14K DAYS

A History of the Poughkeepsie Laboratory

"14K Days" reflects the golden years of the IBM Poughkeepsie Laboratory and represents the 40-year history of the Laboratory as expressed in days.

Dedicated to the memory of Robert E. Crosby. During his long career with IBM, Mr. Crosby held many technical and management positions in large systems design and development in Poughkeepsie, and also served as the Director of the Poughkeepsie Laboratory from 1978 until 1983. Under his capable direction, the Poughkeepsie Laboratory made many contributions in the field of computer technology and information processing.

November 30, 1984

Reading about the people, projects, and products depicted in the following pages, it's easy for any of us to see why the Poughkeepsie Laboratory has played such a leading role in IBM since its founding in 1944.

Dedication to excellence and ability to overcome obstacles best describe the people of this laboratory. These characteristics have remained constant through 40 years of business, economic, and technological changes.

The Poughkeepsie Laboratory's record is virtually a history of American mainframe computer development, and its successes are largely responsible for IBM's preeminence today in information systems.

My congratulations to the many fine people whose contributions have helped build the Poughkeepsie Laboratory's outstanding record, and best wishes for the years ahead.

Carl J. Conti
IBM Vice President and
President, Data Systems Division

November 30, 1984

The Poughkeepsie Laboratory has experienced four decades of excellence because you have consistently responded to the challenges of the business with innovation after innovation.

From the lab's first entry in electronic accounting with the IBM 604 Electronic Calculator to the technological wonders of IBM System/360 and the 308X series, your efforts have shaped, changed and advanced information processing.

These achievements stand as an enduring tribute to the talents and hard work of all the people who have made contributions to the laboratory's growth.

I wish you continued success.

Michael C. Duffy
Data System Division
Vice President and
Poughkeepsie General Manager

November 30, 1984

This is a special year for the IBM Poughkeepsie Laboratory - its 40th anniversary. "14K Days" of the Poughkeepsie Laboratory is an anthology of some of the people and events that have highlighted our history thus far. In this golden age of automation, the prospects for the future are still dazzling.

Forty years ago the Poughkeepsie Laboratory was developing typewriters and accounting machines. Today we are developing high performance computers. What happened in the intervening years? What events took place? Who were the leaders? What were the products? How did the Poughkeepsie Laboratory contribute to the development of IBM as a world-wide leader in the computer industry?

The Laboratory story is one of continual change and challenge from technological inventiveness to the generation of advanced ideas that have been reflected in and influenced the evolution of information processing. Its history is a tribute to the dedication, skills and teamwork of all of you. It is a history to be proud of. I am glad, as I know you are, to have had the opportunity to have played a part in the shaping of it.

Frank R. Moore

Frank R. Moore
Director of the Poughkeepsie
Laboratory, Data Systems Division

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THINK

Introduction

The history of the International Business Machines Corporation is more than a narrative of incidents and events; it's a story of people, products, and progress.

The precepts on which the Poughkeepsie Laboratory was founded date back to 1914 when Mr. Thomas J. Watson, Sr. joined the Company as General Manager.

Twenty years after joining IBM, he confessed to a sales class: "As a boy, I was more interested in reading stories of the pioneers in our country than anything else... I felt that the pioneer work had all been done. Then I began to realize the great pioneering work was ahead, not behind. I have always kept that thought in mind, particularly in the development of our business."

Mr. Watson's belief was that no manufacturer can progress without constantly developing his product and opening new fields. As he once stated: "Life is never static. The only thing we can be sure of is perpetual change...today's method will not be suitable for tomorrow. It is the part of business leaders to determine the needs of the future. Tomorrow's methods must be planned today."

Mr. Watson's doctrine of engineering in business was that engineering is insurance for the future. He stated that engineering should study the consumer's needs first. "It is fitting and it is essential that these men (engineers) should have one of the most completely equipped industrial laboratories in the world in which to study the future demands of business, and to devise new machines to fill these demands." At a time when tradition and engineering policy usually dominated design, Mr. Watson insisted that commercial need and function must control engineering design.

When talking about the expense of engineering, Mr. Watson once said, "I don't want to put any limit on imagination." This commitment to engineering in IBM was an outcome of his restless urge for constant improvement. His philosophy was: "Never feel satisfied...we cannot stand still on development work. You must not feel that because you have accomplished a lot in the past you can rest on your laurels - the goods you now have must be improved; you must get out new things; somebody must develop something entirely new - something that is not in the mind of anyone here today."

In the mid-30's he made the commitment: "We are going to spend a lot of money this year and every year building for the future so that 20 years from now you can look back and see that the policy of this company in spending all that money in the years past was what was responsible for its growth."

As illustrated, Mr. Watson was firm in his fundamental policies of continual product evolvement. This led to the decision to provide the facilities for a "problem-solving" division within the company, the development of our present Research/Development Laboratory. "Problem-solving" characterizes the business of IBM. The term covers the company's development from accounting machines through the electronic computer to the data processing industry.

▲ *The Kenyon House, c. 1945, displaying a modest sign stating "IBM Engineering Laboratory."*

▲ *The original ambiance of the entrance hall of the Kenyon house h been retained through many changes of management.*

▲ *A view of the Kenyon House not seen by many - the east facade.*

The Kenyon Estate - Birthplace of the Poughkeepsie Laboratory

▲ *A view of "the circle" from the southeast. These buildings housed some of the first laboratory employees from Rochester and East Orange, as well as actual lab space.*

In the 1940's, as the need for a research and development facility became more evident, the location and personnel to staff it became the next order of priority. A manufacturing facility had already been established in the Poughkeepsie area. Logically, what better place to base a research and development effort.

On July 1, 1944, Walter J. Niles, general manager of IBM Poughkeepsie Plant No. 2, announced that IBM had purchased "Cliffdale," a 217 acre estate along Boardman Road belonging to the Kenyon family. It was announced that, "When priority for materials can be obtained, a modern research and engineering laboratory will be built in Poughkeepsie. In the meantime, the buildings on the Kenyon property will be used temporarily for laboratory purposes."

The big house became the birthplace of the Poughkeepsie Laboratory. The mansion was built in 1913 by Clarence Kenyon, a Brooklyn manufacturer of clothing and of rubber products, who bought the 600-acre Cliffdale estate in 1909 jointly with his brother-in-law, James E. Sague, former mayor of the city of Poughkeepsie. Later dividing the property between them, Mr. Kenyon retained the 217-acre portion of the estate with the woods, cliffs, and ponds. The mansion was designed by Poughkeepsie architect Percival M. Lloyd. It was designed and built for outstanding strength and fire resistance. The Mediterranean style structure has concrete foundations made from Rosendale cement, with basement walls of washed limestone from nearby Wappingers Falls. The wood in the original structure was cut on the property, seasoned, dried and milled at a small sawmill Mr. Kenyon had erected for that purpose.

The previous owner was Andrew Boardman, a New York attorney who bought 14 farms shortly after the Civil War and combined them to form Cliffdale. Boardman Road, which runs through the property, was named in his honor.

The birthplace of the Poughkeepsie Laboratory was also to become the birthplace of many advances in IBM's technology.

The talents to staff IBM's new lab came primarily from a typewriter group in Rochester, New York, and from the company's East Orange, New Jersey, engineering lab.

The first laboratory manager was Ralph E. Page from East Orange. Mr. Page had started with the company in 1917. His secretary was Helen Hart, who started with the lab in October of 1944. When profiled in the *IBM News* (September 1973), she recalled her work in the Kenyon House. In addition to being a secretary, she also served as cashier, timekeeper, receptionist, and sometime purchasing agent. She also answered the single

▲ *A 407 control panel, all of which was wired by hand, prior to the advent of the Gardiner-Denver machine.*

▲ *The IBM 407 had punched card input on the left and printer in the center top. This was the last of the electromechanical accounting machines.*

phone which was on the first floor, and when summoning someone in the typewriter group on the third floor would "give a holler" up the stairs.

It was here that Ralph Page, Bud Beattie, and Ed Rabenda did much of their work on the IBM 407 and 408 accounting machines. H.S. "Bud" Beattie moved in 1944 from East Orange, where he had the main responsibility for a "wheel printer" favored by T. J. Watson, Sr. over other contending printers. The work on the wheel printer continued in Poughkeepsie and it was incorporated into the 407 accounting machine. Ed Rabenda also contributed a great deal to the 407, mainly in the electrical area where he was named as inventor on 13 patents. The printer portion represented improved speed and performance over the traditional bar-type printers. At a rate of 150 lines a minute, the 407 was one of IBM's most versatile accounting machines. It prepared documents from punched and sorted cards. It would print all necessary alphabetical descriptions and would add, subtract, classify, and list data while spacing the forms automatically. The 407 became, at that time, one of IBM's largest revenue producers, and was also one of the last of the old electromechanical accounting machines.

Several different projects were underway. Eugen Buhler, J. F. Smathers, Ronald Dodge, and others were busy improving typewriters. In 1946, Dodge received a Certificate of Recognition from the Franklin Institute for the proportional

Dick Neville and Ron Dodge shown a work in one of the thirteen converted bedrooms of the Kenyon house, c. 1945.▼

▲ *The IBM Executive electric typewriter - this innovative machine automatically proportioned the space occupied by each letter, resulting in a more "printed" appearance of the typed documents.*

escapement used in the IBM typewriter to permit proportional spacing of typed letters. Others were heavily involved in completing the construction of three special Navy machines.

Ralph L. Palmer, former supervisor of the Endicott Electrical Laboratory, returned from service in the Navy during World War II to Endicott late in 1945. He was asked to set up an Electronics group in the Poughkeepsie Laboratory. Palmer was soon joined by Jerry Haddad, Max Femmer, and Byron Phelps. They were part of the group that produced the 604 electronic calculating punch (a machine with over 1400 vacuum tubes). The 604 made electronic computing speeds available in punched-card handling systems and could complete a typical transaction several times faster than the machine it replaced and at far lower costs.

The serene, stately old mansion had been transformed, with drafting tables in the living room, work benches in the bedrooms, model makers cooking up schemes in the kitchen, and people thinking on the porch. The dining room contained a strange clunking machine (a 407) undergoing tests which resulted in pounding on the ceiling from the employees in the lower level. A fervor of mission permeated the very walls, and this was just a beginning. Byron Phelps recalled, "The 604 model was built alongside the water tank in the basement of the old Kenyon Lab, and the engineering offices were in the attic on the third floor, so the engineers got plenty of exercise running up and down three flights of stairs."

Planners had forecast a market for the 604 of approximately 75 units, but more than 5,600 of the small systems were delivered. Such volume justified efforts by vacuum tube manufacturers to improve quality, making practical the larger computers that were to follow. As of 1975, more than four hundred 604's were still being used by customers.

▲*With initial development started in 1945, the 604 was demonstrated in July 1948, and deliveries started that Fall.*

With development activity increasing, the group began to expand. Phil Fox came to Poughkeepsie and began working on cathode-ray tube storage, Nathaniel Rochester began working on ideas for design of stored-program computers, and Jack Goetz, an experienced vacuum tube engineer, also joined the group.

By mid-1949 a substantial hiring effort was in progress, and as the expansion began Mr. Palmer had to divide his work force between the Kenyon estate and the Delapenha house. Most of the electronic engineering was done at the Delapenha house (now known as the Cliff house) while the planning group and several other activities remained in the Kenyon mansion.

ELECTRO-MAGNETICS

VACUUM TUBES

700 Series

The country saw many changes following World War II. The population exploded, the economy expanded beyond expectations, and the resulting proliferation of paperwork and records created an ever-increasing demand for business-type machines.

IBM had acquired a degree of competence in the new field of computers and, anticipating the need, started building the first of our many families of computers, the 700 Series.

The impetus had come with the outbreak of the Korean War in June 1950. The Korean War brought about a great expansion in the defense-related industries and a greatly increased need for computation of all kinds. Mr. Watson, Sr., the company's chairman at the time, asked the government what IBM could do.

Build a large scientific computer, he was told, one that could be used for aircraft design, nuclear development, and munitions manufacture.

The 701 became a product in less than two years. Pencil hadn't hit paper until January 1, 1951. By the last day of December 1952, the first production machine went from Poughkeepsie to New York City.

The company had already constructed several one-of-a-kind machines, but to consider undertaking volume production of a large machine was a different matter. Was there a market beyond the immediate require-

Operator's console of the 701 computer with one of the cover doors open to show a portion of the complexity of this new machine.▼

ments of the government? Could a somewhat special machine be designed to serve a diverse array of needs (projects calling for many repetitive operations)? And could it be turned out in volume in factory production?

In late 1950, Jim Birkenstock, then director of product planning and market analysis, along with Ralph Palmer and master salesman Cuthbert Hurd, toured the United States visiting numerous government and aerospace companies to determine their requirements for electronic computation. They picked up orders for 18 such machines. "That was enough to convince me," said Watson, "that we were in the electronics business and that we'd better move pretty fast."

Until then, IBM's production experience had been limited to smaller, substantially slower, electronic calculators, notably the 604.

Jerrier Haddad, in charge of engineering, shared development responsibility with Nathaniel "Nat" Rochester, who had overall architecture and programming responsibility. The major challenge facing the group was to see whether we could make a single machine that would simultaneously satisfy the needs of nearly 20 customers.

Due to the complexity and scope of this new project, Ralph Palmer, who was now head of the Poughkeepsie Laboratory, hired 30 new people with master's degrees to assist in developing this new system.

As manpower increased, IBM found it necessary to lease additional temporary quarters in the area to house laboratory personnel. Clarence Frizzell, a project manager at the time, recalled the setting. "We started on the third floor of a tie factory and finished in a supermarket - later to become the South Road laboratory annex."

▲ *A demonstration of tape reel removal. The vacuum columns clearly show the long tape stress during reel reversal.*

The 701 presented problems for which there were no precedents. There was a host of untried technologies to be wrestled with. One was the computer's main memory. It was agreed that the main memory would have to consist of some sort of special vacuum tube. Phil Fox, in charge of 701 storage system design, conducted studies of various tube designs and finally settled on the Williams tube, a device invented a few years earlier by F. C. Williams and T. Kilburn of the University of Manchester in England.

In the early tape drive program, an electrostatic clutch design looked promising and it was decided that all drives would use this clutch. Early tests in the Kenyon Lab looked promising. The 701 was then moved to the third floor of a building located at High Street. The building was steam heated, it was winter, and in the very dry air the electrostatic clutches would not work reliably. The air valves were removed from the radiators to raise the humidity in the room, and this was sufficient for awhile, but eventually a new type of pinch roller drive was developed to solve the problem and was subsequently used on all drives until the mid-1960's.

Tape control also presented problems and nothing seemed to work until Jim Weidenhammer, a development engineer at the time, came up with his invention of the vacuum column for controlling magnetic tape. These vertical columns control a portion of slack tape so as the reel starts and stops, the strain on the tape is minimal. In mid-1953 a need arose for a flexible airtight material from which to make a diaphragm-actuated pressure switch to sense the position of the magnetic tape loop in the column. An idea resulted in someone being sent to a drugstore for a pair of infant's rubber pants. Portions of the elastic, airtight material were cut to fit the application. It was just the thing for the switch, and for computers in their infancy.

John Backus, of the applied science department at 590 Madison Avenue, and others contended with the problems of programming the 701. Along the way, they came up with a programming system called Speedcoding. Backus later helped develop FORTRAN and started IBM on the track of major programming efforts.

The first symbolic assembly program was also written. As Nat Rochester once related, "I had wanted to work on this idea, but I never seemed to have the time. Then one morning my wife woke me up and announced, 'I have the mumps.' She was expecting our fourth child, so I stayed home to take care of her. While I was recuperating from the mumps I wrote the assembly program."

Difficulties were encountered in the first machines that went into the customer's offices. Jerry Haddad had anticipated this and had earlier assembled a group of about 20 people to be trained to go out to the field and work with field engineering people to bridge the gap from electromechanical to electronic machines. As customer installations were occurring, assignments were falling in place. Of the group, four were held back from being assigned a specific installation and were kept as roving specialists instead. One was a new recruit by the name of Bob O. Evans, a now retired IBM vice president. Another was Peter K. Spatz, who was destined to become a manager of some of the future systems. This small group served as super trouble shooters on the 701.

April 7, 1953, was the unveiling date at IBM World Headquarters in New York of the 701, the first large-scale, high-speed, stored-program electronic computer to be produced in volume by IBM. It contained a large electrostatic memory and extensive input-output devices. Standard IBM cards with either conventional decimal numerical and alphabetic punching or binary punching could be used. The greatest advantage of a digital computer like the 701 was its ability to rapidly solve the many complex equations encountered in research and development work with the quantity of arithmetic involved. One day of digital computer time was equal to 500 years of pencil and paper calculations. The 701 marked IBM's entry into the computer era.

Stimulated by the successful demand for the 701, IBM decided to analyze the commercial market for computer possibilities. The analysis showed a good potential for a high-speed machine that could meet the needs of large corporations for use in payroll, inventories, and other accounting functions. The task of coming up with a computer that would be able to absorb large quantities of information, compute calculations at high speeds, and print the results in quantity was assigned to a group of research and development people headed up by Charles J. Bashe. In 1953, IBM announced the 702, essentially a new concept in commercial machine accounting based on the use of magnetic tapes. It was capable of reading and recording data on a variety of media including punched

701 Uses

The Atomic Energy Commission has three to figure out complex problems on its nuclear production line.

The Navy has a 701 keeping track of inventories and shipments, calculating when to reorder thousands of different items and how much to buy.

The Weather Bureau utilizes a 701 by feeding into it hundreds of reports on rainfall, temperature, humidity, etc. to be able to predict more accurate weather in the U.S. 48 hours in advance.

Several West Coast aircraft companies have at least one. The 701, given all the characteristics of a plane; e.g., weight, wing stress, imaginary speeds, etc. would tell what would happen in real flight.

Computer Games

One pioneer in the use of computers for game-playing was Dr. Arthur L. Samuel.

In 1947, Dr. Samuel, who was then teaching at the University of Illinois, wrote a checkers program for an experimental computer being built at the University. In 1949, he came to IBM in the engineering department at Poughkeepsie.

"IBM was looking for programs to test the 701 computer. It was then in the engineering stage. I updated my checkers program and submitted it," Dr. Samuel recalls. "It was one of the early programs run on the 701."

▲ *The 702 computer incorporated many features of the 701, but was modified and refined toward the needs of the business community rather than the scientific community.*

▲ *The 702 used large tape reels, so a new cabinet was designed. The vacuum columns are revealed here due to the lower cover having been removed.*

cards, magnetic tape, magnetic drums, and line printing. A tape buffer unit was added to the 702 to make it possible to read and write to tape simultaneously.

702 Machine Makes Debut

The IBM 702 machine was announced via closed-circuit television from the Lab Annex on May 24, 1954, to more than 1300 members of the IBM Hundred Percent Club and the press gathered at the Waldorf Astoria hotel in New York City.

Television cameras relayed the picture from a specially erected tower at the Lab Annex to a pick-up point located atop Bear Mountain which, in turn, relayed it to New York. Cameras threw it upon a large screen in the hotel ballroom where the announcement was heard simultaneously by audiences in Poughkeepsie and in New York.

This was the first time that IBM used the new field of television for such an announcement.

56024

SAGE

▲ *SAGE was one of the first large computer networks to provide man-machine interaction in "real time" as events were occurring. This system, weighing 113 tons and containing 5,800 vacuum tubes, processed data from outlying domestic radar defense networks for immediate evaluation.*

MIT hosted a Joint Computer Conference in June 1952. IBM's John McPherson was there and Norm Taylor of MIT advised him that MIT was looking for a commercial concern to manufacture a digital computer for a proposed domestic air defense system.

Fifteen or so companies were considered, with IBM being chosen over all others because MIT's investigators liked their high degree of purposefulness, esprit de corps, and the integration of research, manufacturing, and field service. Also cited were various IBM systems in operation and field proven.

The third floor of a necktie factory on High Street in the city of Poughkeepsie, which had previously been used by IBM, was renovated to make room for this project. It was here on High Street that "Project High" was initially designed. By November of 1953 there were about 300 people working on this project. MIT's portion of the project was coded as "Project Whirlwind," but both names were soon unified into Project SAGE (Semi-Automatic Ground Environment.)

The prototype was shipped in January 1955. Twenty-seven subsequent units were manufactured in Kingston, where most of IBM's military contracts were done.

Banking System

In mid-1953, Jim Weidenhammer was appointed manager of a group developing equipment for bank check processing. This included paper feeding, check sorting, inscribing, and reading techniques for bar-coded check handling machines. This work progressed until late 1956 when the American Bankers Association determined that they would use a Magnetic Ink Character Recognition (MICR) system. Work on the bar recognition system was reorganized with Charles Bashe heading the program and Weidenhammer handling the mechanical aspect of sorting, handling, and inscribing equipment, trying to salvage as much as possible from the discontinued system.

▲ *Chris Letzeisen shown operating an electro-mechanical bank proof machine during a customer demonstration.*

A Permanent Home

Due to the need for additional research and development space, the decision to build was made and ground broken in April 1953 for what was to become the 701 building on Boardman Road. The plans included building a new road to the North, paralleling an existing inadequate residential road, piping city water some 7500 feet to the site, and a remote boiler house for heating and cooling the planned and any proposed buildings.

Upon completion of this project, dedication ceremonies were held on October 9, 1954, with nearly 6,000 people in attendance. Thomas J. Watson, Jr., president of IBM, presided at the ceremony. He stated in his opening remarks, "we believe this laboratory to be the finest for its size and purpose in the world today."

1954 also marked the one-hundredth anniversary of Poughkeepsie's incorporation as a city. In a proclamation drawn up by Mayor R. E. Stevens for the occasion, October was set aside as Business Progress month with Saturday, October 9th, being designated as "Research Day" thereby calling attention to the continuing effort of American business to further advance the well-being of all mankind.

The year 1954 was also a personal milestone for Thomas J. Watson, Sr., chairman of the board, as it marked his 40th year as head of International Business Machines Corporation. Among the first speakers was Mayor Stevens, who appointed Mr. Watson, Sr. an honorary Poughkeepsie centenary year citizen, in honor of his efforts for the community at large. James Brehm, president of the Chamber of Commerce, presented a bronze plaque to Mr. Watson, Sr., commemorating forty years of "ingenious pioneering" to "further

▲ *View from the southwest of the completed 701 building in what was at one time a cornfield of the Kenyon estate.*

◀ *Bronze plaque presented by Poughkeepsie Chamber of Commerce is presently affixed on the 701 building.*

▲ *Overall view of spectators with IBM band in background.*

▲ *Dr. James Killian, President of Massachusetts Institute of Technology, delivering the dedication address of the 701 building.*

T.J. Watson, Sr. aided by J. Furness, placing time capsule in conerstone. Looking on are Mr. Hajos (partially obscured), Mr. A. Newmann, and Mr. T.J. Watson, Jr. ▶

◀ *Parchment proclamation presented to T.J. Watson, Sr. by Mayor of Poughkeepsie.*

▲ *Mr. J. Jiudice, Supervisor, Town of Poughkeepsie with Mr. & Mrs. R. Palmer view one of the product displays.*

◀ *Trowel presented to T.J. Watson, Sr. and used by him to apply mortar to the 701 cornerstone.*

Left to right: Mrs. Watson, Sr., James Melton, Patrice Munsel, Mr. Watson, Sr. ▶

enrich the lives of men." Mr. Brehm further noted that this was the third major dedication of industrial assets of the company, recalling the 1948 plant dedication and the 1952 dedication of two wings which doubled the size of the facility.

John B. Furness, chairman of Poughkeepsie IBM Advisory Board, speaking in behalf of the 8,000 IBM employees employed in Poughkeepsie, presented an engraved mason's trowel to Mr. Watson, Sr., symbolizing the solid foundation on which Mr. Watson built the organization. Mr. Watson, Sr., then walked to the corner of the new building where he spread mortar around the cornerstone and placed a copper box "time capsule" within the stone. Then with a turn of a lever, the cornerstone was slid into place hydraulically. The box contained such items as a Bible, coins, stamps, miniature flags of the United Nations, and microfilmed photos of IBM officers, plants, and products. Also included was a copy of the 100th anniversary special edition of the The Poughkeepsie Sunday New Yorker, among other records. Mr. Watson spoke briefly of his appreciation of the honors received and expressed a desire for the success of the United Nations.

James Melton and Patrice Munsel, Metropolitan Opera stars entertained with several vocal selections, classical and popular.

The dedication address was given by Dr. James R. Killian, Jr., president of Massachusetts Institute of Technology, who warned of a growing shortage of scientists and engineers. He urged more emphasis on the beneficial and humane uses of science and technology.

Guided tours of the new building followed the ceremony. Visitors were shown displays of past IBM products and reminded that this building was built to further business machines that were as yet undreamed of.

Upon completion and occupancy of building 701, the outbuildings around the circle continued to be used as offices, labs, or storage as the need arose. The Kenyon House was retrofitted for meeting facilities and housing for visiting dignitaries and renamed "The Homestead." It continued in this capacity until 1963, when the new Homestead immediately north of the Kenyon House was completed to accommodate the growth in numbers of visitors and customer education programs. The Kenyon House now became the home of the Corporate Headquarters Management School - Northeast. Gone, perhaps, but not forgotten were those magnificent men and their calculating machines.

Bust of Joseph Henry Placed in 701 Gallery

By general consent, Henry was the foremost American Physicist of his time. Born in Albany in 1797, he quit school at age 13. He later attended the Albany Academy. He discovered the phenomenon of self-induction. Every electric generator or motor uses the electro-magnet practically in the form it was left by Henry in 1829. He invented and demonstrated the electro-magnetic telegraph in Albany in 1830. In 1842 he was elected the first secretary of the Smithsonian Institution in Washington, D.C. There he founded the U.S. Weather Bureau. He was also a charter member of the National Academy of Science.

700 Series Enhanced

Industry was soon demanding more improvements in computer speeds and versatility. In 1954, IBM announced two new computers, one scientific and the other commercial - the IBM 704 to replace the 701 and the 705 to replace the 702. The major differences with respect to their immediate predecessors were that greater internal information storage capacities were provided, faster arithmetic units were fitted, and the range of program instructions extended. Also, magnetic cores were used for immediate access stores, replacing the cathode-ray tubes of the earlier machines.

Meanwhile, the IBM 705 was under constant improvement, and in 1957 IBM announced the 705-III. The 705-III introduced the Data Synchronizer, a new and superior type of magnetic tape input and output control which greatly increased the production rate of the entire 705 processing system. By using two or more Data Synchronizers, the computer could read, write, and compute simultaneously. This was a milestone in computer technology. Ten years after filing an application for a patent on this invention, the three co-inventors; Carl L. Christiansen, then Systems Architecture Manager, Lawrence E. Kanter, then Large Systems Development Manager, and George R. Monroe, then Technical Advisor, each received an Outstanding Invention Award for $60,000.

An increased understanding of the data handling needs of scientific computing caused IBM to re-evaluate the effectiveness of its computers. This led to the development of the 709. The major difference, and the really important advance over the 704, was a new input/output system that permitted reading from tape or cards, writing on tape or printer, and computation to occur simultaneously. This was made possible by time-sharing the core memory between the central computer and as many as six data channels. An interrupt system was included in the design of the 709 and has been in most computers built since that time.

▲ *In September1957, Joseph F. Degan, plant superintendent, William J. Mair, vice president and general manager, and Isaac J. Stetler, assistant superintendent, electronic manufacturing, inspect the console of the IBM 704 destined for Project Vanguard where it would be used to plot the earth satellite's course on the basis of received radio transmissions.*

▲ *The 705 units shown in this rather unusual photo are arranged in an artistic composition rather than shown as they would be in an actual operating environment.*

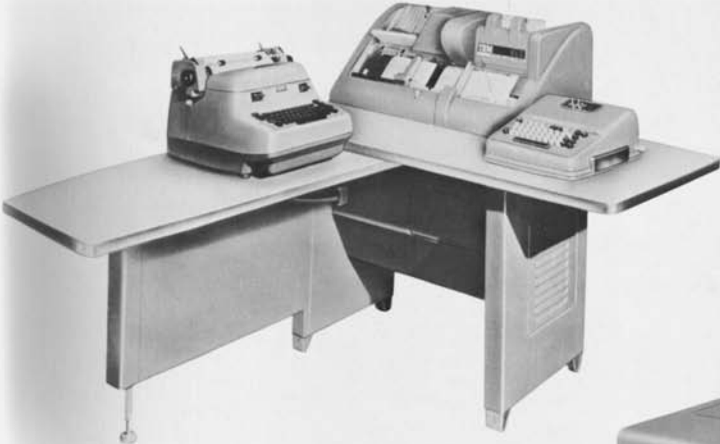
The 709 was the last of the 700 series computers. ▶

EAM Announcements

In keeping with IBM's philosophy of making the office more efficient, several new Electronic Accounting Machines (EAM) were announced in 1955.

The Card Sorter (083) operates at ▲ speeds of 1000 cards a minute. It is equipped with a self-checking feature that assures sorting accuracy, an automatic pocket stop which stops the machine when any pocket is filled to capacity, and several other features of ease of operation.

◀ The Tape-to-Card Punch (046) converts all or part of the information contained in a perforated tape to IBM punched cards and follows all the punching instructions also contained on the tape. It operates at a normal speed of 20 columns per second and requires an operator only to load or unload the cards and tape.



◀ The Typewriter Card Punch (824-826) consists of two units, an IBM electric typewriter and a card punch to form a dual-purpose machine which types documents and punches cards simultaneously. The operator activates the punching unit merely by depressing the typewriter shift key. All information is then recorded in cards in punched form, as well as on the typewritten document.

▲ The Data Transceiver (065) reads cards in one unit and sends the information over ordinary telephone or telegraph circuits to another unit where a duplicate set of cards is immediately punched. The units can be any distance apart. It will transmit and reproduce up to 11 fully punched 80-column cards a minute and automatically check itself for errors.

The Printing Summary Punch (526) combines a standard printing card punch with summary punching features which gives it the unique ability to punch and print simultaneously. It completely eliminates the need for a separate interpreting operation. ▶

TRANSISTORS

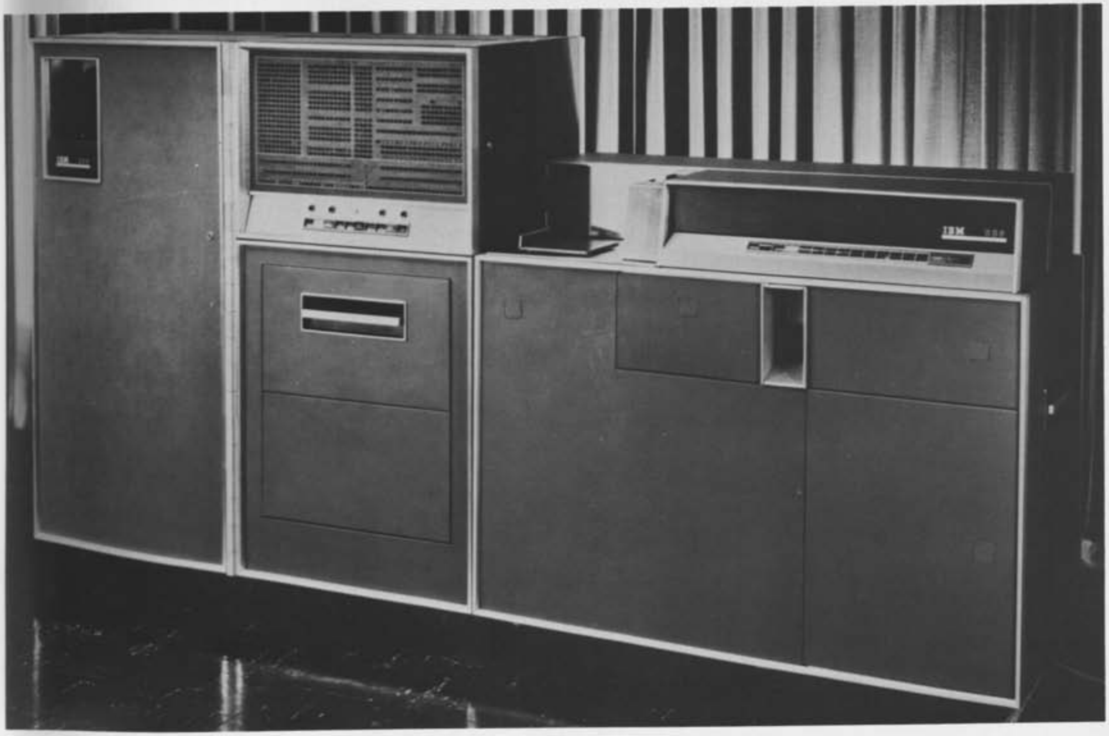
Transistor Technology

It had become apparent that transistors could be used in very large numbers and at very high speeds to produce computers whose performance would dwarf that of the largest vacuum tube computers ever built. A transistor would shorten the time needed for electrical impulses to complete a circuit, would generate much less heat, was more reliable, lowered production costs, and was only 1/200 the size of the bulky vacuum tube.

In 1955, IBM announced the 608 Transistor calculator. More than 3,000 transistors were used in the 608, which did not contain even one standard vacuum tube. The transistors were mounted on 700 printed circuit cards. The circuit cards eliminated a great deal of bulky wiring. The 608 was capable of handling bigger and more complex problems than the 604 and 607 and yet was only half as large and required only 10% of the power.

Almost from the time it was invented

IBM's first commercial transistor machine was the 608 calculator. The 608 helped to break ground for the larger transistor computers to come. ▼



at Bell Labs in 1948, the transistor was expected to revolutionize computer technology. But as with many inventions, it's a long road between invention and application. There's a period of time where it has to be perfected and proven; i.e., it must be capable of being produced in quantity, economically feasible, and uniformly reliable.

Project Stretch

The computer industry was investing some of its own money in preliminary research toward the development of the big transistorized computers, but the real venture capital in this area came from the United States Government through the Livermore and Los Alamos research laboratories of the Atomic Energy Commission. Los Alamos contracted with IBM for a computer, which became known as Stretch.

The Stretch project was headed by Steve Dunwell whose task was Herculean at least. He had to take IBM's scientific computer system and integrate it with IBM's business computer system. It was like mixing oil and water, so Dunwell and his people had to start from scratch.

Working with a new technology brought to light many problems for which there were no precedents, and new processes and procedures had to be developed. Dunwell held frequent brainstorming sessions with Werner Buchholz and Gene Amdahl to define potential problem areas and define a strategy for getting these issues resolved.

Among the problems that surfaced were modifying the circuit cards, redesigning the back panels for these cards to plug into, and how to relate decimal and binary in a single system. Also, card readers, card punches, and printers were being developed for each system. They performed the same function, but they were wired in an entirely different way. No one had looked at how to arrive at a single method of connection that would work for all classes of input/output equipment -- a standard interface.

It was an extremely creative period in the lab. Problems couldn't be solved by the old methods, and innovation prevailed. Early in the development stages it became apparent that a machine the size of Stretch could not be constructed or designed by the old techniques with manual circuit drawings, manual tables, etc., and still maintain any degree of reliability. The high volume of paperwork left a wide margin for error which would result in problems in debugging the system. The high volume of paper would also create enormous recordkeeping problems. This led to the concept of design automation. A group was put together to concern itself with the use of computers to simplify the design process. It took about a year and a half to develop a process. By the time Stretch was completed, the general concept was adopted, but in the meantime it had cost the Stretch project much in manpower and resources. Its development alone cost several million dollars. But, as Dunwell saw it, there was no choice but to do this if they were going to be successful.

The system organization in Stretch was much more complex than any of its predecessors. To manage this effectively, the whole thing was broken down into about ten different design groups with each one having its own area of responsibility; i.e., memory group, frame group, power supply group, etc.

Meanwhile another government contract had been accepted by the Poughkeepsie laboratory with an earlier delivery date than that of Stretch. It, too, was to be a transistorized machine. So Stretch found itself with a competitor in the lab that was going to use the same componentry and had an earlier schedule. A lot of ground work had been done for the new group to base their system on. It was flattering to Dunwell's group that their technology was being picked up and adopted, but it created a very serious tension in the lab because they both needed the same

▲ *S.W. Dunwell, later to be made an IBM Fellow by Mr. Watson, is shown with a scale model of the STRETCH computer, with the original operating in the background.*

parts and there simply were not enough to go around.

Texas Instruments had been contracted to manufacture the transistors for both Stretch and the new machine nicknamed DEW-line (Distant Early Warning) system. However, at the time, the transistors were on a test rack where they would be for approximately 90 days. Dunwell flew to Dallas to convince Texas Instruments to release the transistors earlier. Immediately on his return to Poughkeepsie, Ralph Palmer, head of the laboratory, confiscated Dunwell's pocketful of transistors and gave them to the other project with an approaching final date.

The Stretch machine was delivered to the Atomic Energy Commission fully tested and operational. One of the most interesting and complicated features of the computer was the look-ahead feature. This, working with an interleaved memory, could provide instructions and operands to one or more processing units at a rate much greater than would be possible in a strictly sequential system. This device read instructions about three levels ahead and, on the basis of having read these instructions, determined what memory references would next be necessary and allocated the memories in advance of the need. Thus the information would be available on the memory register by the time it was required by the computer. The look-ahead concept was developed by a number of people among whom were Dunwell himself, Bill Stringfellow, Ernie Stevens, and Vaughn Winkler.

Stretch costs were astronomical, but the project had set the basis of a technology that future systems could build and improve upon.

Over a year later, after realizing how immensely the technological fallout from Stretch had benefitted the company, Mr. Watson conferred an IBM Fellowship on Dunwell.

Growth brought with it an increased demand for space, and two inter-connected Engineering laboratory buildings were constructed on the former Kenyon property on Boardman Road. The buildings added 95,000 square feet of floor space to the existing laboratory facilities.

Building 702 with Building 703 in the background. The buildings were designed by Eliot Noyes and were completed in 1956. These buildings were necessary to house IBM's rapidly expanding research and development effort. ▼

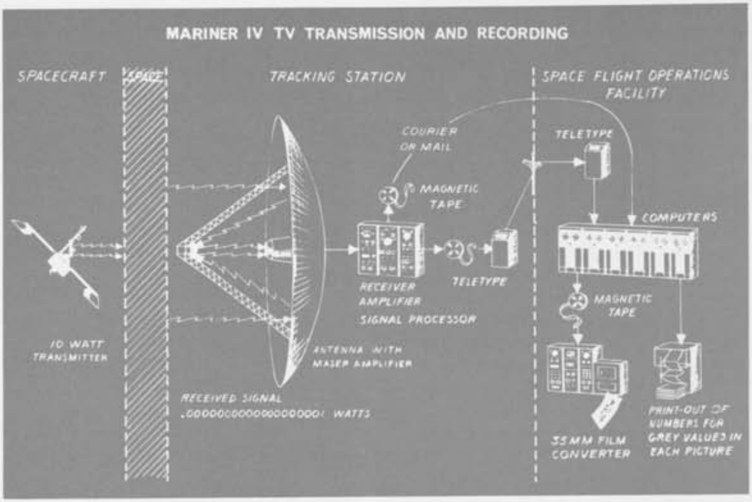
7090 (DEW-line)

Early in 1958, the Ballistic Missile Early Warning System (BMEWS) project requested bids from computer manufacturers to supply a number of very large, fast computers for data analysis and general computation. They made it clear that they would not consider vacuum tube computers, since several manufacturers had already announced transistorized computers that would be able to handle the job.

IBM won the contract by offering to deliver the 709, a vacuum tube computer, almost immediately to permit design and checkout of early warning system programs. Then IBM undertook to deliver, in a little over a year, a completely transistorized logically compatible computer.

The data processing system that evolved was quite complex. Statistics showed that in round numbers it included 50,000 transistors, 125,000 resistors, approximately 500,000 connections points, and more than 20 miles of wire. The project was headed up by George Monroe and became known as the IBM 7090. An important feature of the 7090 was a new unit called a "multiplexor." This controlled and co-ordinated the transfer of all information within the data processing system. Up to eight data transmission channels could be associated with the multiplexor so that as many as eight input-output devices could operate while the central processing unit (CPU) performed a calculation.

The 7090 utilized a large amount of the technology, processes, and procedures that had been developed and implemented by Stretch. If there had been no project Stretch, IBM might very well have been two years later in the development of the 7090; which became one of IBM's most successful large-scale computers.



▲ *This diagram show how photographs of Mars taken by the Mariner IV spacecraft were processed. The signals were received by a world-wide network of antennas and sent to the Jet Propulsion Laboratory, Pasedena, California by phone or Teletype lines. At JPL the photographs, in digital form, were developed by an IBM 7090 computer into 40,000 picture elements. Each element, or dot, of the picture can have any one of 64 possible shades of gray.*

◀ *Against the flame and roar of Saturn's huge 30,000,000 horsepower super-booster is the scientist who directed computaton of test-firing results, Dr. Helmut Hoelzer, with a model of the new IBM 7090 computer. Dr. Hoelzer and his space team associates used the 7090 to explore new areas of rocket engine research. The 7090's computing ability was used to analyze rocket vibration, heat transfer, and dozens of other elements.*

The first two 7090 transistorized computers were delivered to BMEWS right on schedule in November 1959. Although the military was the impetus in the development of the 7090, it was designed as a general purpose data processing system with a variety of applications. When this new computer was officially introduced, it was met with tremendous acceptance. In business it could be used for large-scale applications such as inventory control, production control, forecasting, and general accounting. Engineers and scientists were also able to utilize its capabilities for a multitude of purposes such as an aid in the design of missiles, jet engines, nuclear reactors, and supersonic aircraft.

N-7090

March 1960: A twin-engined aero-commander airplane arrived at Dutchess County Airport. Owned by IBM Corporation, it will be used for executive transportation. This aircraft bore a unique license number: N-7090, requested from and granted by the FAA to coincide with the successful 7090 computer system in production in Poughkeepsie.

Milestone Shipments

May 1961: Three production milestones were reached when the 100th IBM 7090 Data Processing System, the 70,000th Card Punch, and the 50,000th Verifier were shipped from the Poughkeepsie Plant.

The first 7090 Data Processing System was shipped in 1959 to the Air Force for use in the Ballistic Missile Early Warning System. The first Card Punches came off the production line in early 1948 and were soon followed by the verifiers.

Each of these products played an important part in IBM and were shipped to customers throughout the world.

7070 - 7080

Plans and discussions ensued on a transistorized architecture to succeed the 705 commercial stored-program computer. Palmer solicited proposals from both Poughkeepsie and Endicott on a replacement system. Then, in 1958, Palmer gave the project to Endicott. The resultant machine was to be the 7070.

In 1959 a company-wide reorganization occurred and Data Processing was divided into three divisions: the Data Systems Division with large system responsibility, the General Products Division with small system responsibility, and the Data Processing Division with sales and service responsibility.

Due to the reorganization, development responsibility for the 7070 was now placed with the Data Systems Division in Poughkeepsie under Steve Dunwell. Dunwell was not completely satisfied with the design of the 7070 and started work on a replacement called the 70AB which was to be twice the speed at half the cost. Due to schedules and pressure to get out a replacement for the 705, work on the 70AB had to be suspended and emphasis put back on the 7070. It was expected that the customers would willingly convert to the word-oriented 7070. In addition to possessing the advantages of a transistor machine, the 7070 could run two programs together. One was designated as the main program and had priority over the secondary program. If the main program was held up temporarily, the 7070 would automatically switch to the secondary program. When the unit causing the delay became available, the computer would return to the main program. In this way, two programs could be performed simultaneously and the machine would be more

▲ *Circuit designs for the new IBM 7080 data precessing system were prepared by the new system's predecessor, the IBM 705 III. Here, during test, the circuitry is checked by Pierre E. Poux, left, and Edward V. Doyle. The large-scale IBM 7080 was the most powerful computer yet designed specifically for developing business information.*

The importance of programming was becoming evident. Shown is a rack of programs for the system 707. ▶

efficiently used.

However, some of the customers with huge investments in 705 programs were not at all willing to convert, and so IBM produced the 7080, a transistorized extension of the 705 which was assured of success because it could run 705 programs. A program for the 705 could be run on the 7080 in one-sixth of the time.

Spread

Bolstered by Mr. Watson's assignment of a corporation mission to plan the next series, Poughkeepsie engineers reviewed the earlier work they had done on the 70AB and began to consider expanding the 70AB into a family of computers to be called the 8000 series. The proposed 8106, based on the earlier 70AB design, would replace the 7070. Also planned was a scientific feature called the 8108, a smaller commerical machine to be called the 8103 and to fill the gap in the scientific area a machine called the 8104.

Endicott was basking in its successes on the 1401 and 1620 and was making plans to expand both of these lines. The 1620 was originally developed in Poughkeepsie in 1959 to fill a gap in IBM's product line for a small scientific computer and was later transferred to Endicott. And, the World Trade Corporation in the Hursley, England, laboratory was busily working on a small binary called SCAMP.

Under the reorganization of 1959, a small staff group, under Don Spaulding, was charged with the responsibility for coordinating the activities of the three newly formed divisions. Spaulding felt that for the new series to be successful a critical cost/performance evaluation should be done first to determine the company's direction. T.V. Learson, who was the group executive responsible for the three divisions, asked B.O. Evans to leave Endicott, where he had been assigned as systems manager for the 7070 and 1410, and go to Poughkeepsie to evaluate the merits of the 8000 series. His instructions were simple: "Look at the 8000 series -- if it is right, build it; if it is not right, build what is right."

In early 1961, Evans moved to Poughkeepsie. Within a few months he was convinced that the 8000 series should not be the basis of IBM's next family of computers. He did not agree with the architecturally dissimilar systems, peripherals that had to be customized by family, circuit technology which differed by machine type, and the amount of programming required for each type of architecture. Another influencing factor in Evans' decision was a study done by an advanced technology task force under the chairmanship of Erich Bloch. This report recommended alternate logic component technologies for the future. The majority of the task force members favored SLT (Solid Logic Technology). This was a hybrid, microminiaturized technology. Instead of using the palm-sized SMS card to package the circuits, SLT used fingernail-sized chips, each containing a single circuit. Evans and his group recommended abandoning the 8000 series and building the new systems in this new technology.

However, Fred Brooks and his staunch supporters defended the 8000 series, resulting in split camps within the Evans' group. The Corporate Management Committee reviewed both points of view, and by May of 1961 decided in favor of Evans' recommendation.

In May of 1961, Evans met with key people from the 8000 series to develop new strategies. It would take time to define, develop, and announce a new series. In the interim, some new products would have to be developed in a short span of time to fill in the gap and allow IBM to hold its position in the marketplace.

During the latter part of 1961 Don Spaulding, head of Group Staff, formed a special task group to establish a plan for development and product direction of data processor products extending to 1970. This special 13-member group was called SPREAD (an acronym for Systems, Programming, Research, Engineering, and Development) and included representatives from the Data Systems Division, the General Products Division, and World Trade. The group was chaired by John Haanstra, who was Director of Development in the General Products Division, with Bob Evans serving as co-chairman. They met for two months of secret, exhausting sessions in a Connecticut motel before delivering their final report on December 28, 1961. The system it proposed was called NPL (New Product Line) and when marketed became known as the IBM System/360. The objectives of the New Product Line were to have a fully compatible line of computers, one that could handle both scientific and business data by integrating into one system the capability of addressing both classes, standardizing peripheral equipment across the system, and developing programming independent of the hardware.

Over the following year there was still some lingering opposition, the fear being that should any failures or delays occur, not only one unit but the entire line of computers would be affected.

Fred Brooks was given overall corporate responsibility for the design of all of the computers in the New Product Line. Although a major portion of the development activity on the New Product Line was assigned to Poughkeepsie, both Endicott and Hursley Laboratories were given the opportunity to develop computers in the new series. This was the first time a development effort of such importance was given to an IBM laboratory outside of the United States.

Extensive development effort was being placed on control stores and growing memory requirements in the New Product Line. A review of the software support effort indicated that there was a deficiency in trained programmers and 200 to 300 would be required. In 1963, a recruiting campaign was in effect to find people with appropriate skills. A definition of a programmer's responsibilities was to write a set of instructions (a program) which would execute in sequence a number of steps that would enable a computer to handle many operations concurrently. The program would include instructions to the computer to calculate, transfer data, sort, merge, etc. By the end of 1965, the total number working on software for the new product line reached approximately 2,000. Programming had come into its own as an integral part of the systems development effort.

To effect better organization control, in 1961 the new Components Division was formed, utilizing the former DSD Poughkeepsie components development group as its nucleus.

Interim Products

Based on the May 1961 decision, IBM began work on a number of crash projects to develop and build interim machines, both processors and peripheral equipment, in an effort to keep a standing in the marketplace.

In October 1961, IBM announced its new Hypertape system. The progression from standard tape to Hypertape was compared to the evolution a few years earlier from vacuum tube to transistorized computers. More information could be recorded on four inches of the new Hypertape than on one foot of magnetic tape on the other currently used tape units. The units making up this new system were the 7340 Hypertape Drive and the 7640 Hypertape Control. They could be linked with IBM's 7074, 7080, and 7090 data processing systems to achieve faster "read" and "write" speeds than attained using previously designed tape units. It was estimated that at top speeds, Hypertape could enter 137 million U.S. Social Security numbers into a computer in an hour. The Hypertape was contained in a two-reel cartridge completely sealed against dust. Each 7340 drive system had a two-cartridge capacity and automatically switched to the new tape cartridge when the first was completed.

In 1962, based on a device originally developed by advanced systems development engineers in San Jose, a "voice assembler" was developed by Poughkeepsie engineers with a planned installation date of early 1965 at the New York Stock Exchange. This would enable a member of the Stock Exchange to dial a four-digit code assigned to the stock he was interested in and the quotation would then be switched from an IBM 1410 memory to the assembler where it would be

More information can be recorded on four inches of the magnetic tape used in the Hypertape system than on a foot of the magnetic tape used in the IBM 729 tape systems. The Hypertape cartridge, at left, contains a reel holding 1,800 feet of tape on which approximately 25 million characters can be recorded. A 7340 Hypertape drive ready for processing can be seen in the background. ▼

◀ *Operator removes a completed Hypertape cartridge from the unit as another is being processed in the 7340 Hypertape drive. He is able to stay one tape ahead of the job being run on the computer by inserting the next cartridge to be used. It will automatically be moved into processing position when the computer is ready for it. The Automatic Cartridge Loader reduces time lost in tape changing.*

▲ *Bellcomm, Inc. an AT&T subsidiary had a single objective - to help NASA's project Apollo put a man on the moon. The system developed by Bellcomm employs a Poughkeepsie developed directly-coupled IBM 7040/7044 (console shown). Through remote terminals, problems can be entered instantly by each user, and directed to remote locations requesting information in return. This system was in response to scientists and engineers requests for immediate answers to thousands of technical problems to enable them to meet each Project Apollo milestone.*

▲ *It looks like a 1410 - it uses 1410 programs - but there the resemblance ends. The 7010 is 350% faster, has 25% more storage in 50% of the space, and is adaptable to both business and scientific uses.*

converted automatically from digital language to spoken words. The system would reply with something like "ABC - four and a half to four and a quarter. Last - four and three quarters."

In November 1962 the 7010 was announced as an extension of the 1400 series product line. Programs designed for the 1410 could be run on the 7010 which featured greater internal processing speeds and greater storage capabilities. Also, customers who already had 1410's could use existing peripheral and input/output equipment. This development effort was under W. R. Rave and E.J. Nordlie.

The 7740 Communication Control System was announced and it marked IBM's entry into the independent message control field. With the new system, IBM could now provide all the data processing elements of a communications network.

In December of 1962 a lab-developed 7750 Programmed Transmission Control Unit was featured in a simulated telecommunications system at a Joint Computer Conference hosted in Philadelphia.

In May of 1963, IBM announced the 7094 Model II. Under the direction of Robert E. Crosby, then project manager, his department, with contributions from other departments, developed this addition to the 7090 line. The 7094 Model II shattered existing speed records at that time in the computer market by reducing the already fast 2-microsecond operating cycle down to 1.4 microseconds.

In September of 1963, a joint effort between Poughkeepsie and the Time/Life group in New York, identified as the 7040/44 Operating System, was announced. It was considered a major achievement in the "art of programming." Its built-in flexibility permitted a variety of computer operations to be performed without rigid requirements for job sequencing.

▲ *The 7740 Project Communication Control System speeds and centralizes a communications operation by accepting data and messages from all points of a network. Over one thousand average length messages per minute can be edited, logged, and sent to their intended destination. This is the culminative effort of several varied disciplines, from computers to communications.*

SLT

PCP

MFT

MVT

New Product Line (NPL)

The development of the New Product Line, headed up by Fred Brooks, which became known as System/360, was not only a busy and exciting time for engineers and programmers, but for many of the laboratory's support groups as well.

A Product Planning group for the System/360, headed by William R. Bradshaw, was formed in 1961. Its charter was to analyze current trends in data processing, including the current and future needs of the customer. They began with field surveys and talks with customers. They asked questions like:

What do you like about IBM systems? What do you dislike?

What capabilities would you like to have included? What are nonessential? What are you doing with your computers now? What will you be doing next year? Five years from now? Ten years?

Over 400 customer accounts were contacted. Late in 1962, the Planning group documented the results of their market analysis in a set of preliminary functional objectives for review by other pertinent areas. Forecasting looked at these with an eye to the marketplace, Pricing with an eye to cost, and Engineering to determine design feasibility.

Industrial Design was charged with creating an image for System/360 which was described as a product to revolutionize the computer industry--a product of advanced technology. This area under the direction of Cal Graser and Walt Kraus worked with human factors engineering to combine functional, structural and appearance design into a package that would emphasize the revolutionary aspects of the system. Each model would have to be designed to reflect compatibility and family relationships among the models of the new line.

▲ *Headlines emphasize the individual, as well as collective effort, that makes the company work.*

The laboratory computation services organization managed by Dana Kilcrease explored the application of computers to automate and unify design of System/360. Design automation efforts relieved an engineer of some of the tedious, but necessary, work and allowed him more time to concentrate his talents on the more creative aspect of the design. An outstanding example of their contribution was SLDA (solid logic design automation) developed specifically for solid logic technology to assist the engineer in integrating new computer circuit designs into a complete system. Initial input to the system was the engineer's rough sketches which were translated by the program into master tape files. On request, other computer programs would then automatically handle other necessary routines.

Publications groups put System/360 on paper. The major effort of technical product and programming systems documentation was shared by two Poughkeepsie laboratory publications groups: Product Publications headed by Anthony F. Smyrski and the Operating System/360 Publications effort headed by John S. Boyd. The two groups handled the technical writing, art, layout, and editing. From Product Publications came documents such as Principles of Operation, Installation Manuals, CE Manuals, parts catalogs, special bulletins and operator's guides. From Programming Systems Publications came manuals on control programs, languages, and generalized programs. Generalized sort/merge and utility program manuals were also included.

Contributions by laboratory photographic services, headed by John Gruber, appeared everywhere. Hundreds of rolls of film were used for color shots and mounted slides that were used in presentations and film and slide shows before, during and after announcement. Their output was also utilized in sales promotion, education, and for various briefing sessions.

Support was given by the purchasing department which found the vendors who would manufacture the parts to specifications at the very lowest cost, the draftsmen who worked late into the night preparing documents containing the computer's design, the mailroom employees who made sure those documents arrived at the proper place, the numerous technicians, model makers, and secretaries who typed countless memos and proposals, and the personnel department which started their work first so that the various departments would have the right people to do the job.

Building 705

With development efforts increasing in scope, more and more people were being recruited and the laboratory quickly outgrew its available facilities. A new building was added to alleviate some of the space problems. While some internal portions of the 705 building were still under construction, groups under the Machine Technology functions were already moving in. By the end of June 1962 the building was complete and also occupied by groups from Programming Systems, Advanced Systems Development, and Laboratory Administration.

Functionalism and aestheticism were combined in the architectural concept to create an agreeable work environment.

The reception area in the center of the building is a spacious room extending the height of both floors. The area done with wood panelling was complemented by beige carpets and contains a free-space stairway leading to a second floor balcony.

The 3,900 square foot cafeteria features a glass wall with an adjoining patio with a brick deck, set in connecting circular patterns and allows diners a view of the Hudson River and highlands in a pleasant and relaxing atmosphere.

IBM Fellowship Program 1963

"Creativity has made the difference," said Thomas J. Watson, Jr., "between our being an ordinary company and one of the great companies of the world." Then, he announced the IBM Fellowship Program to honor technical people with "sustained records of innovation and achievement." Among the first eight IBM Fellows were: Ralph Palmer, who conceived the 604 calculator, directed development of the 701 and 702 computer systems and assisted in the development of the 7000 series; Ronald Dodge, who invented proportional typewriter spacing, and from Poughkeepsie, Charles R. Doty, Sr., who pioneered ways of transmitting punched card data via telephone and telegraph.

▲ *Panels of concrete honeycomb facade complement the strong lines of the 705 building by day and are impressive by night as well, when the interior lights shine from behind the panels and cast a display of lights and shadows.*

System/360

On April 7, 1964, at 8:30 a.m., a special chartered train left New York's Grand Central Station carrying members of the press to Poughkeepsie for one of the largest industrial press conferences of its kind ever held.

During the two-hour, 72-miles ride north along the Hudson River, press members were served breakfast and given press kits containing a detailed description of System/360. When the train arrived in Poughkeepsie it was met by buses which took the press to the IBM Poughkeepsie Education Center, site of the press conference.

About 200 editors, writers, and reporters from national news magazines, newspapers, news services, and radio stations attended the one-and-a-half hour conference in the auditorium. They heard IBM Chairman Thomas J. Watson, Jr., refer to System/360 as "the beginning of a new generation, not only of computers but of their application in business, science and government." The press audience then saw a color film that featured System/360's history, concepts and mission. Similar announcements were being made in approximately 165 cities in the United States and in the World Trade Corporation countries as well. After the conference, the press was taken on a tour of the Poughkeepsie laboratory facilities where they had an opportunity to see firsthand the products they had heard about earlier in the day.

The announcement was the unveiling of the IBM System/360 with separate, yet compatible, processors. The new line ended the distinction between scientific and commercial computers. Each model had the ability to process work through binary, decimal or floating point arithmetic facilities. The six new models consisted of the Model 30 developed in Endicott, the Model 40 developed in Hursley,

Mr. T.J. Watson, Jr. announcing the System/360 in Poughkeepsie on April 7, 1964. ▶

Members of the press waiting to board a special chartered train for the Poughkeepsie Press Conference. ▼

Dr. Frederick P. Brooks, Jr., IBM Processor and Advanced Programming Systems Manager, explains the new System/360 architecture to members of the press. ▶

England, and the Models 50, 60, 62 and 70 developed by the Poughkeepsie Engineering Laboratory.

Also announced was the availability of 44 peripheral devices, 26 of which were being offered for the first time. All of the processors worked with most of the 44 attachments. The new line covered the performance range of practically all preceding IBM computers and was available in 19 combinations of graduated speed and memory capacities. A customer could select from a number of devices from printers to optical readers to visual display terminals that could be attached to the new computers. In doing so, he could tailor a system to best suit his needs.

▲*James Halloran, IBM Engineer, and Thomas J. Watson, Jr. inspect a portion of the new System/360.*

▲*By closed-circuit television, Bob O. Evans showed the audience actual System/360 equipment in the Data Systems Development Laboratory in Poughkeepsie.*

With the new single system concept, a program written for one model could be run on any of the others, providing that there was enough memory capacity and enough input-output equipment, and as long as the program was not geared to a specific operating speed. A customer could start with a small computer and upgrade within the 360 series without having to reprogram. Also, customers with a larger unit could tie in with a smaller installation and speak the same language.

An early sampling was taken to determine customer reaction. There was general feeling among many customers that progress is a way of life with IBM. They greeted System/360 with virtually unqualified enthusiasm, and many could see definite applications for the new system in their business.

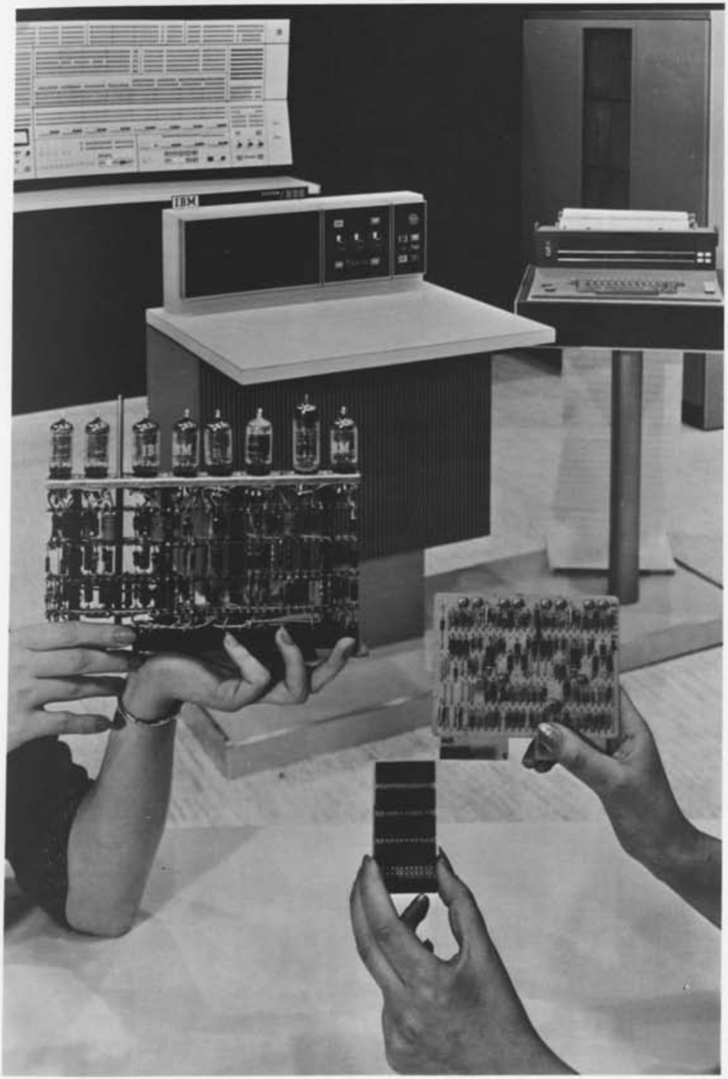
Mr. Watson called the System/360 announcement the most important new product announcement in IBM's history. What more appropriate time for such a major product announcement than on the 50th anniversary of the company.

1965 was the year of establishing System/360 in the marketplace. Shipments started to customers in April and hundreds more were delivered throughout the year. It was also a year when announced products were modified and changed to include new capabilities as engineers continued to make performance improvements in System/360. New products were added to the line: Model 44, a joint Poughkeepsie and Hursley effort, designed for the medium-priced scientific market, Model 67 for time-sharing, and the Models 65 and 75 for more powerful computing power.

The mammoth task facing the programming area became evident through the evolution of System/360. Writing programs for the comprehensive new Operating System/360 was substantially more complex than the standard programming efforts undertaken previously. In May of 1965 the programming area restructured to better meet time, cost and quality criteria of current, as well as future, customer software requirements.

Carl H. Reynolds, then Director of Programming, explained the reorganization and defined the roles of the newly-created programming center, system managers, and advanced development groups before an audience of programming and other managers at the Poughkeepsie Education Center.

With a System/360 console in the background, fifteen years of computer technology is shown. One large computer previously held thousands of the vacuum tube assemblies shown at left. This evolved to circuit cards, shown at right, containing transistors and diodes to replace the vacuum tubes and reduce size while increasing speed. System/360 uses solid logic technology circuit cards, foreground, further reducing physical size with increased calculation speeds measured in billionths of a second.▶



Housing for these activities had become a problem, and to meet the expanding needs of the programming area, building 706 was completed by the summer of 1965.

In the center of building 706 one of IBM's largest computing centers was constructed solely for the creation of programming products. The center was a single room of 28,000 square feet, over half the size of a football field. The room was quickly filled with machines and consoles and manned by shifts of operations personnel. It was estimated that the center handled more than 4,000 jobs per week. Jobs ranged from a small correction on part of a program under development to the assembly and testing of entire sections of Operating System/360.

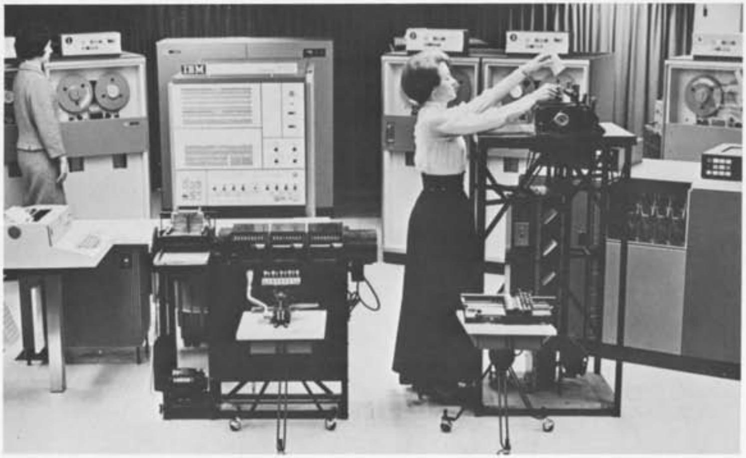
Poughkeepsie Programming System, in concert with other locations, produced major programs for customer data processing requirements. In July 1965 the BPS FORTRAN IV Compiler, the third program of the Basic Programming Support package for System/360, was released. Between March 31, 1966 and December 7, 1966, eight releases of Operating System/360 were made available. The new programming system grew from a Primary Control Program (PCP) to Multiprogramming with a Fixed number of Tasks (MFT) and then, in 1967, to Multiprogramming with a Variable number of Tasks (MVT).

Efforts were also being made to customize systems to fill specialized customer requirements. In 1965, IBM announced shipment of its first 9020 system, a joint effort between Poughkeepsie and Kingston, which was based on System/360 technologies and architecture. This 9020 was shipped to the National Aviation Facilities Experimental Center in Atlantic City, New Jersey, to be incorporated into a new experimental

▲ Portland, Ore., June 14...James Attig, data processing manager of U-Haul, is shown monitoring information from the firm's 8,000 dealers as the data is fed into an IBM System/360. The new computer keeps track of 100,000 trucks and trailers that are constantly on the move throughout the nation. The firm handles hundreds of thousands of rental contracts each month and with the computer, can forecast where in the country equipment will be needed most.

With much fanfare, a System/360 arrives at a customer's location in Japan.▼

With the latest in technology, an IBM System/360 as a background, a model in period costume operates a Hollerith vertical sorter. The punch machine for the Hollerith card system is shown center.▶

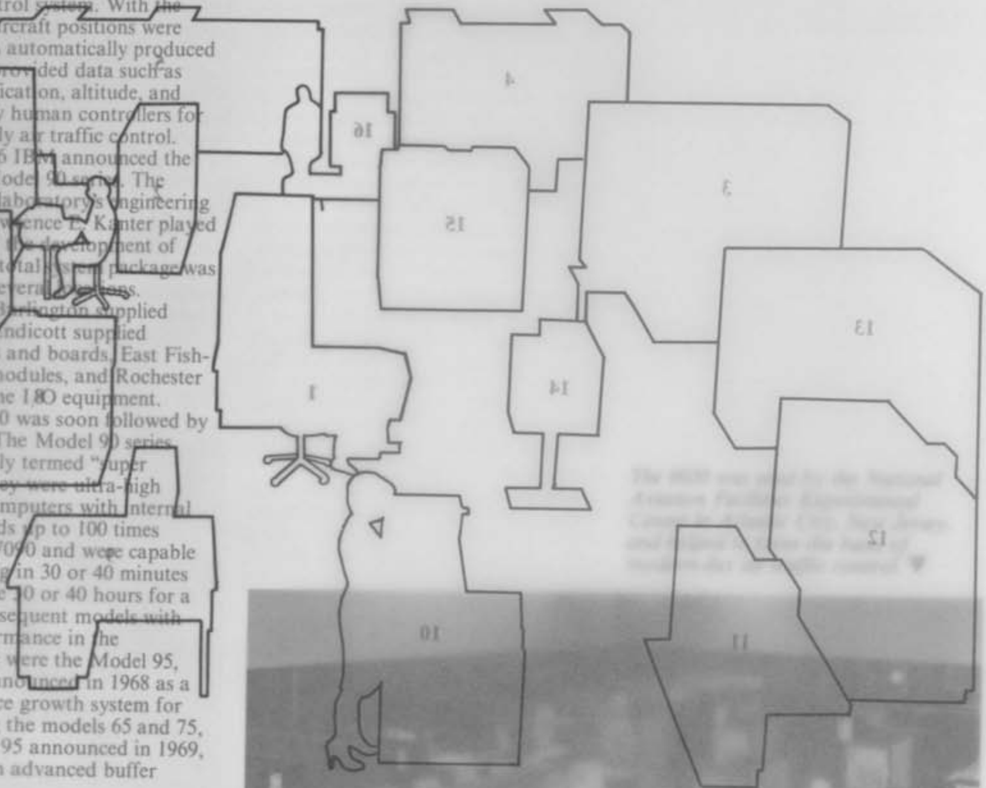


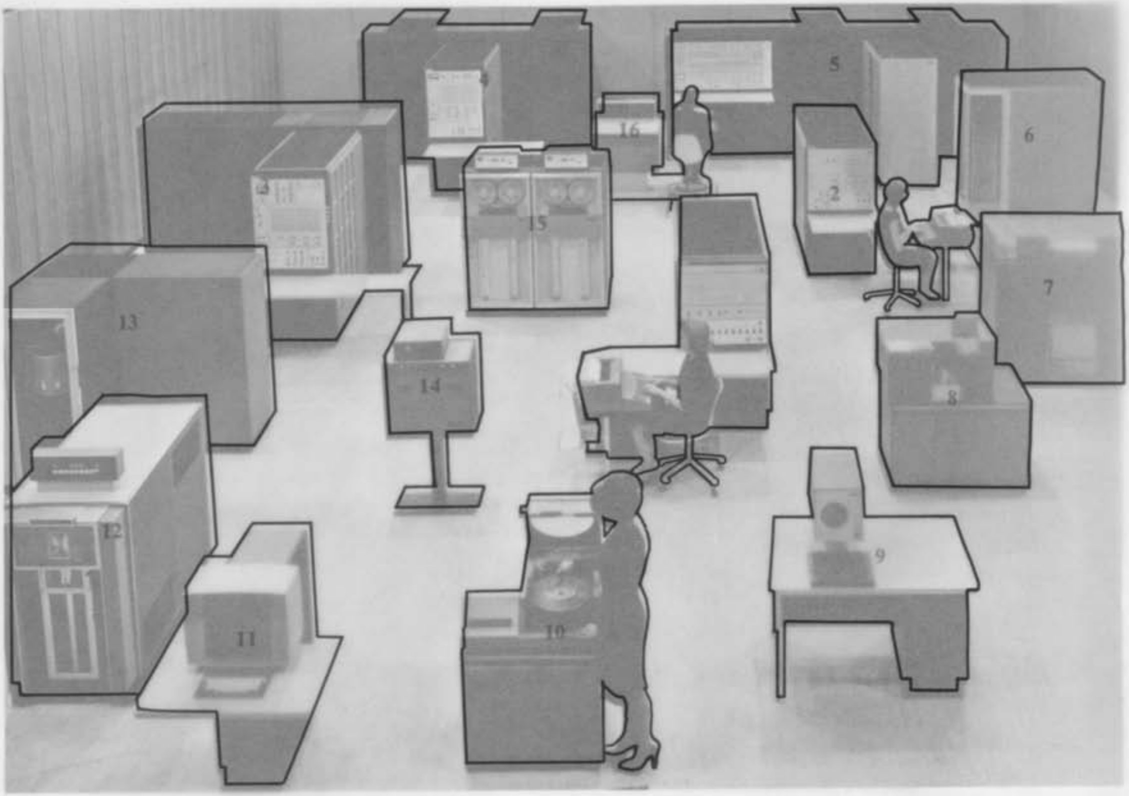
◀ Named after the complete circle, System/360 is shown here with the console in the center and several of its components and peripheral accessories in a symbolic circle.

air traffic control system. With the new system, aircraft positions were displayed with automatically produced "tags" which provided data such as aircraft identification, altitude, and type needed by human controllers for safe and orderly air traffic control.

In early 1966 IBM announced the System/360 Model 90 series. The Poughkeepsie laboratory's engineering team under Lawrence E. Kanter played a major role in the development of Model 90. The total system package was supported by several locations. Kingston and Burlington supplied storage units, Endicott supplied advanced cards and boards, East Fishkill furnished modules, and Rochester and San Jose the I/O equipment.

The Model 90 was soon followed by the Model 91. The Model 90 series were analogously termed "super computers." They were ultra-high performance computers with internal processing speeds up to 100 times faster than the 7090 and were capable of accomplishing in 30 or 40 minutes what would take 30 or 40 hours for a 7090 to do. Subsequent models with improved performance in the System/360 line were the Model 95, the Model 85 announced in 1968 as a high-performance growth system for computers using the models 65 and 75, and the Model 195 announced in 1969, which utilized an advanced buffer storage concept.





PORTRAIT OF A COMPUTER — Key elements of the new IBM system/360, keyed to numbers on the diagram at the right, include these 16 individual units. Processing unit 1 through 5 make 19 combinations of memory capacity and speed available. Other equipment, which is part of the system, include: 6—Core storage of up to two million characters. Multiple units can be tied in to the system to link more than eight million characters of information at microsecond speed; 7—High-speed printer; 8—One of several units that read and punch cards; 9—Terminal to display visual replies; 10—Storage drive using removable disk packs storing up to 15 million digits; 11—Unit to visually present information stored in the system. An operator can modify information with this unit; 12—Hypertape which reads and records information on cartridged magnetic tape at up to 680,000 digits a second; 13—Data cell drive which makes up to 800 million digits available in random sequence; 14—On-line data collection terminal to feed information from the factor floor; 15—Nine channel tape drives with speeds ranging from 22,500 to 90,000 letters and numbers a second or up to 180,000 digits a second; 16—Operator's control console.

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The 9020 was used by the National Aviation Facilities Experimental Center in Atlantic City, New Jersey, and helped to form the basis of modern-day air traffic control. ▼

Devices, Tools & Programs

The complexity of the new computers called for more sophisticated devices for incorporation into the planning and development of future systems, as well as tools for measuring performance of current systems. Several prominent devices surfaced in the late 1960's.

Four monitoring devices were developed to help detect programming problems. Development of these devices was accomplished by Performance Instrumentation under Robert O. Kahl and Measurement Techniques under Richard G. Neville. They included the Program Monitor, the Execution Plotter, the Program Event Counter and SEER recording device.

Dr. Sidney Phillips, a chemist in Materials and Process Engineering, presented a proposal for designing and building a new potentiostat when he discovered that none were available commercially that would satisfy his laboratory needs. A potentiostat is an operational amplifier that will electrically maintain a constant applied potential or current. It is used widely in corrosion research, electrokinetic studies, and electroanalytical applications. Commercially available potentiostats had a rise time in microseconds. The one built by Dr. Phillips with the assistance of departments under Machine Technology had a frequency response of sufficient range to give a rise time in the hundreds of nanoseconds range.

In Systems Analysis, a new device called the Systems Activity Measuring Instrument was developed to record time, sequence and distribution of events within a working computer without disturbing its normal operation.

Also developed was a microprobe tester designed to replace elaborate techniques requiring optical equipment and special darkrooms.

Technical Evaluations, a Poughkeepsie Laboratory programming group, played a key role in the first use of computer-driven graphics in the 1966 election coverage. CBS News in its election night coverage used an IBM 2250 display unit for its "Victorygraph," which visually depicted a continually changing graph representing the Voter Profile Analysis for key election contests throughout the country. Although only the programmers' end product was seen by people watching CBS, many IBMers throughout the Corporation contributed to this project. At the heart of this highly complex system were two Model 50's, duplexed so that failure in one allowed immediate switchover to bring second into operation, plus numerous pieces of peripheral equipment.

Poughkeepsie Programming was busily assisting in the development of tools both as an aid to assist programmers in writing programs and for customers who wanted to expand their capabilities.

In 1967 a new program called System/360 Flowchart was released. System/360 Flowchart was an outgrowth of Autochart, a lab-developed program that was first used in the days of 7000 series computers, then refined and brought up-to-date for System/360. Autochart produced flowcharts from descriptive statements written by programmers. The flowcharts provided a graphic diagram of how a program worked, illustrated with many conventional symbols such as rectangles, diamonds, and boxes which represented common programming steps such as decisions, connectors and so on. The completed chart was used as a guide in coding the program and later as an aid in understanding, using, and modifying the program. The system was developed by a Poughkeepsie Laboratory group headed by Vernon S. Mercer for use by IBM programmers for internal documentation purposes. It was decided that such a program would be useful to customers but had to be modified for ease of use. It was, therefore, updated to permit users to write English-like statements as input to the flowcharting system. This enabled people with little or no programming experience to produce and update these diagrams.

Raymond E. Rose, DSD, holds a completed FLOWCHART with a portion of the program instructions in the foreground. ▼

Releases 9 through 13 of Operating System/360 were made available in 1967. In addition to introducing MVT, enhancements included Remote Job Entry (RJE), Version II of MFT, the Time Sharing System (TSS/360), and the Graphic Job Processor. This rapid pace of programming development continued through 1968 with releases 14-16 of OS/360 and enhancements to

RJE and TSS. System Management Facilities (SMF) was also introduced.

"Not enough hours in a day," is a common complaint among people. Programming recognized this growing problem and decided to do something about it. Eliminating wasted time would also result in more productive hours per day. In 1969, a major programming product was made available - Release 17 of Operating System/360. Under this release, a data generator was added that allowed the programmer to test his program while he developed it. Another feature, check point/restart, provided OS/360 with the ability to recover lost processing time on a program that had gone awry. Previously, a program that had run for four hours and then stopped because of an error or miscalculation would be lost. After the mistake had been corrected, the program would have to run through in its entirety again. By placing checkpoints along the run, the checkpoint/restart feature allowed restarting of the program at the checkpoint just prior to the error or miscalculation, thus resulting in a considerable time savings.

1969 also brought the announcement of TSO (time sharing option), which added a fully integrated time sharing capability that could operate under a single control program. TSO was basically developed by Poughkeepsie Programming which held responsibility for overall design, Scheduler, Utilities, and other important aspects. More than 500 laboratory people were involved in the design, development, test, integration and documentation activities. Donald J. Gavis, then systems manager, OS/Programming, was responsible for directing the overall TSO effort. TSO was capable of handling a full range of data processing activities concurrently. Mathematicians, engineers, scientists, actuaries, forecasters, and business analysts could all get rapid solutions to their problems. It was fully compatible with all standard OS/360 data formats and service programs. It also granted remote terminal users direct, immediate access to their central System/360. With TSO, more jobs could be handled concurrently and more users could share the computer's resources. This added up to increased productivity from the computer, programmers, problem solvers, and other users.

In June of 1969, IBM announced a change in the way it would offer programming for its data processing equipment. New IBM programming, much of it coming from the Poughkeepsie programming center, included System Control Programming (SCP) and Program Products (PP). The SCP was defined as fundamental to the operation and maintenance of the sytem and was available without charge. PPs were related to the application of the system to user tasks and were available to anyone under a License Agreement for IBM Program Products.

Custom Systems

Diversified requests from large and small customers alike placed varied demands on Custom Systems, a group that adapted IBM products and designed customized products to fit special customer needs.

A 27-unit order for an additional storage feature that would push up the computing capabilities of the Allstate Insurance Company was filled by the Poughkeepsie Custom Systems Lab.

They also played a key role in the development of SPRINT -- a special police radio inquiry network. This unique, computer-assisted dispatch system was designed to cut emergency response time in half for the New York City Police Department. Emergency assistance could be requested by a person calling into the police communication center. Information supplied by the caller would be fed into a computer. This information plus additional data extracted from the main computer would then be transmitted to the appropriate radio dispatcher who would receive the basic incident information on a screen installed for this specific use. Data included would be type of emergency, location, patrol cars available, and hospital zone for incident address.

Unit Records

On February 28, 1969, shipment of the new IBM 50 Magnetic Data Inscriber (MDI) and the 2495 Tape Cartridge Reader was made to the State Farm Insurance Company. Both were easily operated. Information was typed on the keyboard of the MDI to record it on magnetic tape. The magnetic tape was in a sealed, self-contained cartridge. The cartridge was then placed in the companion unit, the 2495, which streamed the data into a System/360 at 900 characters per second. Up to 12 cartridges could be placed in the reader, which fed, read, rewound and stacked the cartridges without operator intervention.

In late 1970, the new IBM 129 Card Data Recorder, which improved the flexibility, versatility and convenience of the IBM card by providing more performance and throughput for the keypunch dollar, was announced. The announcement culminated ten months of dedicated effort on the part of such people as Jerry Lieberman, Robert M. Goth, Edmund Turner, and many others that made up the Key Entry team managed by Roy F. Bonner.

Two of the three new IBM 129 models were capable of operating both as a punch and verifier, thus providing the same flexibility in verifying as in punching. Error cards could also be corrected during the verification process.

Another new feature allowed the operator to continue keying during automatic functions such as skipping, duplicating, and card feeding or reading. On standard card punches, the operator had to wait for each of

▲ *The IBM 129 Card Data Recorder has a monolithic-circuit memory that helps speed punching of familiar 80-column cards for computers and other business machines.*

◀ *The operator of the IBM 50 Magnetic Data Inscriber console (left foreground) types information on the keyboard to record it on magnetic tape contained in the plastic cartridge. Up to 12 cartridges can be placed in the IBM 2495 Tape Cartridge Reader (right) for automatic processing.*

these functions to complete and could then resume keying.

Herman Geisler, then assistant general manager of the Toronto, Canada, plant was on hand for the announcement, as his plant was scheduled to assume manufacturing responsibility for the 129 both in Canadian and domestic markets.

The best bit of news on announcement day came from the salesmen in the field. Before the close of business on that day, orders for 500 of the new machines had been received.

Engineering Information Systems (EIS)

1970 brought with it a major Engineering Automation milestone with the release of the new EIS (Engineering Information System). This system was developed to support a large quantity of records and provide functions necessary in the design, development and release of a computer. It gave the engineer a wealth of assistance - logical and physical designs of a computer, simulation, design variations, and a history of where he'd been. Just as the system's data base, or catalogue of information, was extremely large, so were the number of applications it could provide. One of EIS's prime jobs was in physical design - determining how the wires would run in the tiny components of a huge computer. The system was compared to an attorney's law library. It was used to check engineering design to insure conformity with numerous rules associated with technologies of the day and to keep track of the scores of records associated with each engineering job.

MST

JES

MVS

SVS

VM

System/370

A milestone in IBM history occurred on June 30, 1970 with the announcement of System/370 Model 155 and Model 165. IBM Chairman Thomas J. Watson, Jr. announced the computer system to Data Processing Group employees via telephone broadcasts. Watson described it as "a system designed for the performance and applications needs of the Seventies."

In New York City, a press conference was held to announce it to the world. Data Processing Division President F. G. "Buck" Rodgers said: "First, we have achieved greatly improved performance by putting much of the advanced technology of IBM's ultra-high performance computers within reach of medium and large-scale computer users. And, we have achieved compatibility, since Systems/360 users will be able to run most of their existing programs on the new system without change."

That same day meetings were held at Data Processing Division branch offices across the country. Customers streamed into the meetings to see the new machine on film and get details on its operation, including information on the System/370's installed and operating within IBM.

In addition to the two new processors, several new peripheral units and new or enhanced program products were announced.

To provide users with higher performance and more information storage capacity for their data processing dollar, IBM utilized the newest technology in the System/370 series - MST, or monolithic systems technology. MST, like its predecessor, was a silicon chip. However, MST chips each contained several complete circuits, whereas SLT packaged only a single circuit on a chip. One MST module was,

▲ *This System/370 Model 155 can work on as many as 15 computer programs simultaneously. The speed and large storage capacity of this system were designed to help users economically meet the remote computing, multiprogramming and large data base applications of the Seventies.*

therefore, equivalent to anywhere from 4 to 24 SLT modules. This miniaturization resulted in more compact systems with room for many more circuits. These circuits were faster, more reliable, and lower in cost. MST was said to be more than twice as reliable as SLT, and 2,000 times as reliable as the old vacuum tube technology.

The System/370 Model 165 was developed primarily in Poughkeepsie with Kingston providing the power supply. It was designed as a natural growth step for users of System/360 Models 65 and 75. According to Robert E. Crosby, then improved 360 processor program manager, it was "designed to satisfy the on-line requirements of the Seventies by combining large-capacity, low-cost storage with a high-performance processor." In addition to its many features, the Model 165 provided a file containing microdiagnostics, system test diagnostics, and memory test diagnostics - all on removable disk cartridges for system servicing.

The IBM System/370 Model 155 was developed, manufactured, and tested in Poughkeepsie. Arthur A. Petersen, then medium systems development manager, called the Model 155 "a significant stride forward in data processing capability."

At the time, the Model 155 was said to represent IBM's "most-tested" large computer system. This was expected to produce a high degree of reliability in performance from the first customer shipment.

Burt Goldberg, then systems manager, medium systems, at Poughkeepsie, noted that 14,000 system hours had already been run prior to announcement on some ten Model 155's installed in IBM locations around the country. These machines were installed in various test environments: in product test and engineering testing at Poughkeepsie, in San Jose for testing new peripherals, and at several programming centers for program tests. Testing included exposing the system to temperature and humidity extremes, vibration, and other environmental tests with all significant combinations of input/output (I/O) devices.

An On-Line Test Executive Program (OLTEP) was available for both models. This program allowed most peripheral equipment to be tested while customer jobs were being run. The new System/370 also had the ability to handle up to 15 different program tasks simultaneously.

As in previous years, with increasingly complex technologies came growth and with growth came expansion. In 1970, building 707 was added to the Poughkeepsie Laboratory complex. The site, adjacent to buildings 705 and 706, was chosen as a step toward consolidating laboratory employees. Building 707 was designed by Sherwood, Mills and Smith, who had been the architects for building 705. The three story structure with two above grade and one below grade, has a 12 foot overhang around the top floor. The building, with an area of approximately 250,000 square feet, was planned to accomodate as many as a thousand employees. The cafeteria, opening to an eastern ground level vista, was designed to double as a meeting area with a comfortable seating capacity for 700 people.

▲ *Building 705 with building 706 to the north and excavation site for the new building 707 to the south.*

▲*John R. Opel, then IBM senior vice president and group executive; Burton S. Goldberg, systems manager, large systems, and Jerrier Haddad chatting between sessions at the country club.*

Lew Branscomb, IBM vice president and chief scientist, discusses announcements of the IBM System/370 Models 158, 168 and OS/VS2.▶

Employees boarding buses to be taken to the country club for announcement meeting.▼

In August 1972, after two years of intense research and development on the very leading edge of system development, IBM announced from the Poughkeepsie Laboratory and 250 branch offices simultaneously the introduction of System/370 Models 158, 168, and OS/VS2. Models 158 and 168 were improvements on the System/370 that contained the innovative concept of Operating Systems/Virtual Storage (2nd generation).

The Operating System (OS) is a complex set of instructions which tells a computer how to carry out its data processing tasks utilizing a revolutionary "floating storage." The Virtual Storage (VS) is a combination of hardware and programming which allows a computer to operate as if it had almost unlimited main storage. This means the ability to handle many more applications than previously in the same data bank, and allows programmers greater flexibility since they are freed from certain storage constraints. This new "floating storage" concept also had the ability to retrofit most System/360's currently in customers' hands. With no need for an all new systems expenditure, customers could upgrade their systems/programs with a quantum leap toward the 21st century, courtesy of IBM's "imagineering."

Based on a recommendation by Norm Vogel, then manager of Laboratory and Technical Operations, this advancement in computer technology was celebrated by management with a free lunch for all laboratory employees. From the memory banks came the following luncheon statistics: 4,275 guests started with 22,000 shrimp in 36 gallons of sauce, followed by 100 gallons of soup with 700 pounds of salad. The entree was 4,500 pounds of the best, choicest, done to perfection, prime ribs of beef with 600 pounds of carrots, 800 pounds of green beans (French cut with sliced almonds), and 175 quarts of sour cream for 3,860 baked potatoes. Finally, 450 calorie ladened pecan pies with 2,640 cartons of milk and an ocean of coffee. And let's not forget the 6,600 rolls. Of course, these totals were spread around various locations with attendant management words of congratulations.

Another significant event came in October 1972 with the announcement

Choice prime rib being prepared for the announcement day luncheon.

Cafeteria workers preparing shrimp cocktails for luncheon.

Employees enjoying announcement day luncheon.

of System/370 Model 125 and the availability of OS/VS2, two months ahead of its announced schedule. The Model 125 was followed by the Model 115 which in 1973 was referred to as IBM's lowest-cost virtual storage computer. Although developed in the Boeblingen Laboratory, a group in Poughkeepsie, under the direction of Angelo S. Ruggiero, small systems product engineering manager, had domestic product engineering responsibility for both models, which also included debugging and testing of various portions of the systems.

To extend the capabilities of System/370, IBM announced, in 1973, two multiprocessing systems - Model 158 MP and 168 MP. The combination of two MP model processors, a multisystem unit, or a multisystem communication unit, and programming support allowed the two individual processors to be connected and controlled as a single system. The MP systems offered a growth path of Model 158 and 168 users in terms of additional computer power, additional channel capacity, and additional monolithic main storage capacity.

They were upgraded in 1975 and announced as the 3158-3 and 3168-3. According to Anthony F. DiMarco, manager of 370 processor development at the time, "The 3158-3 and 3168-3 are significant enhancements at the top of the System/370 line. The combination of additional performance plus improved and new machine functions will enable our customers to extend the life of their installed systems because the 3158 and 3168 are field upgradable."

The years 1973-1976 saw a continuous flow of programming enhancements from the Poughkeepsie programming center. OS/VS2 Release 2 and 3 were delivered to the field. Release 2 introduced the Job Entry Subsystem products (JES2 and JES3) and expanded virtual addressing space to 16 million bytes. The Resource Access Control Facility (RACF) product was introduced to enhance user's data security. A Selectable Unit (SU) process was introduced as vehicle for reducing the customer's effort in applying programming changes to his system.

▲ *Among the engineers who participated in the development of the System/370 Model 168 MP were: (l. to r.) Rich Partridge, Dale Junod, Dean Caswell, Joe Foglietta, Bill Hoyt, Ed Axelsen, Joel Fox and Geoff Small.*

▲ *Watching the loading of the Model 158 CPU and the console for the Model 125 are (left to right): Arthur Petersen, who was System/370 Model 158 engineering manager; Louis Voerman, then SPD vice president and general manager, Mid-Hudson Valley Manufacturing; Curtis Smoyer, then new products manager, Kingston/Poughkeepsie; and Angelo Ruggiero, Model 125 engineering manager.*

The high-performance Model 168 has a main storage capacity of up to 4 million characters and can take full advantage of virtual storage, which permits use of a System/370 as if it had up to 16 million characters of main storage. ▼

The 158 MP virtual storage system can be operated as either a single system or as two independent computers. Made up of two System/370 Model 158's, the 158 MP system is available with up to 8 million characters of storage. An enhanced control program permits the two computers to be interconnected. This interconnection of computers is called multiprocessing. ▶

Satellite Communications

IBM first demonstrated satellite data communications with the Telestar satellite in 1961, and later conducted tests and demonstrations with Intelstat satellites. These experiments were concerned with voice-grade communications.

In the summer of 1973, an experiment was in progress concerned with high-speed, computer-to-computer digital data transmissions utilizing satellites.

Under contract to IBM, RCA Global Communications erected a portable transmitter/receiver with a 36-foot diameter dish antenna in the 703 parking lot. Under FCC authorization, signals were transmitted to a Canadian geostationary satellite, and returned to the same source, with the quality of the transmission being analyzed for future computer use.

This project was headed by Daniel P. White, Jr., telecommunications systems technology manager. At the Systems Development Division in Raleigh, transmission technology manager Harold Markey's group was responsible for designing and producing some of the peripheral equipment used in the experiment. The overall systems coordination was under the direction of Donald C. Flemming, systems engineering manager.

A northeasterly view of the RCA 36-foot diameter transportable antenna located in the Building 703 parking lot for satellite data transmission/receiving experiments in 1973. ▼

◀ *A close-up view of the 36-foot diameter microwave antenna used in satellite/computer transmission experiments.*

Analytical Systems

October 14, 1975; IBM announced two new analytical systems, the 7840 Film Thickness Analyzer and the 7841 Textile Color Analyzer. Both of these systems used a sample holder with light source and a spectrophotometer, and a data processor that analyzed a reflected light from the sample and stored the data on an IBM diskette. Each system was complete with keyboard for entering instructions, a display tube on which was shown results or specifics as requested, and a printer. The diskette could be transferred to a customer's central computer for further analysis or entered into a product historical data bank. This was not a requirement, as each unit was self-contained.

The 7840 Film Thickness Analyzer measured thermal, pyrolytic and sputtered silicon dioxide, silicon nitride films and photoresist thickness on silicon substrates. The measurement range was from 30 to 5,500 nanometers (300 to 55,000 angstroms). This system eliminated operator transcription and interpretation errors and allowed many more tests in a given amount of time. In the semiconductor industry, accuracy and quality control are of the utmost importance, and this analyzer filled an important need in technological advancement.

The 7841 Textile Color Analyzer was demonstrated to the attendees of the 1975 National Technical Conference of the American Association of Textile Chemists and Colorists in Chicago in conjunction with IBM's product announcement. As a sample was being analyzed, the operator could determine and store pertinent data by referring to a table of options and type in prompting routines. The data processor also had a prompting routine ability to instruct the operator to provide additional input data. The color spectrum could be graphically displayed on the screen for matching or dye formulating or dye analysis.

For each of these systems, the announced price averaged about $82,000 (1975). In this price range, even relatively small industrial customers could benefit from IBM's advanced technology.

The IBM 7841 Textile Color Analyzer show here can be used in a variety of applications including color matching, dye analysis, shade sorting and dye inventory control. ▼

303X Series

Late in 1975 development work progressed on a new processor which was to become the 3033. Anthony DiMarco, then manager of 3000 series processor development, spearheaded the effort.

The first order of business was specifying chip requirements. For the 168, chips had been developed that compressed four or five circuits on a single silicon chip approximately one-twelfth of an inch square. New requirements called for a chip design with almost twice the switching speed, and one that averaged ten times as many circuits in the same space. The 3033 also called for a greater number of chips with different kinds of circuits. The logic chip for the Model 168 had 18 different circuit layouts, the chip for the 3033 called for 43. To assist in the circuit design, engineers relied heavily on computer simulation. Working with TV-like terminals, they created circuit patterns and looked to the computer to simulate circuit performance.

The newly developed processor had almost twice the internal execution rate of the 168 and yet was roughly only half the size of the 168. The space savings came not only from the denser circuitry, but from the newly designed channels which were integrated into the main frame of the processor instead of being packaged in separate frames as in earlier machines.

When interviewed for an article in *Think* magazine dated January/February 1979, DiMarco was asked how the development of the 3033 differed from the development of other processors. He recalled that it was more of the same - yet different.

"Different," he said, "in that we were doing things not only serially, but also in parallel. Ordinarily, we would design the machine. Then build it and test it. And in testing it, work out the bugs. But with Meridian (code name of the 3033), we had planned to design, build and test the several elements of the machine as we went along. In other words, we didn't have to go in single file from the beginning to the end. We could advance on what you might call a broad front."

By mid-1976, cadres of engineers had arrived in Poughkeepsie from various IBM World Trade plants and labs. Some had come to incorporate their own special marketplace requirements into the design of the machine. Others came to lay the groundwork for the transfer of manufacturing of the 3033 to IBM overseas plants. The 3033 was to be manufactured and marketed internationally as a transnational machine, and it had to be developed with international design criteria in mind.

The 3033 was introduced to the world in March 1977. Also announced were two new program products and programming enhancements, developed by Poughkeepsie programmers, to support the 3033 processor on MVS (multiple virtual storage), SVS (single virtual storage), and VM (virtual machine)/370 programming systems. The announcement of the MVS/Systems Extension (MVS/SE) program product marked the first time that a portion of the systems control program (SCP) was made available to customers. Three weeks later, hundreds of orders for IBM's 3033 were already on the books.

This was followed in the fall of 1977 by two new additions to the large systems product line. The 3031 and 3032 processors, developed by the Poughkeepsie laboratory, which provided improved levels of performance to intermediate and large system users who wanted to expand their data processing capabilities but did not require the capacity or performance of the 3033 processor.

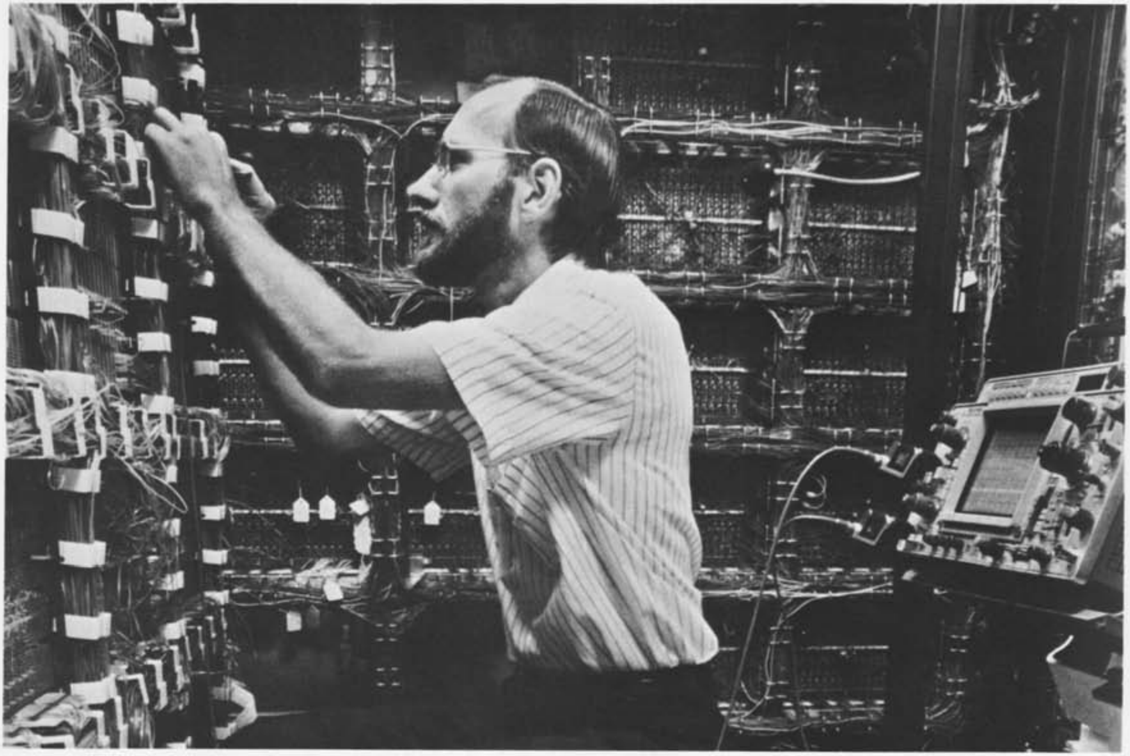
Programming enhancements continued throughout 1977 and 1978. JES2, JES3, RACF, and TSO were enhanced. A new product, Resource Measurement Facility (RMF), was released that significantly enhanced MVS data collection and provided a reporting tool for that data. Processors and other hardware devices were supported on a regular basis.

The first IBM 3031, 3032, and 3033 processors, developed in Poughkeepsie, were shipped to customers from Poughkeepsie on March 17, 1978. According to Ray F. Boedecker, then vice president, Systems Products Division and general manager of manufacturing - Brooklyn/Kingston/Poughkeepsie, "This is the first time in the company's history that the first customer shipment of three such major systems has taken place on the same day." The 3031 went to The Credit Life Insurance Company in Springfield, Ohio, the 3032 went to the U.S. Air Force's Data Service Center in Washington, D.C. and the 3033 to the Singer Company in Wayne, New Jersey.

To recognize this achievement, an employee recognition day was held on Thursday, March 30th. This included a complimentary luncheon for all Poughkeepsie employees and for the SPD employees at Kingston. "Congratulations for a job well done" was the theme of the employee recognition day. In addition to the luncheon, each employee received a pen commemorating the event. Among the corporate executives to visit Poughkeepsie for the day's festivities were John R. Opel, Paul J. Rizzo, Theodore C. Papas, Jr., and John E. Bertram.

March 30th had additional significance for Poughkeepsie Laboratory employees. On that day, IBM announced a powerful, multiprocessor version of its 3033 processor, capping another achievement for Poughkeepsie's

▲ *The 3031, 3032, and 3033 had simultaneous first customer shipment dates.*



▲ *An engineer in the Poughkeepsie laboratory takes measurements and verifies circuit board interconnections on this engineering model of an IBM 3032 processor.*

development organization.

When the first 3031, 3032, and 3033 processors were shipped, development was already under way on the new 3033 Attached Processor (AP) by a group headed by Geoffrey Small. The 3033 AP featured improved performance without the need for another complete 3033 processor complex. It was announced in January 1979 with first customer shipment going to John Deere & Company in Moline, Illinois, in December 1979.

In November 1979 the 3033 Model Group N was announced. It had internal performance up to 30 percent faster than the 3032 processor and could be upgraded at the customer location to a 3033. Harry Carlson, then 3032/3033 engineering manager, and John Gasparini, 3000 series processor development manager, directed the development of the Model Group N processor.

Throughout the year, the Poughkeepsie Programming Center announced new software products to keep pace with the advanced computers. In one significant software development, the Center released Virtual Machine/System Extension 2 (SE2). The main virtue of this program product was that it allowed the more efficient running of guest control programs in conjuction with host control programs.

In June 1980, programming development took another major step toward pricing all software. System Products (SPs) were introduced that combined major portions of the system control program with either a JES2 or a JES3 package.

While improvements were being made on the current product line, another group within the laboratory was applying itself to Future Systems.

3848 Cryptographic Unit

In December 1979, IBM announced its new 3848 cryptographic unit. It was designed for data processing installations as a protection against unauthorized disclosure or alteration of information stored on computer tapes and disks. This is especially valuable to users in protecting personal and sensitive information such as financial records and trade secrets from unauthorized disclosure or alteration.

Only a user with the proper key can decipher data encrypted by the subsystem. It offered 72,000,000,000,000,000 (quadrillion) possible combinations. It was said that an intruder could try one million combinations every second and conceivably spend more than 2,000 years trying to gain access. Also, keys could be changed frequently, providing increased protection. Enciphered data could be transmitted through other computer systems, but would remain unreadable except for those locations equipped and selected to decipher it.

The engineering effort was done by groups under Walt Bankowski and Bill Polgrean with support effort by the Poughkeepsie programming center and the Federal Systems Division in Gaithersburg.

TCM VLSI

MVS/XA

TSO/E

▲ *Dr. J. Bertram, at the time DSD president, congratulates Poughkeepsie employees on their creativity, dedication and hard work.*

308X

November 12, 1980, was called Celebration Day in IBM Poughkeepsie. The cause to celebrate was the simultaneous announcement of the 3033 Model Group S, enhancements to the 3033 product line, the first in a new series of computers called the 3081, and their supporting programming packages.

The IBM 3033 processor family was expanded with the announcement of the lower entry IBM 3033 Model Group S processor complex. The new processor configurations were designed with 3000 series technology primarily to provide additional processing power for System/370 Model 158 and IBM 3031 users. It consisted of a complete redesign of a major portion of the processor storage control function of the 3033, including the design and implementation of a new high-speed buffer which utilized a more cost effective technology.

Announcement meetings were held by various laboratory and manufacturing groups for first, second and third shift employees to unveil the new processors and enhancements.

The first announcement meeting was hosted by Don M. Powers, then manager of advanced processor development, whose group had primary development responsibility for the 3081, IBM's new, top-of-the-line large processor.

As part of the announcement day activities, more than 400 Data Processing Division regional managers, branch managers, and account executives met in Dallas to hear about the new products. In addition to the corporate executives who introduced the new systems, they also heard from John Stone, manager of the Poughkeepsie information systems group, who addressed the group via satellite television

▲ *Employees receive news about the new announcements.*

In celebration of the announcements employees were treated to lunch with live entertainment. ▶

transmission from Poughkeepsie. Stone spoke as a customer of the IBM 3081. A processor had been installed in the information systems area in a production environment for stress tests. It was the first time that a Poughkeepsie-developed processor had been used internally in a production environment prior to announcement.

The 3081 was hailed as an evolutionary step into the future. The fact that the 3081 offered lower cost, higher performance, and greater reliability than any of its predecessors was attributed to the advanced technologies incorporated into its design.

The 3081 had up to 2.1 times the internal operating speed of the 3033. It also used 60 percent less energy, dissipated 55 percent less heat, and occupied 55 percent less floor space. Also, because of its compactness, IBM customer engineers could install it in less than 24 hours compared with 72 hours for a 3033.

Availability was improved by the utilization of a dyadic processor approach. The 3081 consists of two integrated central processing units, each having equal access to central storage and two sets of channels that link it with input/output devices. If one of the twin processor units fails, it does not impact the performance of the other. This permits the customer to defer maintenance to a more convenient time.

The 3081's tremendous improvements in reliability were largely attributed to a new packaging concept known as the Thermal Conduction Module (TCM) which reduced the number of interconnections such as were found in earlier processors. It was estimated that one TCM had the processing capacity of a System/370 Model 148. The 3081 contained twenty-six such TCM's, each about the size of your hand, weighing about as much as a telephone. All twenty-six TCM's are

Doug Willoughby and Arlin Lee discuss 3081 on display at the Country Club. ▼

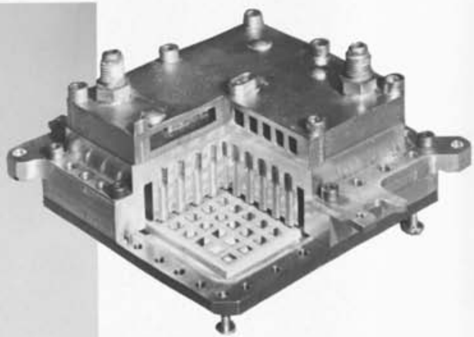
Announcement displays were set up throughout the lab. Representing some of the key contributing areas: (l. to r.) Gregg Hiatt, Marvin Pittler, William Polgrean, Don Powers, and Robert Simek. ▼

contained in about four cubic feet. The concept of the water-cooled TCM is to shorten the distance each electrical impulse has to travel to its destination. The closer together circuits are packaged, the shorter the distances electrical impulses must travel. The shorter the distance, the faster are the internal operating speeds, and the more instructions the computer can carry out per second. Erich Bloch, who had been East Fishkill's general manager during the development phase, said, "This is the first time our industry has seen microminiaturization pushed this far. The IBM 3081 is truly a Very Large Scale Integration machine. VLSI isn't just a dense chip."

Design model of a typical Poughkeepsie-developed IBM 3081 processor installation. ▼

The complexity and density of the 3081 rendered previous service strategies obsolete and/or inadequate. The serviceability and reliability group, then under Warren Ryan, worked on devising a scheme for maintenance and service that would minimize computer downtime in a customer's environment. Previously a customer engineer in the field had to recreate a problem and make the machine fail in the same way it had previously before he could analyze the cause of the trouble and take corrective action. To make a more precise problem determination with a minimum of disruption, a special processor controller was incorporated into the 3081 design which constantly monitors the computer and processing operation for power, heat, voltages, and coolant. In addition to saving information pertinent to the failure, the processor controller also automatically sets in motion special diagnostics to find or isolate the cause.

From conception to announcement, various groups made a number of significant contributions to the new system. The power design group, headed by Frank Ferraiolo, worked on a new design which would increase the power density to the processor while at the same time reducing the number of power supplies needed. Howard Roth's area worked on special circuitry for monitoring power and cooling while Robert Werner's group contributed in the area of heat distribution, logic requirements, timing, and clocking. Technical direction for packaging the various elements (circuits, modules, etc.)



▲ *Thermal Conduction Module. As many as 118 logic chips - providing a total of 45,000 circuits - are contained in this new IBM-designed module used in the IBM 3081. Within the module, shown in this cutaway picture, spring-loaded pistons in contact with each chip convey heat through a metal plate to a circulating chilled water system.*

was handled by the Large Systems Technology/Applications Engineering group under Clive Collins. The Packaging Design and Planning group headed at the time by Bob Patrick, devised a system to replace screw connections with snap-together, self-locking electrical connectors. This, in addition to lowering assembly cost, also contributed to improving field installation time. These were just a few of the many contributions. Jim Bitonti, who had been Poughkeepsie's general manager during early development work on the 3081, said, "To create the 3081, our people had to reorient their thinking. Our engineers had to develop new approaches, our production people had to master new skills. We had to restructure space in our facility, create new processes and design new tools."

By October of 1981 the refinements developed over the last year were of such magnitude that management determined that an announcement of expanded capabilities was in order.

On announcement day, employees throughout the Poughkeepsie site and DSD employees in Kingston and Brooklyn were treated to a complimentary lunch in recognition of their numerous contributions to the business.

Meetings were held at the IBM Poughkeepsie Country Club for the Poughkeepsie advanced processor development organization and the development programming organization in recognition of the announcements. Also, two videotape recordings that described the new processors and programming products were broadcast in site cafeterias featuring then IBM Vice President and Data Systems Division President John E. Bertram and then Data Processing Division President George H. Conrades.

Dr. Bertram summed up the importance of the day's announcements by saying, "We not only introduced new hardware, but clearly indicated the growth paths we've developed for our customers. I believe the announcements will be very well received in the marketplace, because they respond in a meaningful way to customers' current and advanced requirements."

The early 1980's saw the 3081 grow from a single system into a whole family of computers which became known as the 308X series. The "X" designation became a 3 (3083) and the a 4 (3084) as smaller and larger computer systems were announced. A variety of models were then added to provide more functions, greater speed, and improved price/performance ratio. The new series then contained several product offerings; three models of a uniprocessor (3083-E,B,J), two additional models of dyadic processors (3081-G,K,), and a dyadic multiprocessor (3084-Q). Engineering improvements included expanding the high-speed buffer storage, modifying the system controller, and development of a new dynamic channel subsystem.

As engineers made changes to the hardware, programmers also had to make changes to the software to keep up with the hardware capabilities. MVS/Extended Architecture (MVS/XA), announced in October 1981 as MVS System Product Version 2 (MVS SP2), was developed to provide control programming and data management support for the System/370 Extended Architecture. Extended Architecture more than doubled the number of devices that could be attached to a 3081. A dynamic channel subsystem when supported by MVS/XA would permit either of the 3081's two central processing units to use any or all of the channel paths and would more efficiently transfer data to and from peripheral devices. Major enhancements in the JES (Job Entry Subsystem) 2 and the JES3 programs were functional Subsystem (FSS), Virtual Storage Constraint Relief (VSCR) and new device support.

Programming products were making available significant new growth options for users of IBM large systems, and these products were now establishing themselves as an increasingly important revenue source for the company.

In early 1982 a special recognition event was held for approximately 3,200 manufacturing and laboratory employees in honor of their contributions to the design, development and manufacture of the 303X and 308X processors. The event was held on four successive Saturday nights. Employees and their guests were invited to dinner at either a site cafeteria or the Ramada Inn. From there they were taken by bus to the Mid-Hudson Civic Center for an evening of entertainment. The entertainment for the first three Saturday nights was pianist Roger Williams and singer Vicki Carr. The fourth night singers Gloria Loring and Mel Tillis entertained.

In 1982 a new programming product under development became available to customers. An entire library of MVS information was now available at a user's fingertips. Over the years, customers of the MVS operating system had from 200 to 400 technical manuals to choose from depending on their application. The new product called Information/Library was designed to retrieve tables of contents, indexes, publication titles, abstracts, and in some cases actual text of some MVS publications. It relieved MVS users of much wasted time in searching through printed indexes.

Mid-1982 saw a move of major proportions take place. It was the move of approximately 800 people, 2,100 boxes, 450 terminals, 20,000

◀ *George Wilder and Ray Lyon listen intently to the announcement.*

The country club was packed to capacity to hear the announcement. ▼

◀ *Gary Popovich, programming center manager, and Dr. J. Bertram, await start of announcement meeting.*

▲ *Among those discussing the impact of the morning accouncement were (l. to r.) Giles Rittenberry, Chuck Tobias and Robert Swann.*

▲ *Ground was broken for the Meyers Corners Road buildings in August 1981. From August 6, 1982, to August 16, 1982, one of the largest DP centers in the world was moved from building 706 in what has been recognized as a major logistics accomplishment.*

On hand for the announcement were (l. to r.) James Cannavino and Gerry Granito. ▼

tapes, 1,500 disk packs, plus an entire data center from the 705/706 complex to new quarters on Myers Corners Road, eight miles away. Six months of planning and developing innovative move techniques went into effecting the move in the shortest possible time with a minimum of service disruption. The move of the data processing equipment, planned and executed by a team managed by Wes Smith, started on Friday, August 6th. From disconnect to "operation bring-up" the move took only a week.

In March 1983, TSO Extensions (TSO/E) was made available for the MVS/XA environment. This product provided significant enhancements for the interactive end-user. It also provided the base for an Information Center Facility, bringing MVS into the office of the business professional.

1983 brought individual technical achievement recognition to many Poughkeepsie laboratory employees at the company's technical recognition event held on June 7th in San Francisco.

Among others, twenty-three Poughkeepsie Laboratory engineers shared a $1 million award for 3081 Engineering Excellence. Sharing the award were: Richard N. Gustafson, Robert J. Bullions, Bruce McGilvray, Samuel R. Levine, Gordon S. Sager, John A. Gerardi, Robert S. James, and Rudolf A. Houdtzagers for their contributions to the central processor, cache subsystem, execution element and storage subsystem. Robert B. Stuart, Carl Zeitler, Peter N. Crockett, Robert P. Jewett, Arthur J. Scriver, Marten J. Halma and David H. Wansor were recognized for contributions to the external data controller, data server element and channel processing element. Also recognized were John J. Reilly and Arthur J. Sutton for contributions to the processor controller; Gerald H. Mootz, Jr., Anthony Lepore and Robert C. Guggenheim for contributions to engineering systems test; Clive A. Collins for contributions to system applications of the new technologies, and Gerry D. Granito and Louis A. Guadagno for their contributions to the processor controller and for their leadership of engineering test.

Also announced was the appointment of four IBM Fellows, one of whom was Richard C. Chu, a recognized expert in cooling technology for large-scale processors.

Earlier, in April, the programming center had held its own recognition event acknowledging the significant accomplishments of 1982, particularly activities supporting the release of MVS/XA SP2.1 and its related products. Because of the number of people involved in programming development by this time, including those who had moved to Kingston the prior year, the event spanned three nights from April 14 through 16. A formal dinner, with entertainment provided by Neil Sedaka, was held in the Poughkeepsie Civic Center.

Bernard R. Aken and John D. Howell received Outstanding Technical Achievement Awards for their MVS/XA SP2.1 work while Allan S. Meritt and Paul J. Wanish received Technical Innovation Awards. Division Awards were presented to Nicolas F. Andruzzi, Michael D. Swanson, Robert C. Barnett, Charles W. Wood, and Janis L. Bender for their support of MVS/XA.

New products continued to emerge from Poughkeepsie. First customer shipment of an IBM (Poughkeepsie developed) 3088 Multisystem Channel Communications Unit was delivered to the Social Security Administration in Baltimore, Maryland. A memory option for the 3084 was announced with a similar option being offered for the 3081 Models G and K. Work also continued on programming products to meet new demands.

Construction is continuing to house the various needs of expanding functions. New buildings are under construction and old ones under renovation.

The Future

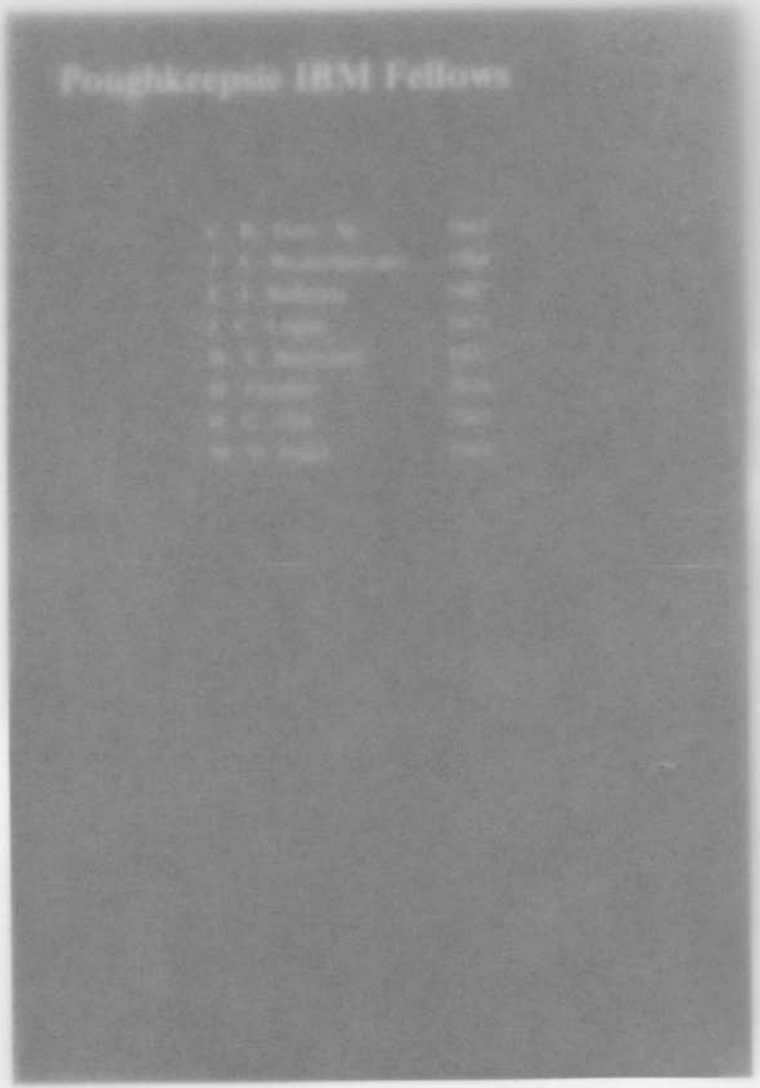
The preceding pages have outlined the first four decades of the Poughkeepsie Research and Development Laboratory. It is not all-inclusive, that would take volumes. The technical record depicted has been, and will continue to be, the result of human endeavor. The employees are the start and finish of each project. Most projects are successful, some are not, but the experience and insight gained either way is added to the sum total to be applied in the future. Here lies the opportunity to create, the freedom to be creative, and the rewards of creativity. The coming decades will most certainly reveal excellence of endeavors as yet undreamed of.

Poughkeepsie IBM Fellows

C. R. Doty, Sr.	1963
J. A. Weidenhammer	1964
E. J. Rabenda	1967
J. C. Logue	1971
W. F. Beausoleil	1972
H. Fleisher	1974
R. C. Chu	1983
M. Y. Hsiao	1984

[illegible] Laboratory Managers

[illegible]	1944
[illegible]	1949
[illegible]	1950
[illegible]	1954
[illegible]	1957
[illegible]	1961
[illegible]	1964
[illegible]	1967
[illegible]	1968
[illegible]	1970
[illegible]	1972
[illegible]	1975
[illegible]	1976
[illegible]	1978
[illegible]	1983


Poughkeepsie IBM Fellows

Poughkeepsie Laboratory Managers

Ralph E. Page	1944
Jim Frazier	1949
Ralph I. Palmer	1950
Horace S. Beattie	1954
H. Ty Marcy	1957
Harold D. Ross	1961
William Rave	1964
Joe Brown	1967
Erich Bloch	1968
Jerrier Haddad	1970
Bernard J. Greenblott	1972
Dr. James Eaton	1975
Arthur F. Collins	1976
Robert E. Crosby	1978
Dr. Frank R. Moore	1983

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And Jim Vega, for his assistance in organizing the material presented.

As with all our endeavors here in the Poughkeepsie Laboratory, the concept has been and will continue to be one of teamwork. Without exception, all who were approached by the author for information and advice responded most enthusiastically. Without such teamwork, this project would not have been possible.

Helen C. Dawes

Helen C. Dawes

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