suggest that there will soon be available mechanical and electrical computing equipment which, in terms of speed and flexibility, will completely outdistance anything thought of before.

With this in mind the desirability of a Conference of those who, in this country and in England, have been recently directly and indirectly connected with the output of large computing machines became evident, and the National Research Council Committee on Mathematical Tables and Other Aids to Computation took steps for its organization. Most of the responsibility of this organization was placed in the hands of the Committee's Subcommittee Z (On Calculating Machines and Mechanical Computation) which then¹ had the following membership:

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|--------------------------------------|------------------|
| L. J. COMRIE, <i>Chairman</i> | J. C. P. MILLER |
| S. H. CALDWELL, <i>Vice-Chairman</i> | G. R. STIBITZ |
| H. H. AIKEN | I. A. TRAVIS |
| D. H. LEHMER | J. R. WOMERSLEY. |

Since the chairman had not yet arrived in this country, the vice-chairman carried out most of the detailed arrangements.

The Massachusetts Institute of Technology not only offered its facilities for such a gathering but also suggested that it should coincide with the first public demonstration of its new Differential Analyzer. The dates for the gathering were fixed as October 29, 30, 31, 1945. There were the following 84 guests who accepted our invitation:

<i>Name</i>	<i>Representing</i>
Abramowitz, Milton	Math. Tables Project, 150 Nassau St., New York City
Aiken, H. H. (Commander)	Computation Project, Cruft Laboratory, Harvard University
Alt, Franz (Lt.)	Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland
Archibald, R. C. (Prof.)	Nat. Res. Council Comm. (Brown University)
Arnold, H. A. (Lt. Commander)	Computation Project, Cruft Laboratory
Bennet, Maude (Miss)	25 Ridgeway Avenue, Needham, Mass.
Bergman, Stefan (Dr.)	Brown University
Berkeley, E. C. (Lt.)	Computation Project, Cruft Laboratory
Block, R. M.	Computation Project, Cruft Laboratory
Bode, H. W. (Dr.)	Bell Telephone Laboratories, New York City
Brainerd, J. G. (Prof.)	University of Pennsylvania
Brendle, Ruth (Miss)	Computation Project, Cruft Laboratory

<i>Name</i>	<i>Representing</i>
Bryant, R. C. (Lt.)	Office of Research & Inventions, 1 Park Avenue, New York City
Bush, Vannevar (Dr.)	Carnegie Institution, Washington, D. C.
Caldwell, S. H. (Prof.)	Nat. Res. Council Comm. (Mass. Inst. of Technology)
Campbell, R. V. D. (Ensign)	Computation Project, Cruft Laboratory
Carter, G. K.	General Electric Co., Schenectady, N. Y.
Colbath, D. L.	General Electric Co.
Comrie, L. J. (Dr.)	Nat. Res. Council Comm. (London, England)
Concordia, Charles	General Electric Co.
Crawford, P. O. jr.	Office of Research & Inventions
Cunningham, L. E. (Dr.)	Ballistic Research Laboratory
Curry, H. B. (Dr.)	Ballistic Research Laboratory
Dederick, L. S. (Dr.)	Ballistic Research Laboratory
Desch, J. R.	National Cash Register Co., Dayton, Ohio
Douglas, E. M.	International Business Machines Corp., 590 Madison Ave., New York City
Dwight, H. B. (Prof.)	Mass. Inst. of Technology
Eckert, J. P. jr.	University of Pennsylvania
Forrester, J. W.	Mass. Inst. of Technology
Goldstine, H. H. (Capt.)	Ballistic Research Laboratory
Gore, O. L. (Lt.)	Office of Research & Inventions
Hamilton, F. E.	International Business Machines Corp.
Haskins, Robert (Lt.)	Office of Research & Inventions
Hazen, H. L. (Prof.)	Mass. Inst. of Technology
Henry, W. E.	Mass. Inst. of Technology
Hopper, Grace (Lt.)	Computation Project, Cruft Laboratory
Hrones, J. A. (Prof.)	Mass. Inst. of Technology
Jordan, W. B.	General Electric Co.
Kelly, T. S. (Prof.)	Institute Math. Statistics (Harvard University)
Kopal, Zdenek (Dr.)	Mass. Inst. of Technology
Kuehni, H. P.	General Electric Company
Lehmer, D. H. (Prof.)	Nat. Res. Council Comm. (Ballistic Research Laboratory)
Löf, J. L. C.	Mass. Inst. of Technology
Lowan, A. N. (Dr.)	Math. Tables Project
Macleish, K. G.	Eastman Kodak Co., Rochester, N. Y.
McPherson, J. C.	International Business Machines Corp.
Maginniss, F. J.	General Electric Co.
Mauchly, J. W. (Prof.)	University of Pennsylvania
Mayall, Margaret (Mrs.)	Harvard Observatory, Harvard University
Mork, R. G.	Office of Research & Inventions
Mumma, R. E.	National Cash Register Co.
Myers, J. E. (Ensign)	Naval Research Laboratory, Anacostia, Md.
von Neumann, John (Prof.)	Institute Math. Statistics (Institute for Advanced Study)
Nyquist, Harry (Dr.)	Bell Telephone Laboratories
O'Neal, R. D.	Eastman Kodak Company, Rochester, N. Y.
Peterson, H. A.	General Electric Co.
Philbrick, G. A.	Foxboro Instrument Company, Foxboro, Mass.
Pitts, W. H.	Mass. Inst. of Technology
Rankin, A. W.	General Electric Co.
Rees, Mina S. (Dr.)	Applied Mathematics Panel (350 Fifth Avenue, New York City)
Roosevelt, C. V. S. (Lt.)	Office of Research & Inventions

<i>Name</i>	<i>Representing</i>
Sandomire, Marion M. (Mrs.)	Bureau of Ships, Washington, D. C.
Sarahan, B. L. (Lt.)	Naval Research Laboratory
Schultz, O. T.	Bell Telephone Laboratories
Shannon, C. E. (Dr.)	Bell Telephone Laboratories
Sternberg, Sidney (Lt.)	Office of Research & Inventions
Stibitz, G. R. (Dr.)	University of Vermont, Burlington, Vt.
Svihel, B. T.	Mass. Inst. of Technology
Taylor, Richard (Prof.)	Mass. Inst. of Technology
Thomas, G. B. jr. (Prof.)	Mass. Inst. of Technology
Tiffany, O. L.	University of Michigan
Tukey, J. W. (Prof.)	Princeton University
Tyler, A. W.	Eastman Kodak Co., Rochester, N. Y.
Verzuh, F. M.	Mass. Inst. of Technology
Wakelin, J. W. jr. (Lt.)	Office of Research & Inventions
Wallman, Henry (Dr.)	Mass. Inst. of Technology
Warren, S. R. jr. (Prof.)	University of Pennsylvania
Watson, F. G. (Lt. Commander)	Hydrographic Office, Navy Dept., Washington, D. C.
Wicklund, H. P. (Lt.)	Office of Research & Inventions
Wiener, Norbert (Prof.)	Mass. Inst. of Technology
Williams, H. M.	National Cash Register Co.
Williams, S. B.	Bell Telephone Laboratories
Wood, H. A. (Dr.)	Chance-Vought Aircraft Div. of the United Aircraft Corp., Stamford, Conn.
Wundheiler, A. W. (Dr.)	Bureau of Ordnance

Most of these delegates arrived on October 29 and attended demonstrations of the working of the new Differential Analyzer, of which there is a detailed illustrated description by VANNEVAR BUSH and S. H. CALDWELL,² in *Franklin Institute, J.*, v. 240, Oct. 1945, p. 255-326. Our frontispiece reproduces a photograph taken at the opening session of the Differential Analyzer demonstration. Grouped about the Main Control Panel are (3) Mr. Hazen, head of the Department of Electrical Engineering at M.I.T., (2 & 4) Messrs. Bush & Caldwell, who were initially responsible for developing the Analyzer, and (1) Mr. Phillips, head of the Department of Mathematics at M.I.T. In the evening the Institute invited the Delegates to a delightful dinner at the Engineers Club on Commonwealth Ave. The addresses of JAMES R. KILLIAN, JR., executive vice-president of the Institute, *presiding officer*, GEORGE R. HARRISON, dean of science at the Institute, LESLIE J. COMRIE, chairman of Section Z, and VANNEVAR BUSH, director of the Carnegie Institution of Washington, were uniformly of exceptionally happy content.

The Program carried out on Tuesday, Wednesday, October 30, 31, with L. J. COMRIE and S. H. CALDWELL presiding, was as follows:

Tuesday Morning, M.I.T.

Address of Welcome to the Institute by President K. T. COMPTON.

Introductory Remarks by VANNEVAR BUSH.

"Some Industrial Applications of Machine Computing Methods" by F. J. MAGINNISS.

"Numerical Computation by the Use of Telephone Relays" by S. B. WILLIAMS.

Tuesday Afternoon, M.I.T.

"Some Principles of Electronic High Speed Computing" by J. G. BRAINERD and J. P. ECKERT, JR.

"A General Summary and a Look at the Future" by J. VON NEUMANN.

Tuesday Evening, Cruft Laboratory, Harvard University

"The Automatic Sequence Calculator"¹ by H. H. AIKEN, and members of his staff.

Wednesday Morning, M.I.T.

"Simulative Techniques as an Aid to Analysis" by G. A. PHILBRICK.

"Application of Punched-Card Methods to Scientific Computation" by W. J. ECKERT, presented by J. C. MCPHERSON.

"The M.I.T. Center-of-Analysis Research Program" by S. H. CALDWELL.

Wednesday Afternoon, M.I.T.

"The Scientific Application of Commercial Calculating Machines" by L. J. COMRIE.

The Conference was most notably successful, and one heard on every side expressions of the hope that such a Conference might become an annual event.

The Committee on Mathematical Tables and Other Aids to Computation is indeed greatly indebted to officers of the administration and members of the staff of the Massachusetts Institute of Technology who did everything in their power to provide a setting for securing fruitful results from such an assembly of experts.

R. C. A.

¹ Beginning with Nov. 1, 1945, S. H. C. became *chairman*, and L. J. C. *vice-chairman*.

² See MAC 19.

³ For illustrated notes on this Calculator see MAC 20.

RECENT MATHEMATICAL TABLES

275[A, E, F].—PEDER PEDERSON, (a) *Über die numerische Berechnung der Kettenbrüche nebst einer Berechnung der Grundzahl der natürlichen Logarithmen*, 36 p., 1940; (b) *Berechnung der Grundzahl e der natürlichen Logarithmen mit 606 Dezimalen*, 17 p., 1942; (c) *Fortsetzung der Berechnung der Grundzahl e der natürlichen Logarithmen bis zur 808. Dezimalstelle*, 21 p., 1944. Denmark, Geodætisk Institut, *Meddelelse*, nos. 14, 16, and 17 respectively. 14.3×22 cm.

These three papers are accounts of the author's calculations of the fundamental constant e . Values of e are given to 404D in (a), to 606D in (b) and to 808D in (c). The method of calculation was based on the continued fraction

$$\frac{e-1}{2} = \frac{1}{1 + \frac{1}{6 + \frac{1}{10 + \frac{1}{14 + \dots}}}}$$

which is due to EULER,¹ but is applicable to any regular continued fraction. The general idea is set forth in (a) and may be roughly described as follows. Let x be the exact value of a continued fraction and let x_n be a given approximation to x which is correct to n decimals. Let also A_k/B_k be any convergent of the continued fraction in which k is large enough so that the value of this convergent would give x to more than n decimals. This means that, roughly speaking, B_k has about $n/2$ digits. Then $x_k B_k$ will be a decimal whose first $n/2$ significant figures are the digits of A_k and whose next $n/2$ digits are zeros. Therefore if we compute denominators B_k only, and compute only the digits of the product $x_k B_k$ which lie near the n th significant figure, the appearance of zeros (or nines) at this place serves as a check on the digits of x_n . Moreover, the method may be used to extend the value of x beyond the n th decimal place by simply filling in those digits which will produce more zeros until the accuracy implicit in a particular B_k is exceeded.

The author started with SHANKS' 137D value of e verified by GLAISHER,² and went on to check the value of Shanks³ (205D, last 18 wrong) and of BOORMAN⁴ (346D, last 123 wrong). The 223 correct decimals of Boorman was then the basis of an extension to