John H. Curtiss

Born December 23, 1909; died August 13, 1977, Port Angeles, Wash.; man of many talents; first and always a mathematician, but also a highly able administrator, musician, and tennis player; during the years 1946-1953 he was at the National Bureau of Standards (NBS) and played a vital role in the development, procurement, and widespread application of computers in the US.

Education: MS, statistics, Northwestern University, 1930; MS, statistics, University of Iowa, PhD, Harvard University, 1935.

Professional Experience: instructor, mathematics, Johns Hopkins University, 1935-1936; mathematics faculty, Cornell University, 1936-1943; Lt. Commander, Bureau of Ships, US Navy, 1943-1946; National Bureau of Standards: assistant to the director, E.U. Condon, 1946-1947; chief, National Applied Mathematics Laboratories (later the Applied Mathematics Division), 1947-1953; visiting lecturer, Harvard University, 1952; executive director, American Mathematical Society (AMS), 1954-1959; professor of mathematics, University of Miami, Coral Gables, 1959-1977.

John Curtiss was born on December 23, 1909, into an academic environment. His father, D.R. Curtiss (1878-1953), was professor of mathematics at Northwestern University, and president of the Mathematical Association of America in 1935-1936; he wrote a standard introduction to complex variable theory (1926), still in print. His uncle, Ralph H. Curtiss, was professor of astronomy at the University of Michigan.

After graduating with highest honors from Northwestern University in 1930, John Curtiss obtained an MS degree in statistics under H.L. Rietz at the University of Iowa, then one of the leading centers in the Midwest for mathematical training. Two of Curtiss' fellow graduate students there were S.S. Wilks and Deane Montgomery, who went on to distinguished mathematical careers at Princeton University and the Institute for Advanced Study, respectively.

John Curtiss then went to Harvard University, where he earned his PhD in 1935 under Professor J.L. Walsh. His first job after obtaining the doctorate was an instructorship in mathematics at Johns Hopkins University in 1935-1936. In 1936 he joined the mathematics faculty at Cornell University, where he taught until entering the US Navy in January 1943. He was stationed in Washington, D.C., with the quality control section of the Bureau of Ships until April 1946, when he was discharged with the rank of Lt. Commander.

He immediately joined the NBS as an assistant to the director, E. U. Condon, and was initially responsible for statistical matters. On July 1, 1947, he was appointed chief of a new division of the NBS initially called the National Applied Mathematics Laboratories; later the designation Applied Mathematics Division (AMD) was used. John Curtiss remained at the NBS until mid-1953, except for a semester as visiting lecturer at Harvard University in 1952. He spent a year at the Courant Institute of New York University, and was executive director of the American Mathematical Society (AMS) in Providence, R.I., from 1954 to 1959. In 1959 he became professor of mathematics at the University of Miami, Coral Gables, where he worked intensively on one of his first areas of interest: approximation theory in the complex domain. One by-product of this period was a graduate text on complex variable theory (1978). He died of heart failure at Port Angeles, Wash., on August 13, 1977, while en route to the AMS summer meeting in Seattle.

While no one can recall ever seeing John Curtiss at the console of a computer—he always said that "I was involved in the salt mines of computing"—his interest in numerical analysis was considerable. He wrote one paper on numerical algebra (1954b) and edited the proceeding of an important symposium (1956). Although the main body of his work on approximation theory is peripheral to practical computation, as a statistician he was deeply interested in "Monte Carlo" methods. One paper on this subject (1950), delivered at an IBM conference in 1949, was much acclaimed, and another (1954a) was translated into Russian. He gave courses on numerical algebra at NYU in 1953-1954 and on numerical analysis at the University of Miami. During his time in Providence he made a careful analysis of the book-sales policies of the AMS.

John Curtiss was quite sure that the nascent computing fraternity had to become a national society with publications of its own if it were to develop appropriately and be able to exert influence. Thus, he helped enthusiastically in the organization of the Eastern Association of Computing Machinery (ACM), which dropped the regional adjective from its title in 1948. He was the first president in 1947 and always encouraged his staff to participate in the work of this and other professional organizations. Of these, Franz L. Alt, Harry D. Huskey, and George E. Forsythe later became presidents of ACM and Thomas H. Southard was president of SIAM. Curtiss also saw that publications were supported, in particular *Mathematical Tables and Other Aids to Computation* and *The Pacific Journal of Mathematics.*

It is appropriate to point out here that John Curtiss' contributions to the development of modern numerical mathematics cannot be overestimated. He realized that any experienced pure mathematician could find attractive, challenging, and important problems in numerical mathematics, if the person chose to do so. From the death of Gauss in 1855 to 1947, the field of numerical mathematics was, with a few exceptions, cultivated by nonprofessional mathematicians whose real interests lay elsewhere. Accordingly Curtiss recruited professionals from far and near to take part in the programs he had envisaged. Indeed, nearly all of his recruits contributed significantly to his program.

John Curtiss once documented the remarkable success of the operation he planned by counting the papers presented at the 1952 International Congress of Mathematicians by various organizations. NBS was in the middle of the top seven; the others were the University of California at Berkeley, the University of Michigan, the University of Chicago, the Institute for Advanced Study, Harvard University, and the University of Pennsylvania—all organizations founded long before the Applied Mathematics Division of NBS.

For further details of the numerical mathematics programs at the NBS see Lowan (1949), Blanch and Rhodes (1974), and Todd (1975).

The Prospects

NBS was no stranger to computing equipment. It had been responsible for the Mathematical Tables Project of the Works Progress Administration in New York since 1938. This group was supported during World War II by the Applied Mathematics Panel of the Office of Scientific Research Development and from 1946 by the organization that later developed into the Office of Naval Research (ONR). Led by Arnold N. Lowan, the group included Milton Abramowitz (later chief of the Computation Laboratory), Ida Rhodes, Gertrude Blanch, Herbert E. Salzer, and Irene A. Stegun.

While John Curtiss was first concerned with statistical matters within NBS, he soon had a national responsibility. Several incidents led to this. In 1945, Eckert and Mauchly, who were largely responsible for the ENIAC, approached the Census Bureau (which, like NBS, was part of the US Department of Commerce) with the suggestion that a computer could facilitate its work—in the coming 1950 census, for example. This suggestion was discussed by the Science Committee of the Department of Commerce, which asked NBS for technical advice. The final agreement (April 1946) was that the Census Bureau would transfer funds to NBS, which would select a suitable computer and purchase it. The Army Ordnance Department also transferred funds to the electronics division of NBS for the development of computer components.

At this time Condon instructed Curtiss to survey the federal needs for computers and for a national computing center. This investigation had its source in ONR, and Rear Admiral H.G. Bown suggested that NBS and ONR should jointly establish such a center, to develop as well as use computers. Funds for this purpose were transferred in September 1946. In other countries, similar plans were being considered (see Todd 1975, p. 362).

Curtiss' investigation led to a broadening of the program. He realized very early, for example, that the mathematics needed to exploit the new computers had also to be developed, an opinion shared by Mina Rees of ONR (1977). The program he formulated was described in the prospectus issued in February 1947. The AMD was to have four sections:

1. Institute for Numerical Analysis (INA)—to be a field station at UCLA.
2. Computation Laboratory (CL).
3. Statistical Engineering Laboratory (SEL)
4. Machine Development Laboratory (MDL)

The last three were to be in Washington, D.C. The nucleus of the CL was to be the Lowan group. The program of the AMD was to be guided, within NBS operations, by the Applied Mathematics Executive Council, consisting of representatives of various federal agencies and some outside experts. Later the title of this group was changed to Applied Mathematics Advisory Council (AMAC). A total staff of about 100 was contemplated, and of that only about 30 were on the NBS payroll when the AMD was founded.

The AMD came into being on July 1, 1947. The prospectus had been a remarkable document insofar as there was little need to change its contents as time passed. Curtiss undertook a massive recruitment program to implement the aims of the AMD. He was highly qualified for this activity, with his outgoing personality and many academic contacts. Fortunately, too, the time was opportune for such an expansion, because many mathematicians were being demobilized from their World War II activities—a-number of them fresh from some experience with applied mathematics.

The soundness of the original structure of AMD is clear from the fact that despite a succession of NBS directors and several reorganizations, the organization was essentially unchanged for 25 years, apart from the transfer of the MDL activities elsewhere.

Procurement Problems

By late 1946, once certain legal situations were resolved, NBS had funds available for two computers. The first was the Univac for the Census Bureau, contracted for with the Eckert-Mauchly organization in 1946, and the second was the NBS computer (financed by ONR), contracted for with the Raytheon Company early in 1947.

The terms of these contracts were discussed by various committees, by advisers (notably, G. Stibitz), and by the AMAC. There were many complications, both administrative and technical. During these discussions the one Univac became three: one for the Air Comptroller and another for the Army Map Service were added.

It is appropriate to mention here the division of responsibilities between the Applied Mathematics Division and the Electronics Division of NBS. The AMD was responsible for the logic design of the computers and their suitability for the jobs envisaged, and for initial liaison with the contractors. The Electronics Division was responsible for the soundness of the design of components and for all engineering matters. Once the development was complete, the divisions were to share the liaison and documentation duties.

The chief of the MDL from 1946 was E.W. Cannon, who succeeded John Curtiss as chief of the AMD in 1953. Ida Rhodes, originally with the Mathematics Tables Project, was active in ensuring the suitability of proposed designs and later in educating the coders and programmers.

Early in 1948, as it became clear that none of these machines would be completed on schedule, two enormously significant events took place. The Air Comptroller, while awaiting the delivery of the Univac, realized that a small “interim” computer to be developed at NBS would provide useful experience. This led to SEAC, discussed below. The Air Materiel Command wanted two computers, one for Wright Field and one for INA, but no supplier could be found. Consequently, it accepted a proposal for a modest machine to be developed at INA by Harry D. Huskey. This led to SWAC.

To end this historical sketch, the Census Univac was completed early in 1951 and was dedicated on June 16, 1951. The Univac for the Air Comptroller was completed in February 1952, and the one for the Army Map Service was completed in April 1952. The Raytheon machine for NBS was never completed, but a related machine was delivered to the Naval Air Missile Test Center at Point Mugu, Calif. in 1952.

SEAC

The NBS Interim Computer, later called SEAC (Standards Eastern Automatic Computer), was constructed for the Air Comptroller by a group in the NBS Electronics Division (led by S.N. Alexander), beginning in the fall of 1948. The MDL collaborated in the design, and it was agreed that as soon as the computer became operational it would be moved to the CL. At that time John Todd was the chief of the CL, and they had a considerable group (led by Alan J. Hoffman) working for the Air Comptroller on linear programming, a subject just being developed by G.B. Dantzig and his associates.

In about 15 months SEAC became productive. On April 7, 1950, with help from R.J. Slutz, Todd ran his first program: solving the Diophantine equation $ax + by = 1$. Actually a and b were originally taken to be the largest pair of consecutive Fibonacci numbers that fitted into the machine (<244); this was chosen to give the slowest Euclidean algorithm. The day before, Franz Alt had run a factorization program using a small sieve.

SEAC was dedicated on June 20, 1950. Originally it had a 512-word delay-line memory, but 512 words of electrostatic memory were added. The original Teletype input/output was supplemented by magnetic wire.[1]

On a visit to Los Alamos in 1951, after Todd had described (perhaps too enthusiastically) the current state of CL operations, the laboratory authorities there decided that SEAC was just the thing they needed for their weapon-related computations. Accordingly they preempted SEAC, providing their own crew (for security reasons and to educate them in the use of computers). Even less time was then available for developmental work, and pleas to move the machine to the CL, where they now realized how odd minutes could be used effectively, were rejected on the grounds that the delicate equipment might not survive the trip. John Curtiss finally negotiated with the AEC for the construction of a cinderblock building abutting the SEAC building, and those in direct contact with the machine moved into the new structure. A few years later the machine was moved to the CL, where it operated until it was retired on April 23, 1964.

SWAC

Earlier, we noted the origin of the Air Materiel Command machine, later called SWAC (Standards Western Automatic Computer). This project began from scratch in January 1949, and the first Williams tube machine to be completed in the US was dedicated on April 7, 1950. Just as the British ACE was designed by a mathematician (A.M. Turing), the SWAC was designed by Harry D. Huskey, who was trained as a mathematician. It was built among and for mathematicians.

There was a rather long period of debugging but in due course all troubles were overcome and SWAC became a reliable machine with many significant accomplishments. When the INA operation closed in 1954, SWAC was transferred to UCLA and remained in operation until 1967.

Conclusion

John Curtiss, with the full support of NBS director E.U. Condon, and with modest encouragement from various federal agencies, accelerated the progress of the US toward a preeminent position in the construction of computers and their exploitation for scientific computations. We have already mentioned the use of SEAC by the AEC; rocket and comet orbits were computed on commercial equipment at INA (Herrick 1973), and perhaps the first automatically computed earth-moon trajectory was done on SEAC (Froberg and Goldstein 1952).

Had Curtiss been able to stay at NBS and had support for INA been continued, there is no doubt that the mathematical development would have kept up with the enormous achievements of the engineers. Those who remained did what they could to carry on the work for which Curtiss laid solid foundations. Those who were with him at NBS enjoy getting together and recalling the exciting times of 1946 to 1953 and were grateful to have had the privilege of working with a fine American mathematician.

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[1] For more technical information, see NBS (1947, 1950, 1951, 1955), Greenwald et al. (1953), Shupe and Kirsch (1953), and Leiner et al. (1954).

Postscript--Some Personal Reminiscences-John Todd

My own first contact with John Curtiss was a letter dated early in 1947, enclosing the prospectus and inviting me to consider joining INA. During World War II, I had been active in organizing an Admiralty Computing Service in Great Britain. Later, with my colleagues A. Erdelyi and D.H. Sadler, I suggested the formation of a National Mathematical Laboratory, later established as a division of the National Physical Laboratory. During that time my wife, Olga Taussky, and I had many contacts with American mathematicians stationed in or visiting Europe, especially H.P. Roberston, H.M. MacNeille, G. Baley Price, R. Courant, and J. von Neumann. They were aware of my activities, and I was in correspondence with members of the Applied Mathematics Panel. Some of these people probably suggested my name to John Curtiss. We arrived in New York on a troop ship late in September 1947. Our first contact with the computer world outside Washington was at the Aberdeen Meeting of ACM on December 11-12, 1947.

John Curtiss was a bachelor who enjoyed fast cars and plenty of good food and drink. In introducing us to Washington society he asked me to arrange a sherry party in his apartment. I provided sherries of varying quality and served them according to his evaluation of the guests, reserving the Bristol Cream for the director. For the benefit of many of the visitors to INA he compiled a list of restaurants labeled according to the civil service gradings P1 to P8.

He did not find the civil service regime too convenient, and much of his activity was spent maintaining contacts with other agencies, often after regular hours. He dictated a diary late at night; a transcription was circulated to his staff the next day so that we were aware of what commitments he had made.

He was not happy on planes and did not travel to Europe until 1976. A letter from him dated May 11, 1976, from the Mathematical Research Institute at Oberwolfach, is addressed to me as “The Savior of Oberwolfach.” (A British naval officer, G.E.H. Reuter, and I were able in 1945 to prevent the dissolution of an institution that has since made great contributions to mathematics, including formal languages, complexity theory, many aspects of numerical analysis, and for instance computerized tomography.) He complained about staying in “magnificent old fire traps” and characterized one of the famous London clubs as “the awfullest fire trap of all, but interesting.” He indicated two remembrances of England, the first “an infinite series of near-head-on collisions,” and the second musical: “I recently got a record of Elgar's organ music at Colston Hall, Bristol, which we inspected amid chaotic preparation for a Salvation Army Choral concert. Then we heard the Sonata itself, included by coincidence in a noon recital in Hertford Chapel in Oxford (and played too slowly).”

My last meeting with John Curtiss was at the 1976 Los Alamos Research Conference on the History of Computing. He said then that he thought that historians, so far, had not fully appreciated the contribution of the National Bureau of Standards in the field. I hope this essay will begin to put things in balance.[1]

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[1] Based on Todd, 1980.

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