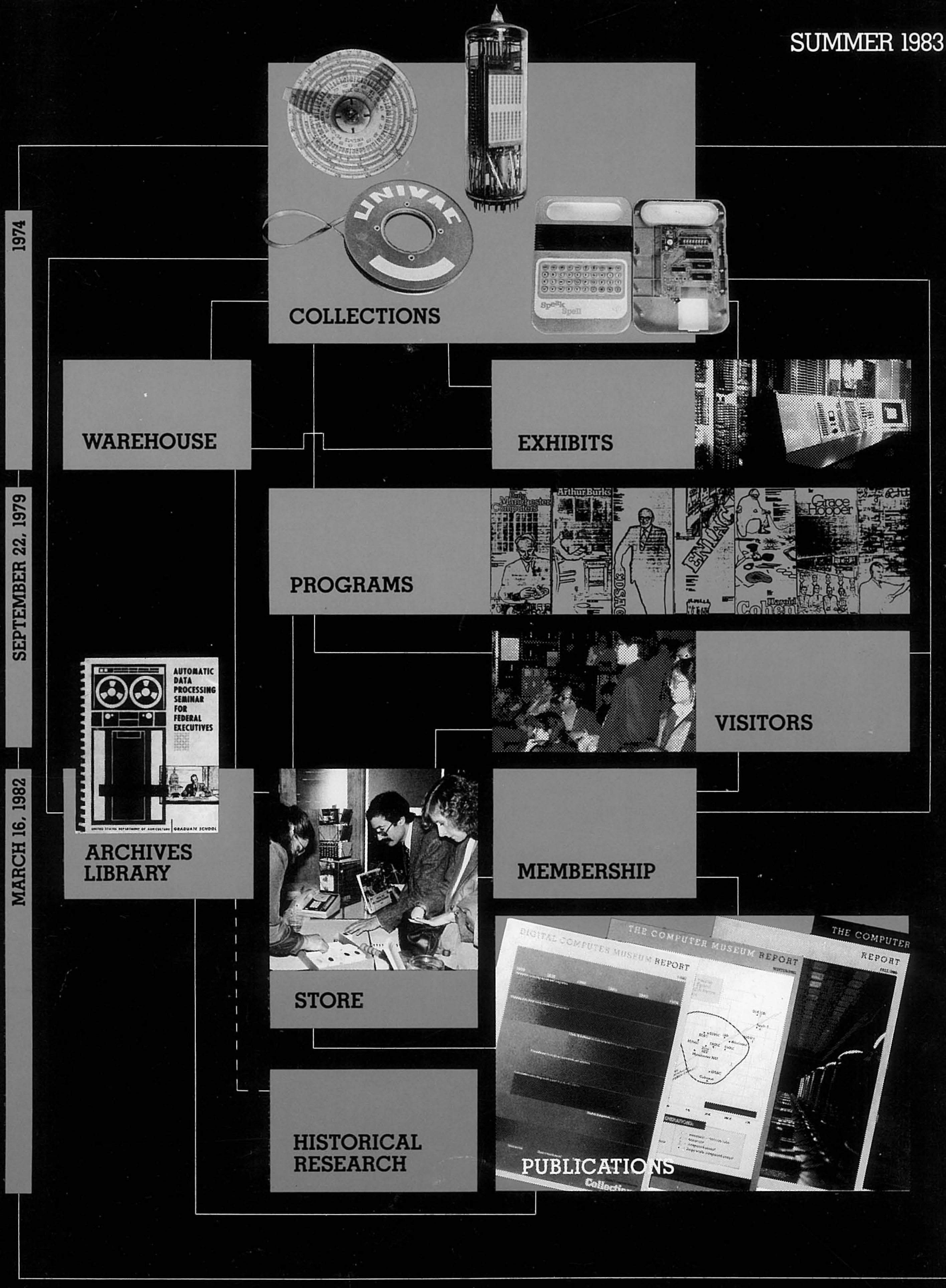
# THE COMPUTER MUSEUM REPORT

SUMMER 1983



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Bill Smith p. 11;
Carolyn Sweeney pp. 18, 19.

## THE COMPUTER MUSEUM

The Computer Museum is a non-profit, public, charitable foundation dedicated to preserving and exhibiting an industry-wide, broad-based collection of the history of information processing. Computer history is interpreted through exhibits, publications, videotapes, lectures, educational programs, and other programs. The Museum archives both artifacts and documentation and makes the materials available for scholarly use.

The Computer Museum is open to the public Sunday through Friday from 1:00 to 6:00 pm. There is no charge for admission. The Museum's lecture hall and reception facilities are available for rent on a prearranged basis. For information call 617-467-4443.

Museum membership is available to individuals and non-profit organizations for $25 annually and to businesses for $125 annually. Members receive the quarterly Report, invitations to all lectures and special programs, new posters, and a ten percent discount in the Museum store.

A Founders program is in effect during the initial two-year period of the Museum, until June 10, 1984. During this period individuals and non-profit organizations may become Founders for $250 and businesses and charitable Foundations may become Founders for $2500. Founders receive all benefits of membership and recognition for their important role in establishing the Museum.

## THE COMPUTER MUSEUM REPORT
**(ISSN 0736-5438)**

The Computer Museum Report is published quarterly by The Computer Museum, One Iron Way, Marlboro, MA 01752. Annual subscription is part of the membership of the Museum ($25 per year for individuals and nonprofit organizations and $125 for corporations).

The purpose is to report on the programs and exhibitions of the Museum. The contents of The Computer Museum Report may not be reproduced without written consent.

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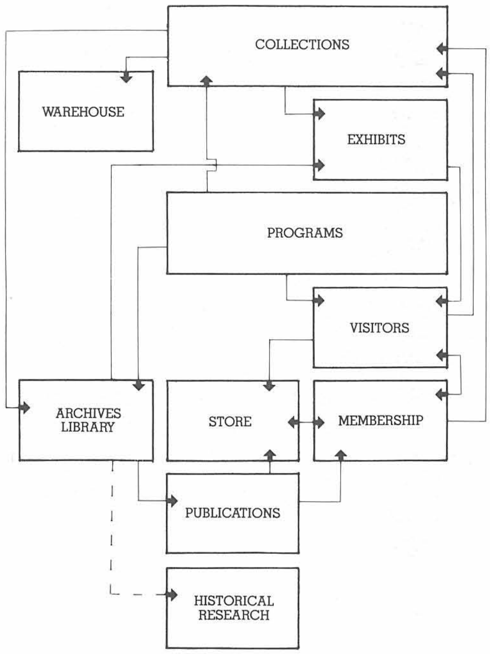
**The Computer Museum**
One Iron Way
Marlboro, Massachusetts 01752
617-467-4036

# The Director's Letter




The Computer Museum operates as a system. It started out with collections, and this is still the backbone of the operation. Jamie Parker, who has been the exhibit coordinator since the museum's inception, explains this part of the operation in detail in her article. The system diagram on the left shows the interconnections and the way the Museum has evolved over time.

Our first program, a lecture by Maurice Wilkes on the EDSAC, September 22, 1979, opened the exhibits. This lecture, and each successive program, have introduced new people to the museum who in turn brought their friends to visit, providing a reinforcing positive feedback loop. The programs of lectures, seminars, field trips, and symposia are designed to improve the knowledge base of the museum and its interpretation through exhibits. The first series of lectures featured the pioneer computers and helped us to put together the timeline of these machines. The speakers aided us in this project both in their lectures and by consulting on the exhibit itself, identifying sources of artifacts and important materials for inclusion. During Harry Huskey's visit for his lecture in the fall, he identified appropriate pieces of the SWAC in storage at the Smithsonian that will be added to the Pioneer Computer Timeline and also sent us enough additional modules to complete our Bendix G-15. The Sunday Bits and Bites programs have allowed us to expand our content area to include applications, software, the arts, and the evolution of the industry.

The March 16th, 1982, notification from the Internal Revenue Service that we had received provisional status as a non-profit charitable foundation, led us to develop archives, a members program, store, and publications. The growth of the archives and library has been spurred both by the collection of artifacts and by the programs. Each artifact is often backed up with archival documentation and reference materials. All lectures and talks are recorded either by video or audio tape, edited, transcribed and made available for scholars.

The growing number of exhibits and programs drew increasing numbers of visitors allowing the establishment of a museum store to provide related educational materials. Books, posters and slides on the history of computing are the backbone of the store, but the fleamarket of old core planes, modules, manuals and calculators provides a unique opportunity: one person's excess baggage is another's heart's desire. One engineer found and reacquired an early manual that he had written, but never kept.

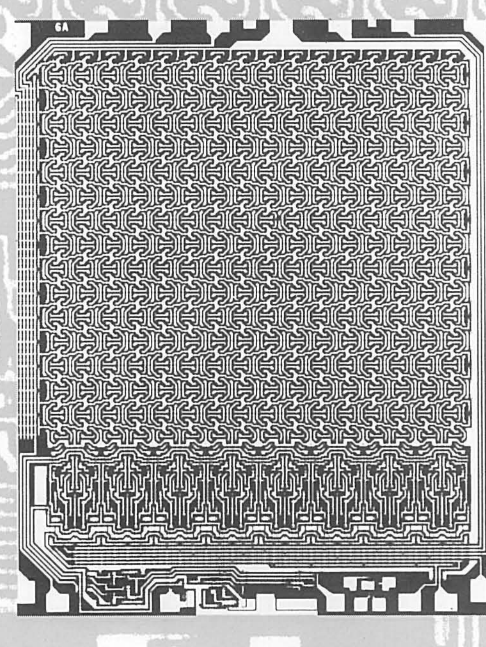
The Museum's members have participated in identifying appropriate programs, selecting materials for the store, and giving their time to make these things happen. The local members, with Kitty Selfridge as chairman, meet on a quarterly basis while we keep in touch with our international members through the mails.

Publication of this quarterly, slide sets and development of other materials will allow the Museum to serve its international audience. *The Computer Museum Report* will grow as the programs and exhibits develop, providing the membership with a record of the activities of the Museum. Not all of the programs are appropriate for the *Report*; some become reviewed articles published in *The Annals of the History of Computing* and others remain in the Museum archives.

As new components, such as a historical research program, are added, they too add new feedback loops that will affect the growth of the other components. What started as a simple collection is now an operating engine driving the growth and development of The Computer Museum.

Gwen Bell
*Director*

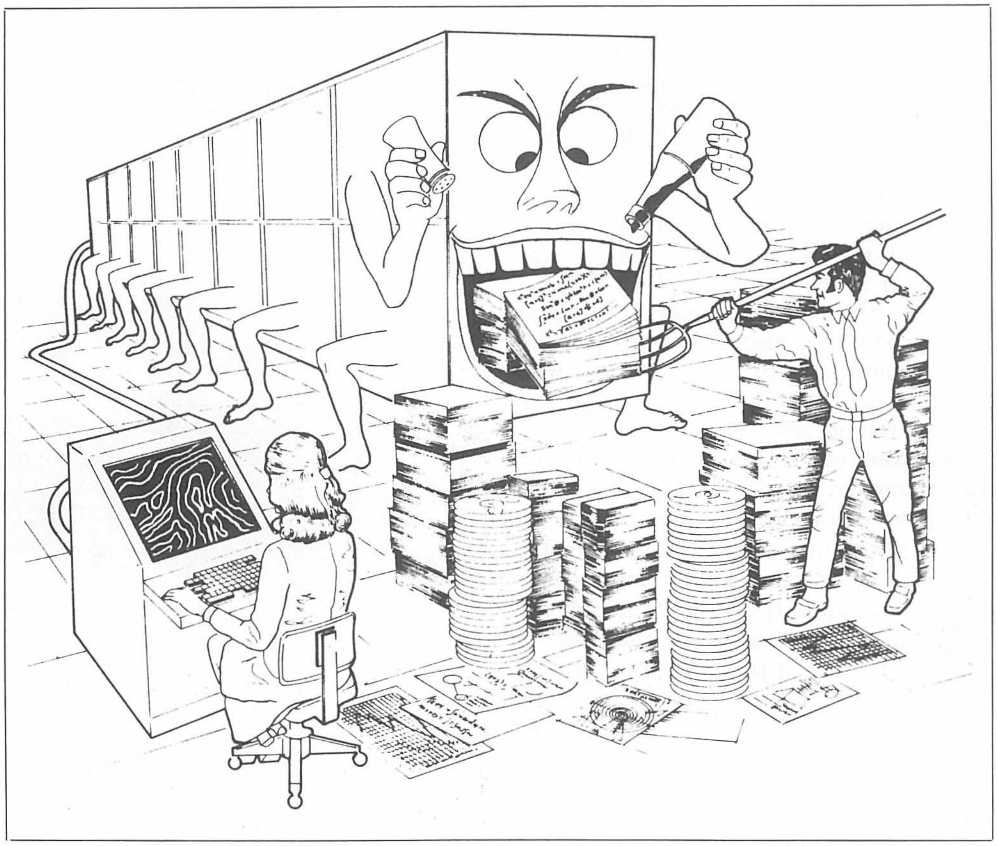
*This 256-bit Fairchild memory chip used in the Illiac IV was the first solid-state random access memory in production. Fairchild Camera and Instrument Corporation donated twenty of their most significant chips to the Computer Museum beginning with their first planar transistor (1959).*



# ILLIAC IV

**R. Michael Hord**

*The most recent addition to the Museum's Hall of Super Computers is the Illiac IV, an advanced computer designed and developed at the University of Illinois in the mid-1960's by Professor Daniel Slotnick and sponsored by the Defense Advanced Research Projects Agency. On loan from NASA Ames where it was delivered in 1971 and used in computational fluid dynamics research, the Illiac IV exhibit at the Museum includes the central unit, the processing unit cabinet with eight processing units and two Burroughs disks. The following article is excerpted from R. Michael Hord's* Illiac IV, The First Supercomputer, *published in 1982 by the Computer Science Press. The book is available at the Museum store. (Reprinted with permission from the author.)*



*Illiac IV's amazing number crunching capabilities! Reproduced from the original Burroughs Corporation Illiac IV bulletin.*

### Project History

It was during the spring of 1970 that the Illiac IV computer project reached its climax. Illiac IV was the culmination of a brilliant parallel computation idea, doggedly pursued by Daniel Slotnick for nearly two decades, from its conception when he was graduate student to its realization in the form of a massive supercomputer. Conceived as a machine to perform a billion operations per second, a speed it was never to achieve, Illiac IV ultimately included more than a million logic gates—by far the largest assemblage of hardware ever in a single machine.

Until 1970, Illiac IV had been a research and development project, whose controversy was limited to the precise debates of computer scientists, the agonizing of system and hardware designers, and the questioning of budget managers. Afterward, the giant machine was to become a more or less practical computational tool, whose disposition would be a matter of achieving the best return on a government investment of more than $31 million.

Illiac IV was funded by the U.S. Department of Defense's Advanced Research Project Agency (ARPA) through the U.S. Air Force Rome Air Defense Center. However, the entire project was not only conceived, but to a large extent managed, by academicians at the University of Illinois. Finally, the system hardware was actually designed and built by manufacturing firms—Burroughs acted as the overall system contractor; key subcontractors included Texas Instruments and Fairchild Semiconductor.

Perhaps the greatest strength of Illiac IV, as an R&D project, was in the pressures it mounted to move the computer state of the art forward. There was a conscious decision on the part of all the technical people involved to press the then-existing limits of technology. Dr. Slotnick [. . .] made it clear to his coworkers that the glamour and publicity attendant to building the fastest and biggest machine in the world were necessary to successfully complete what they had started.

### Design History

The story of Illiac IV begins in the mid-1960's. Then, as now, the computational community had requirements for machines much faster and with more capacity than were available. Large classes of important calculational problems were outside the realm of practicality because the most powerful machines of the day were too slow by orders of magnitude to execute the programs in plausible time. These applications included ballistic missile defense analyses, reactor design calculations, climate modelling, large linear programming, hydrodynamic simulations, seismic data processing and a host of others.

Designers realized that new kinds of logical organization were needed to break through the speed of light barrier [186,000 miles per second] to sequential computers. The response to this need was parallel architecture. It was not the only response. Another architectural approach that met with some success was overlapping or pipelining wherein an assembly line process is set up for performing sequential operations at different stations within the computer in the way an automobile is fabricated. The Illiac IV incorporates both of these architectural features.

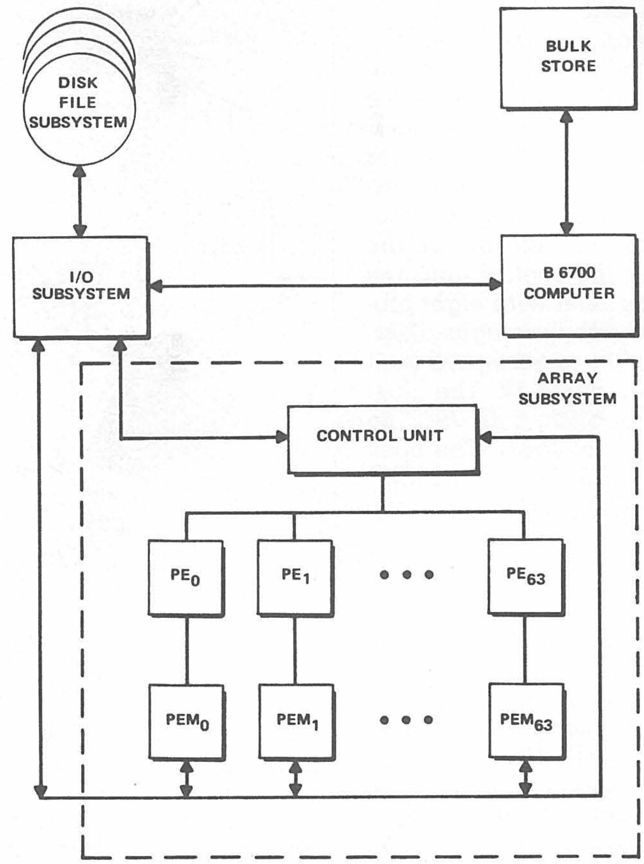
The Illiac IV is the fourth in a series of advanced computers from the University of Illinois; its predecessors include a vacuum tube machine completed in 1952 (11,000 operations per second), a transistor machine completed in 1963 (500,000 operations per second) and a 1966 machine designed for automatic scanning of large quantities of visual data. The Illiac IV is a parallel processor in which 64 separate computers work in tandem on the same problem. This parallel approach to computation allows the Illiac IV to achieve up to 300 million operations per second.

The logical design of the Illiac IV is patterned after the Solomon computers. Prototypes of these were built in the early 1960's by the Westinghouse Electric Company. This type of computer architecture is referred to as SIMD, Single Instruction Multiple Datastream. In this design there is a single control processor which sends instructions broadcast style to a multitude of replicated processing units termed elements. Each of these processing elements has an individual memory unit; the control unit transmits addresses to these processing element memories. The processing elements execute the same instruction simultaneously on data that differs in each processing element memory.

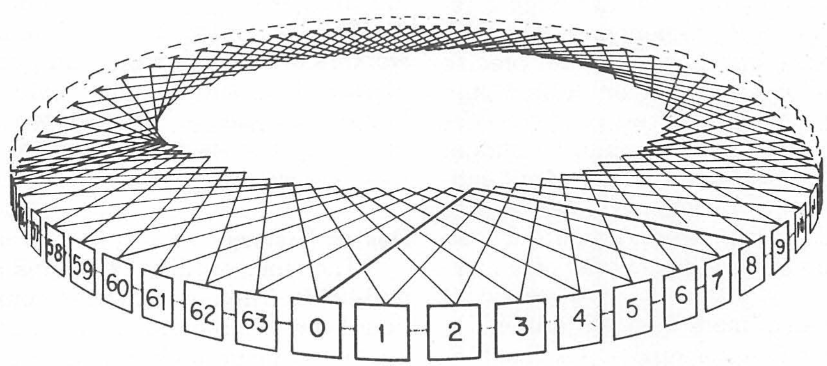
In the particular case of the Illiac IV, each of the processing element memories has a capacity of 2,048 words of 64-bit length. In aggregate, the processing element memories provide a megabyte of storage. The time required to fetch a number from this memory is 188 nanoseconds, but because additional logic circuitry is needed to resolve contention when two sections of the Illiac IV access memory simultaneously, the minimum time between successive operations is somewhat longer.

In the execution of a program it is often necessary to move data or intermediate results from one processor to another. One way of regarding this interconnection pattern is to consider the processing elements as a linear string numbered from 0 to 63. Each processor is provided a direct data path to four other processors, its immediate right and left neighbors and the neighbors spaced eight elements away. So, for example, processor 10 is directly connected to processors 9, 11, 2, and 18. This interconnection structure is wrapped around, so processor 63 is directly connected to processor 0.

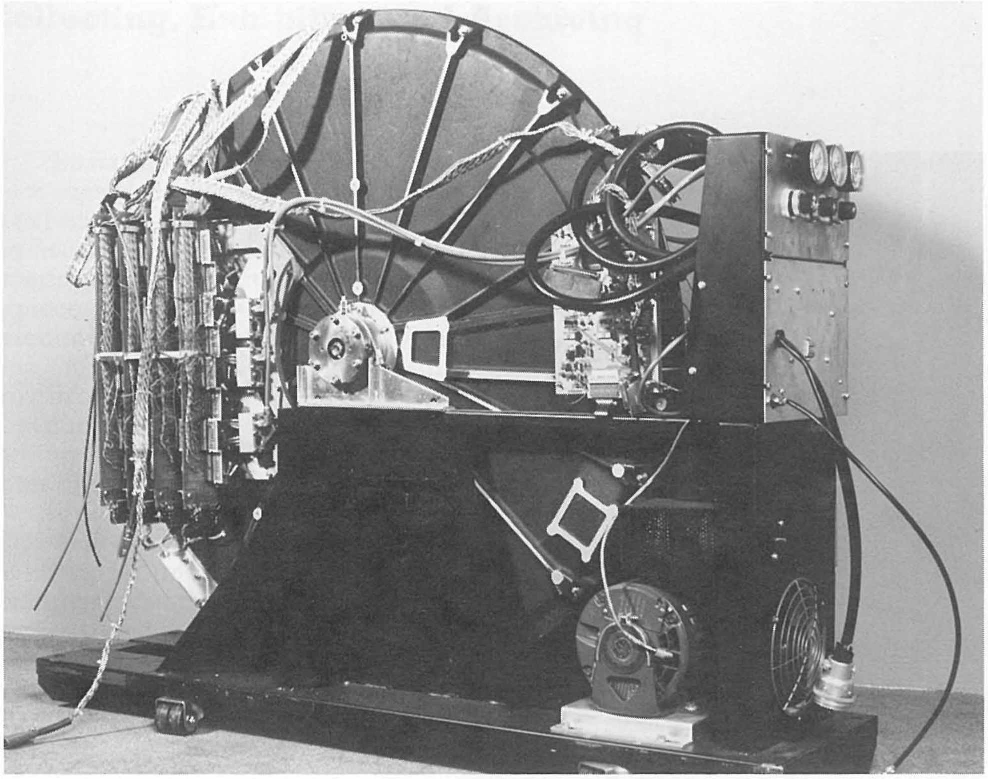
The other major control feature that characterizes the Illiac IV is the enable/disable function. While it's true that the 64 processing elements are under centralized control, each of the processing elements has some degree of individual control [provided] by a mode value. For a given processor [it] is either 1 or 0, corresponding to the processor being enabled "on" or disabled "off". The 64 mode values can be set independently under program control, depending on the different data values unique to each processing element. Enabled processors respond to commands from the control




*Illiac IV functional diagram.*




*This routing diagram shows schematically the neighbor-to-neighbor linkages which form the 64 processing elements (PE) into a ring, as well as the connections of the PE's eight apart such that data can bypass intermediate PE's when the distance to be covered is large.*



*This Burroughs Disk exhibited at The Computer Museum is only one of the thirteen synchronously rotating fixed head disks that comprised the 16M word main memory of Illiac IV.*

unit; disabled elements respond only to a command to change mode. Mode values can be set on specific conditions encountered during program execution. For example, the contents of two registers can be compared and the mode value can be set on the outcome of the comparison. Hence iterative calculations can be terminated in some processors while the iteration continues in others, when, say, a quantity exceeded a specific numerical limit.

In addition to the megabyte of processor element memory, the Illiac IV has a main memory with a sixteen million word capacity. This main memory is implemented in magnetic rotating disks. Thirteen fixed head disks in synchronized rotation are organized into 52 bands of 300 pages each (an Illiac page is 1,024 words). This billion-bit storage subsystem is termed the Illiac IV Disk Memory or I4DM. The access time is determined by the rotation rate of the disks. Each disk rotates once in 40 milliseconds so the average access time is 20 milliseconds. This latency makes the access time about 100,000 times longer than the access time for processor element memory. The transfer rate, however, is 500 million bits per second.

This memory subsystem, the input/output peripherals and the management of the other parts of the system [were] under the direction of a Digital Equipment Corporation PDP-10 conventional computer. A Burroughs B-6700 computer compiles the programs submitted to the Illiac into machine language.

**Circuitry**

Initial plans for Illiac IV circuitry envisioned bipolar emitter-coupled logic (ECL) gates capable of speeds of the order of 2-3 ns. The ECL circuits were to be packaged with 20 gates per chip—a level of complexity that later would be called medium scale integration. [Texas Instruments was chosen as the subcontractor for these circuits.] Illiac IV initial specifications called for a 2,048-word, 64-bits-per-word, 240-ns cycle time memory for each of its processing elements. In 1966, the only technology that seemed to meet the requirements was the thin-film memory. At that time, a few developmental semiconductor memory chips were being studied, but no computer manufacturer would yet consider them seriously for main memory use.

[However, a change] to smaller ECL circuit chips proved a death blow to thin-film memory. When the smaller chips' requirements for added space on circuit boards and interconnections were taken into account, it turned out that there was not enough room for the smallest feasible thin-film memory configuration. Strangely, the failures of the ECL circuits and thin-film memories also set the stage for a brilliant hardware success: Illiac IV was to be one of the first computers to use all semiconductor main memories. Slotnick chose Fairchild as the semiconductor memory subcontractor.

Called for were 2,048 words (64 bits/word) of memory for each of the 64 Illiac processing elements, a total of 131,072 bits per processing element. The memory was to operate with a cycle time of 240 ns and access time of 120 ns. Slotnick recalls the development proudly: "I was the first user of semiconductor memories, [and] Illiac IV was the first machine to have all-semiconductor memories. Fairchild did a magnificent job of pulling our chestnuts out of the fire [. . .] the memories were superb and their reliability to this day is just incredibly good."

**Results**

The end results this pioneering [project] had on computer hardware were impressive: Illiac IV was one of the first computers to use all semiconductor main memories; the project also helped to make faster and more highly integrated bipolar logic circuits available; in a negative but decisive sense, Illiac IV gave a death blow to thin-film memories; the physical design, using large, 15-layer printed circuit boards, challenged the capabilities of automated design techniques.

# Installing the Illiac IV

Jay Patton


*Jay Patton, Manager of Installation Planning at Burroughs Corporation, coordinated the initial set up of the Illiac IV at NASA Ames in 1970 and came to the Computer Museum in December to reinstall it. Comments made during his gallery talk follow, conveying an idea of the massive size of the computer and its capabilities.*

"In 1970, ARPA (Advanced Research Project Agency) determined that the Illiac IV parallel architecture could best be tested in an environment that had research programs requiring the potential power of the machine. A new wing was built to house Illiac IV. It took one month to disassemble the unit from our testbed in Paoli, which had 100 tons of air conditioning built into it. The computer totalled 53′ in length, and took 11 40′ vans to house it, weighing 99 tons. One truck alone had only power supplies in it.

Illiac IV had a total of 11,739 pc boards. You can imagine what the spares problem was, and projecting what the failure rate would be. There was a group of people who did nothing but work on equations such as the mean time between failure rate. Inside each pc board were 12 layers of pc material. Each of the boards is coded with a letter code at the top, and a number code at the bottom. You cannot physically put a wrong board in the wrong spot.

From the control unit to each one of the processing extenders (which is a separate computer all in itself) there were belted cables in the back running the length—in one unit alone, there's over 85 miles of cable. The cooling air was 45,000 cubic feet of air per minute. It used over a half a megawatt of power. When we turned it on, we had to do it by sections, not all at once.

The disk system had a transfer rate of $500 \times 10^6$ bits per second, when you had two disks running in parallel. The parallel concept for Illiac was used to bypass the speed of light limitation, because you could do 64 additions, subtractions, or multiplications simultaneously. The maximum speed intended by the design was $200 \times 10^6$ operations per second; it actually achieved an effective speed of over 60 million instructions per second on some applications.

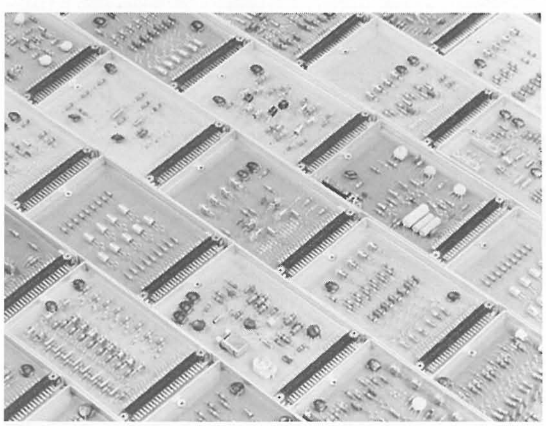
You can imagine the traumatic experience I had when I compared the 1970 National Geographic photograph of the Illiac IV and the recent National Geographic (October 1982) photograph of Illiac being torn apart and having an autopsy done on it. Then you can imagine how I felt when a call came from Marcie Smith [NASA Ames] to tell me that the Computer Museum was going to ask me to help put Illiac back together—she asked me to control my laughter. The computer really was the dinosaur of the sixties. What you see in the museum are the skeletal remains of a once-proud unit."

## Collecting, Exhibiting and Archiving

The Exhibits and Archives department rarely refuses donations offered to expand the collection. With computing technology changing so rapidly, determining the future significance of a piece is difficult. To turn away a potential acquisition because it seems less important hinders the future growth of the collection. The collection now numbers about 450 pieces, representing the largest holding of computer artifacts anywhere.

As the Museum has evolved, it has established a close relationship with its members and friends—engineers, computer scientists and history buffs—who are responsible for many donations. Often they refer the department to an available artifact, or make a donation from their own collections. When an object is offered to the collection, they act as curators, illuminating the importance of the acquisition, and sometimes preparing text for an exhibit. While not actually employed by the Museum, they act in its behalf as the experts in computing technology.

The collections policy outlines the process of acquiring artifacts. A deaccessioning clause clarifies to donors that the piece they donate today may not always be part of the permanent collection for reasons of space, a lessening of historical value, or duplication. The deaccessioning policy contributes to our habitual "squirrelling" of artifacts; the donor has agreed that the piece may be taken off the catalog listing and traded with another Museum for another piece, or its parts, if it is a duplicate, could be sold to other collectors through the Museum store. Very little is ever scrapped.



*These Digital Equipment Corporation modules circa 1962 are examples of some of the components the Museum accepts for exhibition, reference or sale in the Museum store. The photograph is part of the archival collection.*

After determining the significance of an acquisition, the artifact is pursued. Most acquisitions require a little detective work and some phone calls to ensure shipment, while a few others are more elusive. In June of 1981, Greg Mellen from Univac in St. Paul called to say he had located a part of the 1956 NTDS (Naval Tactical Data System) in an office in St. Paul. Seymour Cray was the director of development for the NTDS project, the first automated command and control system within the Navy. Initial letters were mailed and calls made to guarantee the CP-642's release to the Museum. It was not until June of 1982 that the paperwork arrived in a large package from the Navy. In order to clear the CP-642, the Navy needed several letters of intent and background from the Museum, all of which had to be notarized, establishing ourselves as a reputable agency for the preservation of computing history. Another six months later, after several follow-up calls, the Navy wrote that they needed a statement from the state of Massachusetts that the Museum was, indeed, tax exempt. In January, 1983, the Navy informed us that the CP-642 was in an office in St. Paul, presumably not due to be shipped until April, 1983, almost two full years after the process started.

When an acquisition arrives at the Museum, it is checked for damage and suitability for immediate display (this usually involves climbing through 40 foot trucks, removing quilted covers and making some on-the-spot decisions). When the nine tons of Illiac IV arrived completely disassembled on the shipping dock—with no Illiac IV experts available in Marlboro—most of the machine, with the exception of the skeleton and several processing units, was sent to storage. Through a contact at NASA Ames, we located Jay Patton at Burroughs, who had originally installed the computer at NASA. Jay spent two days at the Museum, retrieving what had been mistakenly shipped away, and piecing Illiac back together.

A sequential identification number is assigned, with the last two digits representing the year of the donation. Each artifact is catalogued by manufacturer, serial number, physical description, date and place in computing history, donor name and address, special characteristics, and a brief explanation of the artifact. It is cross referenced to its archival documentation if any exists. An acknowledgement letter, collections policy and receipt for tax purposes are sent to the donor for his records.

The Museum's archives and library began with active solicitation of documentation of collected machines. The understanding was that original manuals would be worthwhile research materials in years to come. This has evolved to the point where relevant photographs, theses, books, films and videotapes are also collected. In collecting archival material, the leads of the Museum's friends and donors are investigated. Contacts for archival material include libraries who wish to donate surplus material from their shelves, and individuals going through personal document collections. On the night of Maurice Wilkes' "Pray, Mr. Babbage" premiere, Mary Hardell donated volume one, number one of the ACM *Journal* and Bill Luebbert donated a full set of the videotapes from the Los Alamos computer conference. A new acquisition, such as Illiac IV, precipitates outside interest and donations. People who worked on the machine or at the University of Illinois are going through file drawers and attics to collect supplementary materials for us.

This summer's *Report* lists the whole collection by appropriate categories. Only one-third of the permanent collection is exhibited, with all material that is in storage documented and available for research purposes. As the collection and exhibitions grow, the ratio will probably remain the same. Some parts of the collection are better developed than others, but by looking at what has been collected, it is easier to determine what should be pursued. The collection's growth reflects a new understanding of the importance of preserving computer history, and the many milestones within the computer industry. Active involvement from members, friends and experts in certain areas of computing technology is an invaluable resource in this development.

Jamie Parker
*Exhibits and Archives Coordinator*

Digital Equipment Corporation
PDP-8

Word Length: 12 bits

Memory Size: 4,096 words (expandable to 32,768 words)

Speed: 333,333 single address instructions per second
1.5 microsecond memory cycle time

Clock rate: 1 Mhz

Arithmetic element: Accumulator and 8 auto-index registers in memory

Instruction format: Single address 3 bit op code, indirect bit, 1 page bit and 7 page address; 32,768 word addressable memory

Technology: Digital R series logic

Power consumption: 780 watts

Size: 8 cubic feet

Number produced: Approximately 5000

Price: $18,000 with 4,096 memory and ty

Project start: 1964

First delivery: April 1965

Predecessor: PDP-5

Successors: PDP-8/S, LINC-8, 8/I, 8/L,

*Exhibit Coordinator Jamie Parker signs the donation contract for a PDP-8 from MITRE Corporation with Ed Townsend of MITRE. The Museum's collection includes several classic PDP-8's. One is exhibited in the Four Generations Gallery. The others, now in storage, will be loaned to museums.*

Software: PAL-8 assembler, Macro 8 asse
Editor, RT-8, and OS-8 operating standalone operation systems
using DECtape and diskpaks

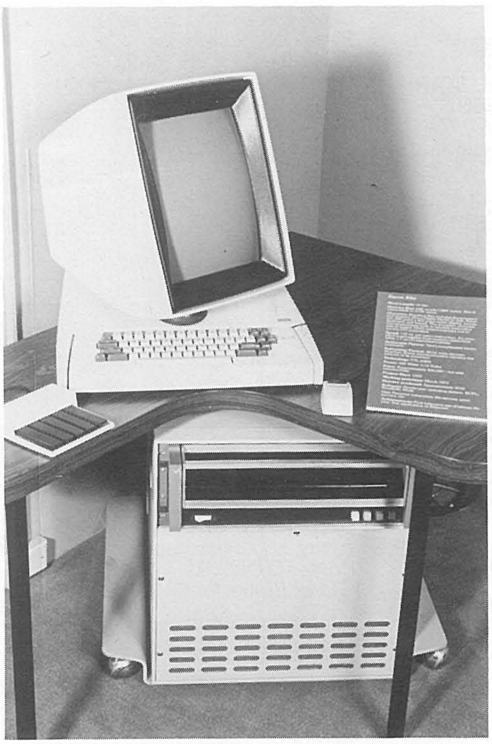
Use: Real time control and data collection. First OEM (Original Equipment Manufacturer) computer. Data communication. Small business data processing. Timeshared computation for very low cost per terminal.

Achievements: Provided the lowest cost computation and performance per unit cost. Produced in high volume; manufactured using wire-wrap technology. Improved ease of interfacing - first DEC computer to use I/O bus structure. Lowest cost per terminal with TSS/8 (smallest scale timesharing system).

Source: The MITRE Corporation
Burlington Road
Bedford, Massachusetts

Reference: Documentation in location TZ-AR16: boxes 20-22. Handbooks and manuals in location TZ.

**Digital computers emerged in the late nineteen-forties from a combination of calculator, control, transducer, links and switches, and memory technologies. They are more than a sum of these parts, as the parts have converged and been modified and molded into a new phenomenon. The listing includes computers and components representing the four generations of computing technology.**



The Alto was designed in 1973 by Xerox Palo Alto Research Center as an experiment in personal computing with the goal of providing sufficient computing power, local storage, and input-output capability to satisfy the computational needs of a single user. The Alto significantly changed the office computing environment through its interactive nature and communication applications, such as electronic mail. On loan from Xerox PARC.

**DIGITAL COMPUTERS**

Bendix G-15 (X48.82)
*Gift of the Science Museum of Minnesota*

Burroughs Corporation and University of Illinois, Illiac IV (X137.82)
*Loan from NASA Ames Research Center*

Clary Corporation, Clary DE60 (X119.82)
*Gift of Colburn Engineering*

Clary Corporation, Clary DE600 (X123.82)
*Gift of Ed Downing, Doland Corporation*

Control Data Corporation, CDC 160A
*Loan from Control Data Corporation*

Control Data Corporation, CDC 6600 (X38.81)
*Gift of Lawrence Livermore National Laboratory*

Data General Corporation, NOVA (X84.82)
*Gift of Data General Corporation*

Digital Equipment Corporation, MINC (D155.80)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation, PDP-1 (XD116.79)
*Gift of Inforonics Corporation*

Digital Equipment Corporation, PDP-1 (X99.82)
*Gift of Center for Computer Science, Harvard University*

Digital Equipment Corporation, PDP-5 (X178.83)
*Gift of School of Engineering and Applied Science, Washington University in St. Louis*

Digital Equipment Corporation, PDP-7 (XD143.80)
*Gift of Worcester Polytechnic Institute*

Digital Equipment Corporation, PDP-8 (D117.80)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation, PDP-8 (X161.82)
*Gift of Dr. Simon, University of Rochester Medical Center*

Digital Equipment Corporation, PDP-8 (X167.83)
*Gift of the MITRE Corporation*

Digital Equipment Corporation, PDP-8/L (X165.83)
*Gift of Robert Miller*

Digital Equipment Corporation, PDP-11/23 Microcomputer (D33.80)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation, PDP 11/34 M (X177.83)
*Gift of Norden Systems*

Digital Equipment Corporation, PDP-11/45 (D9.81)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation, PDP-12 (D156.81)
*Gift of Digital Equipment Corporation*

Fairchild Camera and Instrument Corporation, Symbol Machine (X117.82)
*Gift of Iowa State University*

Honeywell, Interface Message Processor (X105.82)
*Gift of Bolt, Beranek and Newman Inc.*

International Business Machines Corporation, IBM 7030, "Stretch" (XD250.81)
*Gift of Computer Services, Brigham Young University*

International Business Machines Corporation, IBM 1130 (X166.83)
*Gift of John Richards*

International Business Machines Corporation, IBM 1620 (X169.83)
*Gift of David Goodwin*

Librascope General Precision, LGP-30 (X14.81)
*Gift of MIT Museum and Historical Collections*

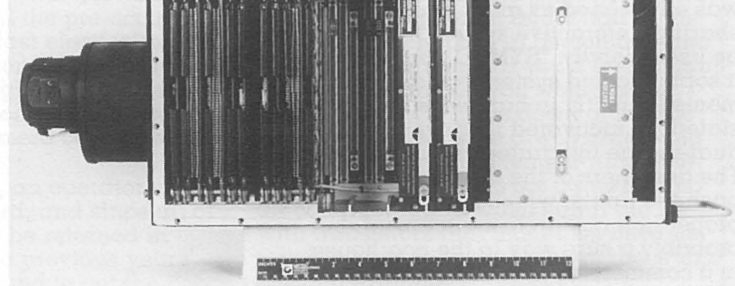
Lincoln Laboratories, LINC (D118.79)

Lincoln Laboratories, TX-O (D154.75)
*Gift of Digital Equipment Corporation*

MITS, Altair 8800 (X58.82)

Massachusetts Institute of Technology, Whirlwind (D29-32.73)
*Gift of Digital Equipment Corporation*

The Norden PDP-11/34M (1976) was a fully militarized version of the DEC PDP-11/34 minicomputer. Built to perform in the severest of military environments, the PDP-11/34M was used for applications ranging from tactical avionics to complex command and control.



NASA Apollo Guidance Computer Prototype (X37.81)
*Gift of Charles Stark Draper Laboratory*

Philco-Ford 212
*Gift of Ford Motor Company*

Raytheon, Polaris Guidance Computer (X89.82)
*Gift of Charles Stark Draper Laboratory*

Remington Rand, Univac Solid State 80 (X33.81)
*Gift of Jodie S. Hobson*

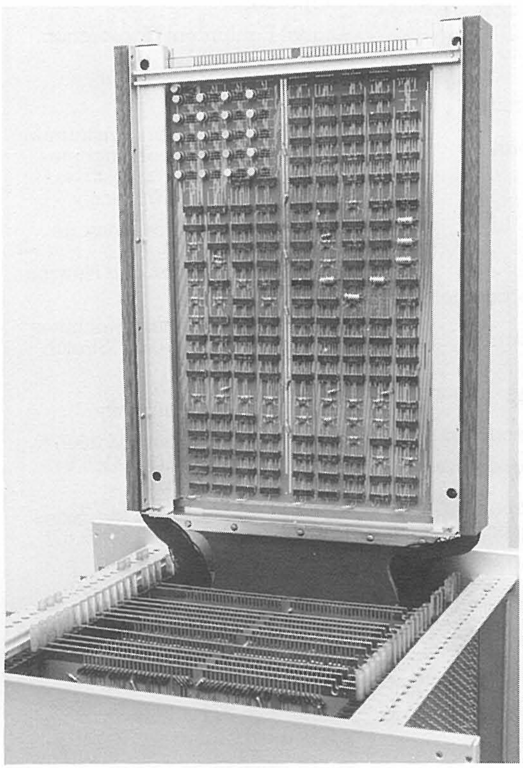
Siemens 2002 (X20.81)
*On loan from Siemens Corporation*

Sperry Univac CP-642/USQ-20 (X184.83)
*Gift of Naval Sea Systems Command*

Texas Instruments, Advanced Scientific Computer (XD224.80)
*Gift of Texas Instruments*

Viatron Computer Products, System 21 Intelligent Terminal Microprocessor (X109-11.82)
*Gift of Nick Wise*

Xerox Corporation, Alto I (X124.82)
*Loan from Xerox Corporation*



**On behalf of Iowa State University, Professor Roy Zingg presented Fairchild's Symbol IIR to the Museum and explained the machine's history and development during a gallery talk. SYMBOL was designed and built at the Digital System Research Department of Fairchild's Research and Development Division between 1963 and 1970, and purchased by Iowa State with the support of an NSF grant. SYMBOL operated at Iowa State until 1978 as a working system that demonstrated a radical computer architecture; an early example of top-down design where the end product was envisioned as an in-house, time-sharing, interactive system that would be user friendly. "SYMBOL proved that a sophisticated system could be implemented directly in hardware," Zingg stated. "It motivated the invention of dual-in-line integrated circuit packaging. The designers of the machine tried to push the limits, which I think is quite proper in a research environment, but probably a sure way to the poorhouse in a commercial environment."**

### COMPUTER COMPONENTS

Amphenol, Vacuum Tubes (X77.80)
*Gift of Gary Papazian*

Bell Telephone Laboratories, Transistor GA-51984 (X31.81)
*Gift of Carver Mead*

Bendix G-15 Bit Slice (D202.80)

Bendix G-15, Logic Modules (X181.83)
*Gift of Harry D. Huskey*

Berkeley Scientific Corporation, Decimal Counting Unit (D205.80)

Burroughs Corporation, E-101 Computer Program Pin Board (X102.82)
*Gift of Bill Smith*

Clar Stat Amperite, Ballast Resistor Tubes (Regulators) (X79.80)
*Gifts of Gary Papazian*

Computer Controls Corporation, Logic Module (D111.80)

Control Data Corporation, STAR Logic Module (XD218.80); 6600 Transfer Board (XD223.80)
*Gifts of Lawrence Livermore National Laboratory*

Cray Research Inc., Cray I Interface Module (XD226.80)
*Gift of Lawrence Livermore National Laboratory*

DCS Power Amplifier (X60.82)
*Gift of Bob Glorioso*

Digital Equipment Corporation, Bit slice triple flip-flop (D201.80); Classroom Module (D206.80); Flip-chip Modules (D213.80); LSI 11 Module (D35.80); PDP-6 System Logic Module; PDP-8/I Logic Module (D220.80); PDP 11/20 Module Artwork (D22.79); System Building Block (D203.80); UART Four Channel Asynchronous Serial Interface (D36.80); VAX Prototype UBA (D166.80)
*Gifts of Digital Equipment Corporation*

Digital Equipment Corporation, PDP-5 Accumulator Boards (X21.81)
*Gift of David Razler*

Digital Equipment Corporation, PDP-1 Parts and Manuals (X347.82)
*Gift of Ramin Khorram, President MIT Electronic Research Society*

Digital Equipment Corporation, PDP-8/I (X182.83)
*Gift of Computer Transceiver Systems*

Electronic Associates Inc., 31R Computer Patch Panel (X88.82)
*Gift of John Runyon*

English Electric Company, Deuce Arithmetic Logic Element (XD4.75)
*Gift of Murray Allen*

ENIAC Function Table
*Loan from the Smithsonian Institution, National Museum of History and Technology*

Fairchild Camera and Instrument Corporation, Collection of integrated circuits chronicling Fairchild logic and memory history from 1959 to 1977 (X106.82)
*Gift of Fairchild Camera and Instrument Corporation*

Fairchild Semiconductor, Semiconductor (X71.82)
*Gift of Bob Glorioso*

Ferranti Corporation, Atlas 1 Printed Circuit Board (XD1.75); Atlas 1 Digits (XD2.75)
*Gift of F.H. Sumner*

Ferranti Corporation, Atlas 1 Four Flip-flop Board (X53.81); Mark I* Logic Door (X66.82)
*Gifts of Department of Computer Science, University of Manchester*

Ferranti Corporation, Atlas 1 Printed Circuit Board (XD128.80)
*Gift of Rutherford Laboratory*

FUJITSU Ltd., Relay No. 56 (XD71.79), Parametron (XD73.79), Logic Circuit Diagrams (XD77.79), FACOM 100 Relay (XD106.80)
*Gifts of FUJITSU, Ltd.*

General Dynamics Form Flash Plates from Stromberg Carlson SC4020 (XD131.80)
*Gift of Rutherford Laboratory*

General Electric, Semiconductor (X70.82)
*Gift of Bob Glorioso*

Hamilton Standard, Microcircuit Module (X96.82)
*Gift of Bob Glorioso*

Harvard University, PDP-1 Space Pen (X164.83)
*Gift of Harvard University, Division of Applied Sciences*

Honeywell Sense Amplifier H4200/8200 (XD253.81)
*Gift of Phil Goldman*

Intel, 4004 and 8008 Chips (X127.-128.82)
*Gifts of Eugene Flath, Intel.*

International Business Machines Corporation, 22XX Printer Buffer Array, Logic card from an IBM Printer (XD132.80)
*Gift of Rutherford Laboratory*

International Business Machines Corporation, IBM 360/91 Console (X73.82)
*Gift of Howard Eskin, Columbia University*

International Business Machines Corporation, IBM 360/195 Console (X180.83)
*Gift of Rutherford Appleton Laboratory*

International Business Machines Corporation, IBM 650 Logic Module (XD12.75)
*Gift of Murray Allen*

International Business Machines Corporation, SMS Logic Module (D113.80)

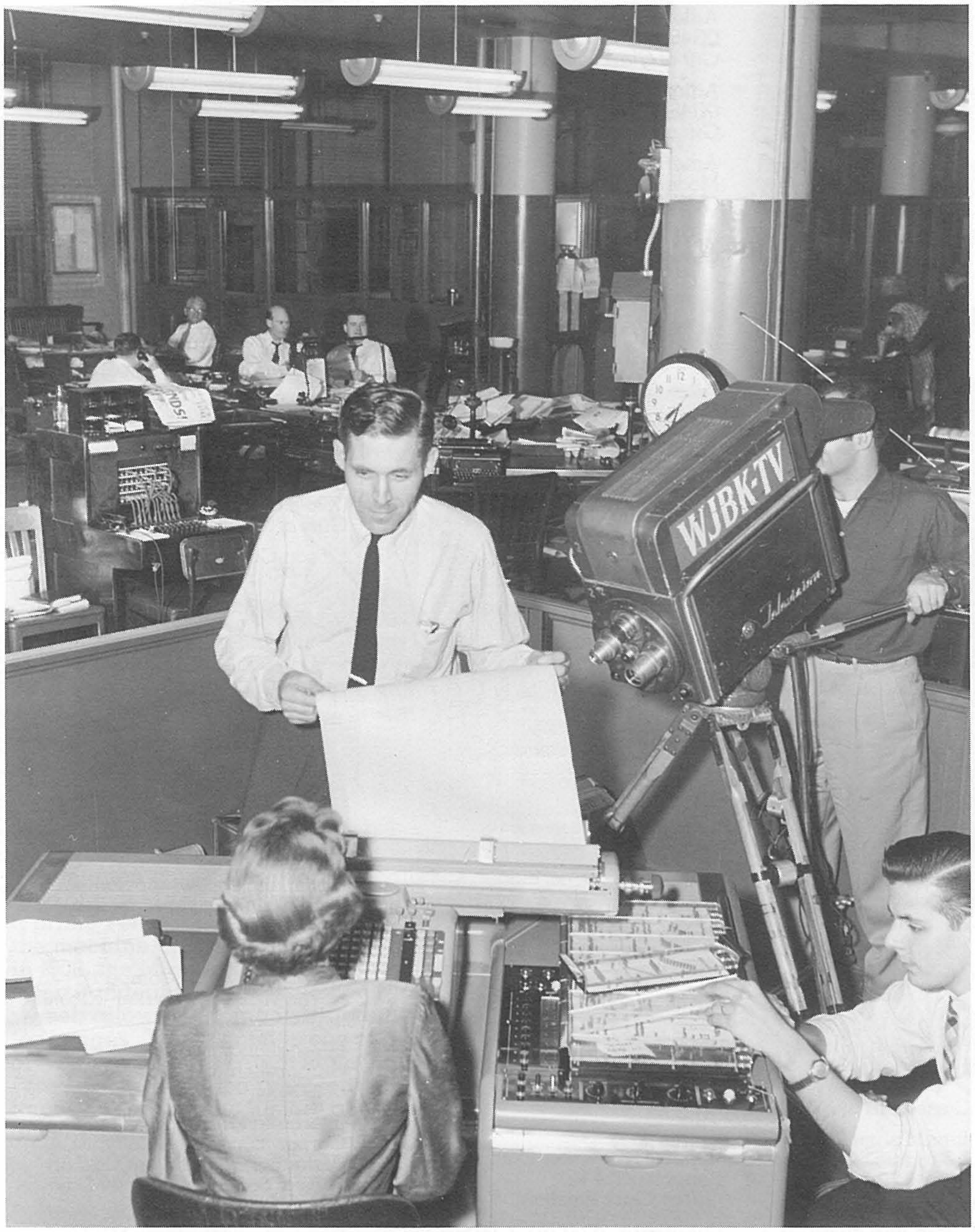
Manchester University, Mark I Valve (XD5.75)
*Gift of Department of Computer Science, Manchester University*

MITS, Altair 8800 CPU Board (X6.80)
*Gift of Ed Luwish*

Motorola, Semiconductor (X68.82)
*Gift of Bob Glorioso*

Motorola, Zener Diode (X97.82)
*Gift of Bob Glorioso*

National Union, Vacuum Tubes (X76.80)
*Gifts of Gary Papazian*




PCK Technology
Multi Wiring Machine (X185.83)
*Gift of PCK Technology Division, Kollmorgen Corporation*

Philco, Transistors (X64.82)
*Gifts of Bob Glorioso*

Raytheon, Electron Tubes (X74.82)
*Gifts of Gary Papazian*

Raytheon, Power Transistor 2N1662 (X59.82)
*Gift of Bob Glorioso*

RCA, Radio and Electron Tubes (X75.80)
*Gifts of Gary Papazian*

RCA, Transistors (X72.82)
*Gifts of Bob Glorioso*

SDS-SD Sales, S-100 CPU Board (XD236.81)
*Gift of David Ramsperger*

Sperry Rand, Solid State Components (X95.82)
*Gift of Ted Bonn*

Sylvania, MOBIDIC Logic Board (XD192.80)
*Gift of Frank Feigin*

Texas Instruments, Semiconductors (X61.82)
*Gifts of Bob Glorioso*

Transitron, Diodes (X63.82); Semiconductor (X69.82)
*Gifts of Bob Glorioso*

University of Illinois, ILLIAC II BLOCK Multiplexor called "Interplay" (XD216.75); ILLIAC III Printed Circuit Module
*Gifts of Clifford Carter*

Westinghouse, RTL Integrated Circuits (X62.82)
*Gifts of Bob Glorioso*

Bill Smith donated a pin board from the 1956 Burroughs E101 computer and gave a gallery talk on the use of the E101 in predicting the Eisenhower-Stevenson election results in 1956. An excerpt from his gallery talk follows.

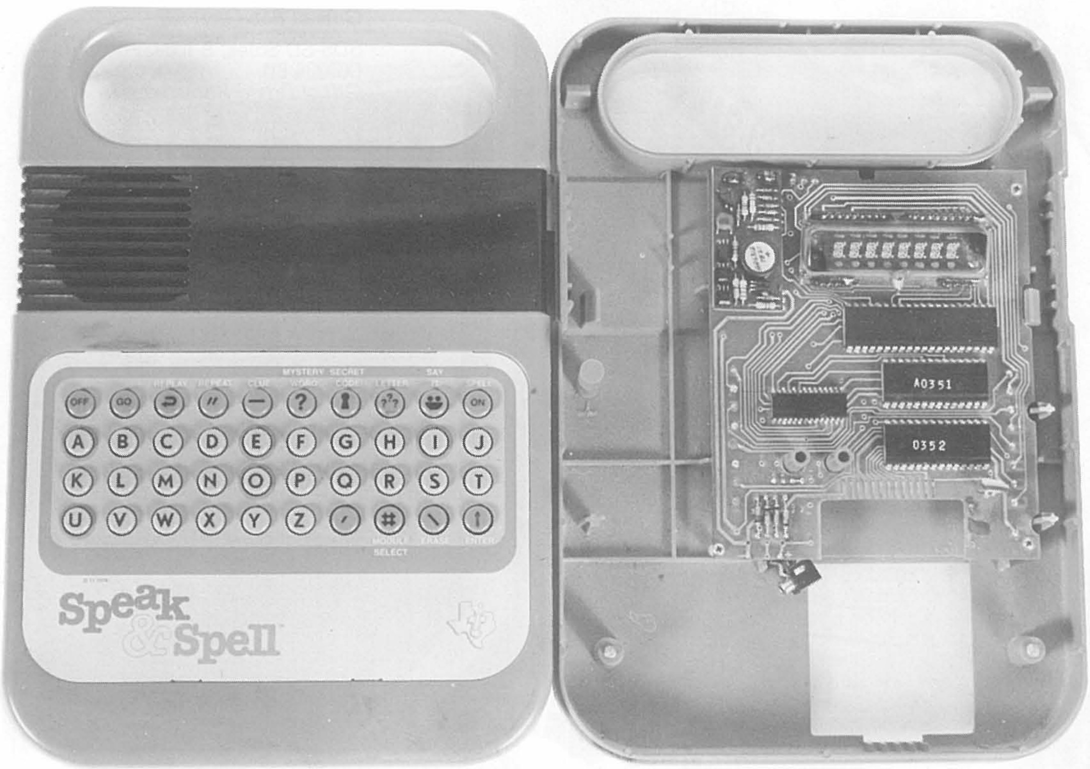
"The E101 was a single address, pin board programmed machine, with a 100 word drum memory, a speed of 3600 rpm and a stepping switch segment that picked up instructions. Instruction fetching was done by stepping switches through sequences across the top of eight pin boards of sixteen steps each. The operator could stop the computer to remove some pin boards and resume or do supplemental steps with a paper tape at ten characters per second, or three instructions per second. Instructions were fetched in about 25 milliseconds, and accounting for drum latency, the speed averaged 10-15 instructions per second. Subroutines, usually constrained by programmers to fit within a pinboard, took anywhere from 1 to 10 seconds.

"Dr. Saul Rosen pioneered election predictions in 1954 in Detroit using Wayne University's UDEC #2, produced by Burroughs and the University of Pennsylvania's Moore School of Electrical Engineering. They predicted the Michigan gubernatorial and U.S. Senate seats and broadcast the results through a radio affiliate. For the Eisenhower-Stevenson election in 1956, we had the pre-accumulated results from the last election from which to make our differential forecast. We brought the Burroughs E101 desk sized computer to the city room of the Detroit Times and had live camera coverage during the evening.

"On election night, an operator would enter data at a keyboard, and since all of the precincts could not be retained in memory, we entered the previous years' results and then computed to get the predictions and judge convergence. Every time we got twelve to twenty new precincts in, we would do another run to test for a new convergence point. The operator entered the previous years' results, the differential, and the new results from this sampling, and then did a comparison, an extraction and finally forecast the prediction on live black and white television.

"For Stevenson and Eisenhower, we were within a percent and a half in the final prediction, both in percentage and in coarse total count. If you'd been listening to the networks, you would have heard that the 701 was down or the 650 was down. They were always breaking down due to the high temperatures created by the 1500 watt spot lights and no air conditioning. It wasn't until the sixties with transistors that machines became reliable enough to run through the whole election evening."

**Transducers take information in one form and put it into another. The earliest example is moveable type and now includes the teleprinter, tape transport, telephone, and television. These machines are becoming more and more sophisticated and less distinguishable from computers.**




The Texas Instruments Speak & Spell was designed as a child's learning aid for spelling using electronically synthesized speech to give the words and an alphanumeric keyboard and display for entry of the answer. The Museum's Speak & Spell, gift of W.R. Hawkins and Gene Frantz, members of the project team, is an early model that was demonstrated on the Today show in 1978.

Adler, Adler-Klein Typewriter (X146.82)
*Gift of Clark Prestia*

Adler, Typewriter Model No. 7 (X148.82)
*Gift of Clark Prestia*

American Typewriter Company, Model No. 8 Typewriter (X152.82)
*Gift of Clark Prestia*

ASR, Teletype Writer (X130.82)
*Gift of Richard Ten Haken*

Bennett Typewriter Company, Bennett (X154.82)
*Gift of Clark Prestia*

Bingwerke, Bing No. 2 Typewriter (X142.82)
*Gift of Clark Prestia*

Blickensderfer Manufacturing Company, Blickensderfer Model No. 7 (X144.82)
*Gift of Clark Prestia*

Bunnell, Telegraph Sender and Receiver (XD229.80)
*Gift of Rodney Bamford*

R.C. Burt, 2 Amplifiers (X112-13.82)
*Gift of D.H. Lehmer*

California Computer Products, Calcomp Model 565 Digital Incremental Plotter (X103.82)
*Gift of J.C. Deck, Inland Steel*

Harold Cohen, "Turtle" (X50.82)
*Loan from Harold Cohen*

Columbia Graphophone Company, Dictaphone, Shaver, Transcriber (D123.79)

Corona Typewriter Company, Inc., Folding Portable No. 3 (X149.82)
*Gift of Clark Prestia*

A.E.G. Deutsche Werke Schreibmaschinen Gesellschaft, Mignon AEG Modell 4 Typewriter (X150.82)
*Gift of Clark Prestia*

Digital Equipment Corporation, Type 30A CRT (X25.81)
*Gift of Harvey Wiggins*

Digital Equipment Corporation, 338 Display Unit (X23.81)
*Gift of Ford Motor Company*

Digital Equipment Corporation, GIGI (D276.82); GT-40 (D10.81); VT 105 (X36.81)
*Gifts of Digital Equipment Corporation*

Digital Equipment Corporation, VT 105 (X36.81)
*Gift of American Computer Group Inc.*

Allen B. Du Mont Laboratories, Inc., Cathode-Ray Oscillographs (X26-8.81)
*Gifts of Ken Olsen*

Edison Company, Ediphone, Utility Shaver and Voice Recorder (D121.80)

"Enigma" (B197-8.81)
*Loan from Gordon and Gwen Bell*

Friden Corporation, Friden Paper Tape Reader (X9.80)
*Gift of Ed Luwish*

Friden, Flexowriter (X107.82)
*Gift of Rick Merrill*

General Automation Corporation, Stored Program Controller,
*Gift of Taan Lee*

Hammond Typewriter Company, Hammond Folding Multiplex Typewriter (X145.82)
*Gift of Clark Prestia*

Harris Typewriter Company, Harris Visible Typewriter (X155.82)
*Gift of Clark Prestia*

International Business Machines Corporation, IBM Card Punch (X40.80)

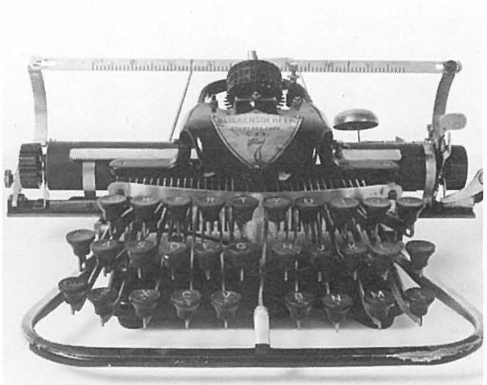
International Business Machines Corporation, IBM Auto-typist Perforator and Printer (X16-7.81)
*Gifts of Solomon Schecter Day School*

International Business Machines Corporation, IBM 650 Control Panel (X129.82)
*Gift of Tony Crugnola*

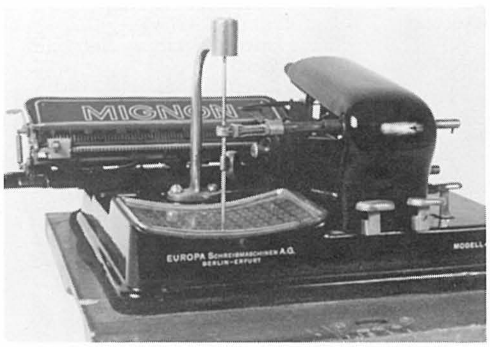
International Telephone and Telegraph, Teletype (D117.80)
*Gift of Jack Brown*

C. Lorenz A-G, Telegraph Transmitter (X30.81)
*Gift of Alexander Vanderburgh Jr.*

Martin Marietta Corporation, Clary Printer adapted for computer output (XD208.80)
*Gift of Clyde Still*



The "Blick" was the first typewriter intended to be readily portable. Designed and patented by George Blickensderfer in 1890, it was first sold in 1893. Each key had three positions, upper and lower case and a figure that positioned three levels of the printing wheel. Gift of Clark Prestia.




The Mignon typewriter is an indicator-type of machine, employing a stylus and a printed character table to manipulate the machine. Manufactured in Germany in 1908, the Mignon's advantage was its interchangeable letter table and type wheel, allowing typing in different languages. The Mignon is one of a gift of twenty-two typewriters from Clark Prestia. The donation represents an important part of the history of transducer equipment.


Produced in 1910 by the Hammond Typewriter Company, the Multiplex had a folding feature designed by Charles Nook for portability. It had interchangeable type shuttles, allowing 17 different styles of type and characters for more than 50 languages. The Hammond Multiplex is a gift of Clark Prestia.

Nixdorf Computer, Printer Head (X100.82)
*Gift of Frank Digilio*

The Noiseless Typewriter Company, "Noiseless Typewriter" (X5.80)
*Gift of Ed Luwish*

The Noiseless Typewriter Company, "Noiseless Typewriter" (X18.81)
*Gift of Trudy Leonard*

Norden Systems, World War II Bombsight (X176.83)
*Gift of Norden Systems*

Oliver Typewriter Company, Oliver No. 5 Standard Visible Writer (X156.82)
*Gift of Clark Prestia*

Railroad Telegraph Transmitter (XD182.80)
*Gift of Cliff Granger*

Reliance Typewriter Company, Reliance Visible (X158.82)
*Gift of Clark Prestia*

Remington Rand, Remington Portable Typewriter (X147.82)
*Gift of Clark Prestia*

Remington Rand, Remington Standard Typewriter, No. 6 (X159.82)
*Gift of Clark Prestia*

Remington Rand, UNIVAC Card Punch (X34.81)
*Gift of National Museum of Science and Technology, Ottawa*

Rheinische Metallwaren & Maschinenfabrik, Rheinmetall Typewriter (X151.82)
*Gift of Clark Prestia*

Royal Typewriter Company, Royal Typewriter (X140.82)
*Gift of Clark Prestia*

Royal Typewriter Company, Royal No. 5 (X143.82)
*Gift of Clark Prestia*

Telegraphen-Bau-Anstalt von Siemens and Halske, Needle Telegraph (X19.81)
*Loan from Siemens Corporation*

Signal Electric Manufacturing Company, "Signal Telegraph Instrument" (B164.81)
*Gift of Gordon and Gwen Bell*

L.C. Smith and Bros., Typewriter Model No. 5 (X141.82)
*Gift of Clark Prestia*

Smith Premier, The Smith Premier Typewriter Model 10 (X139.82)
*Gift of Clark Prestia*

Teletype Corporation, Model 19 Teletypewriter (XD159.80)
*Gift of Dick Eckhouse*

Texas Instruments, Speak and Spell (X122.82)
*Gift of Gene Frantz and W.R. Hawkins*

Triadex Inc., "The Muse" (XD254.81)
*Gift of Ed Fredkin*

Underwood Typewriter Company, Standard Portable Typewriter (X153.82)
*Gift of Clark Prestia*

Underwood Typewriter Company, Underwood No. 12 (X157.82)
*Gift of Clark Prestia*

Versatec, Model 800 Printer/Plotter (X163.83)
*Gift of Xerox Corporation*

Western Electric, Telephone (X32.81)
*Gift of Daniel Rizzo*

Western Electric, Telephone (X56.80)
*Gift of James Parker*

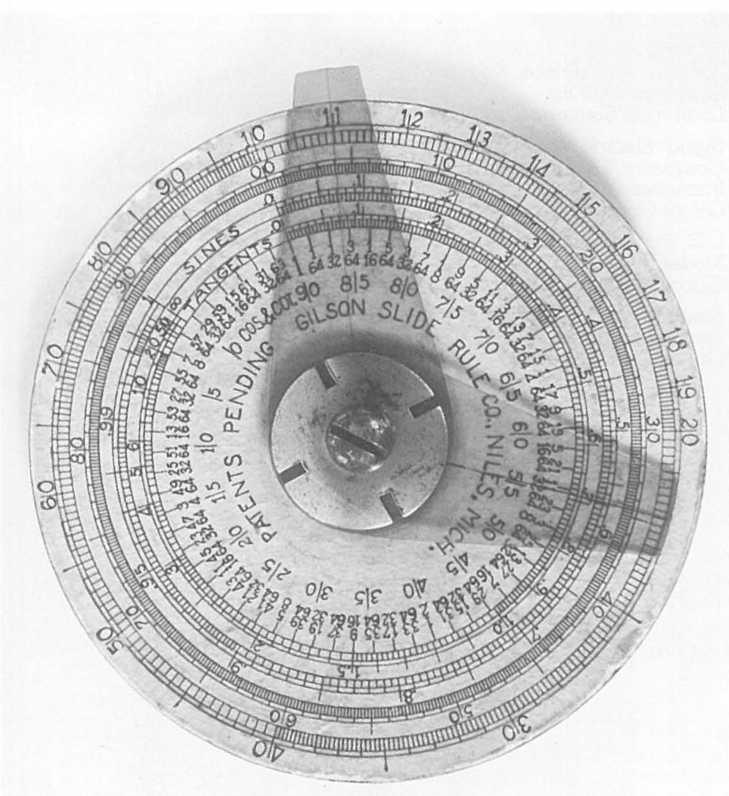
Weston Electrical Instrument Corporation, DC Voltmeter (X125.82)
*Gift of Carl Klempner*

Weston Electrical Instrument Corporation, Portable Wattmeter (X126.82)
*Gift of Carl Klempner*

Yost Typewriter Company Ltd., Typewriter (X138.82)
*Gift of Clark Prestia*

**Calculators, other than the manual bead devices, did not develop until the nineteenth century and have been virtually displaced by computers. Fundamentally calculators are defined as data operators carrying out arithmetic operations. Either calculators have become embedded in computers or miniaturized computers have been embedded in what have traditionally been considered calculators.**

The Gilson circular slide rule was used for logarithmic calculations. It is one of several devices donated to the calculator collection by Thomas McIntyre.




Abacus (B93.80)
*Gift of Gordon and Gwen Bell*

ADDI-COSMOS, "B.U.G. Calculator" (B131.80)
*Loan from Gordon and Gwen Bell*

Aeroproducts Research, Inc., Flight Plan Calculator (X55.82)
*Loan from Steve Kallis*

R.C. Allen, "ARITHMA" (XD125.80)
*Gift of Arthur Hall III*

American Can Company, "American Adding Machine" (B180.81)
*Gift of Gordon and Gwen Bell*

Anita, Electronic Calculator (XD209.80)
*Gift of Leonard Woodall*

Atanasoff-Berry Computer Breadboard (X12.80)
*Loan from John Vincent Atanasoff*

Automatic Adding Machine Company, "Golden Gem Adding Machine" (X2.81)
*Gift of Erwin Tomash*

Bell Telephone Laboratories Calculator, prototype adder reproduced by George Stibitz (XD127.80)
*Gift of George Stibitz*

Bohn Contex, Desk Calculator (X43.81)
*Gift of Bob Olthoff*

Brical Pocket Adding Machine (X13.80)
*Loan from Dick Rubinstein*

Burroughs Corporation, Mechanical Biller Series M (X120.82)
*Gift of Cosmopolitan Manufacturing Corporation*

"Circular Concise Slide Rule" (B114.80)
*Gift of Gordon and Gwen Bell*

Clary Corporation, Clary DE600 (X35.81)
*Gift of Lee McKusick*

Colossus Narrow Tape Pulley (X49.81)
*Gift of Toby Harper*

Contina Ag Mauren, "Curta" (B87.79)
*Gift of Brian Randell*

Contina AG Mauren, Curta Calculator (X104.82)
*Gift of Robert Bickford*

Drawing Instruments ca 1850 (B106.80)
*Loan from Gordon and Gwen Bell*

Dring and Fage, Inland Revenue Slide Rule (B55.80)
*Loan from Gordon and Gwen Bell*

Dring and Fage, "Leadbetter Slide Rule" (B108.80)
*Gift of Gordon and Gwen Bell*

Hans W. Egli, "Millionaire" (B1.75); (B136.81)
*Loan from Gordon and Gwen Bell*

Hans W. Egli, "Millionaire" (B91.76)
*Gift of Gordon and Gwen Bell*

"EXACTUS" (B36.79)
*Gift of Gordon and Gwen Bell*

Fowler and Company, "Fowler's Textile Calculator" (B112.80)
*Loan from Gordon and Gwen Bell*

Fowler and Company, Fowler's Universal Calculator (X172.83)
*Gift of Thomas McIntyre*

J.F. Fuller, "Palmer's Improved by Fuller Computing Scale" (B110.80)
*Gift of Gordon and Gwen Bell*

J.F. Fuller, "Palmer's Improved by Fuller Computing Scale" (X1.81)
*Gift of Erwin Tomash*

General Precision Systems, General Purpose Analog Computer (X42.79)
*Gift of Lincoln-Sudbury Regional High School*

Gilson Slide Rule Company, Trigonometric Slide Rule (X131.82)
*Gift of Stanton Vanderbilt*

Gilson Slide Rule Company, Circular Slide Rule (X174.83)
*Gift of Thomas McIntyre*

Gunter Rule (B41.79)
*Gift of Gordon and Gwen Bell*

Gunter Rule (B4.76)
*Loan from Gordon and Gwen Bell*

H.C., Calculigraphe (X173.83)
*Gift of Thomas McIntyre*

Halden, "Calculex" Patent Circular Slide Rule (X171.83)
*Gift of Thomas McIntyre*

Hewlett-Packard, "HP-35" (B34.79)
*Gift of Gordon and Gwen Bell*

Hewlett-Packard, 9100A Calculator (X83.82)
*Gift of Clyde Still*

The Hollerith Electric Tabulating System, Reproduction by Roberto Guatelli (D231.81)
*Gift of Digital Equipment Corporation*

Jacquard Loom Mechanism (B117.80)
*Loan from Gordon and Gwen Bell*

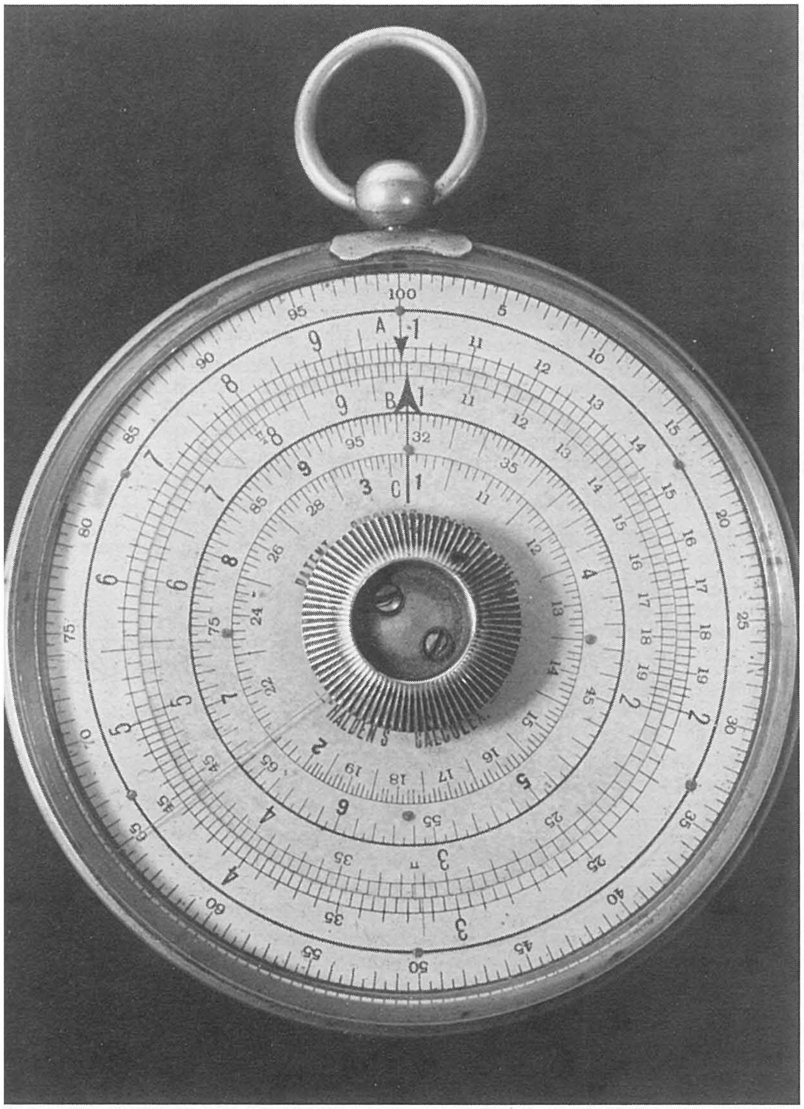
Keuffel & Esser, Slide Rule (XD50.76)
*Gift of Dick Clayton*

Keuffel & Esser, Slide Rule (X170.83)
*Gift of Thomas McIntyre.*

Keuffel & Esser, "Thacher's Calculating Instrument" (B56.80)
*Loan from Gordon and Gwen Bell*

C & E Layton, "Tates Arithmometer" (B82.80)
*Loan from Gordon and Gwen Bell*

Lewis & Tylor, Ltd., "Hydralculator" (B113.80)
*Gift of Gordon and Gwen Bell*



Manufactured by J. Halden and Company, London, during the 1920's, the pocket watch style calculator and slide rule has two logarithmic scales, A and B, on one side for multiplication, division and proportion which correspond to the A and B scales of an ordinary slide rule. Around the outer edge is a scale of logarithms read by a cursor. The inner circles contain a scale of square roots. The other side of the Calculex contains A and B scales for inverse proportions. Gift of Thomas McIntyre.

D.H. Lehmer, Photoelectric Number Sieve (X85.82)
*Gift of D.H. Lehmer*

D.H. Lehmer, Berkeley Number Sieve (X86.82)
*Gift of D.H. Lehmer*

D.H. Lehmer, Film Number Sieve (X87.82)
*Gift of D.H. Lehmer*

L.I.D., Timber Calculating Slide Rule (B30.77)
*Loan from Gordon and Gwen Bell*

The Lightning Calculator Company, Lightning Calculator (X175.83)
*Gift of Thomas McIntyre*

Lightning Portable Adding Machine from the desk of George Forsythe (X15.81)
*Gift of Gio C.M. Wiederhold*

Marchant Electric Calculator (XD235.81)
*Gift of Robert Floyd*

Monroe, Desk Calculator (X90.82)
*Gift of Gordon Osborne*

National Radio Communication Slide Rule (X133.82)
*Gift of Stanton Vanderbilt*

Navigator's Gunter Rule (B54.80)
*Loan from Gordon and Gwen Bell*

Navigator's Sector (B21.78)
*Loan from Gordon and Gwen Bell*

Ohmite Manufacturing Company, Ohm's Law Calculator (X134.82)
*Gift of Stanton Vanderbilt*

Aaron Palmer, "Palmer's Pocket Scale" (B194.81)
*Loan from Gordon and Gwen Bell*

Pascal Adder, Reproduction by Roberto Guatelli (B150.81)
*Loan from Gordon and Gwen Bell*

Pickett and Eckel, Inc., Slide Rule (X121.82)
*Gift of Lynn Yarbrough*

Frederick Post Company, "Versalog Slide Rule" (X47.81)
*Gift of Cliff Hafen Jr.*

Powers Samas Card Processing System (XD14.81)
*Gift of the Biological Research Centre, Institute of Terrestrial Ecology*

Precision Adding Machine Company, Inc., "Quixsum Adding Machine Model C" (B38.79)
*Loan from Gordon and Gwen Bell*

RCA Manufacturing Company, Decibel Slide Rule (X132.82)
*Gift of Stanton Vanderbilt*

Raytheon, Hawk Missile Auto Pilot (XD144.80)
*Gift of Joe Kuprevich*

Reliable Typewriter & Adding Machine Corporation, "Addometer" (B85.79)
*Gift of Gordon and Gwen Bell*

J. Sang, "Platometer" (B6.76)
*Loan from Gordon and Gwen Bell*

Selective Educational Equipment Corporation, "SEE CALCULATOR" (B31.79)

Servo Calculator Company, "Direct Reading Frequence Response Slide Rule" (X3.81)
*Gift of Jack Worlton*

Sharp Corporation, Electronic Printing Desk Calculator (X101.82)
*Gift of Nicolas Johnson and Martin Harrison*

Stanley Rule & Level Company, Timber Slide Rule (B99.80)
*Gift of Gordon and Gwen Bell*

M. Thomas de Colmar, "Arithmometer" (B3.76)
*Gift of Gordon and Gwen Bell*

M. Thomas de Colmar, "Instruction pour se servir de l'Arithmometre Machine à Calculer" (X4.81)
*Gift of Erwin Tomash*

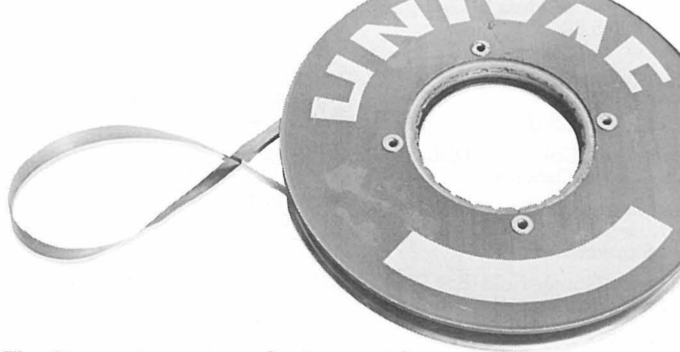
J. Thomlinson, Ltd., "Thomlinson's Equivalent Paper Slide Rule" (B107.80)
*Gift of Gordon and Gwen Bell*

Texas Instruments, Slide Rule Calculator (XD237.81)
*Gift of Mike Riggle*

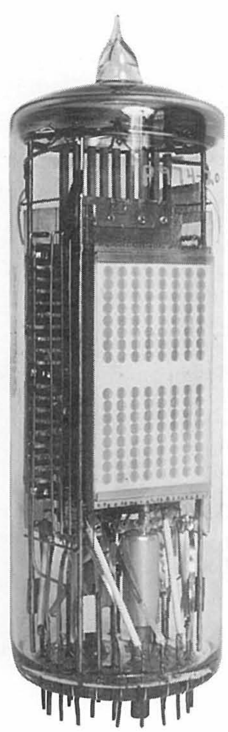
Tinker Toy Computer (X39.81)
*Gift of Danny Hillis, Brian Silverman and friends*

Wolverine Supply and Manufacturing Company, "Adding Machine" (B167.81)
*Gift of Gordon and Gwen Bell*

**Memory is probably the oldest class in the computing classification system, starting with early markings on caves and continuing as a significant part of computers and automata. The ability of machines to either write or read on memory is the primary distinction separating these devices.**




The first mass storage devices used commercially in the Univac were oxide-coated metallic tapes with two recording density modes. As a buffered system the tape could read forward and backward at speeds comparable to more recent tape systems. Two hundred bits per inch was the linear density on each of seven tracks used simultaneously. Data are organized into 60-word blocks. Each word has twelve decimal digits, each of these having seven bits. The tape, displayed in the Four Generations gallery, is a gift of Lawrence Livermore Laboratories.



The RCA Selective Electrostatic Storage Tube, used in the JOHNNIAC as a primary memory device, was developed for high speed registry and read-out of digital information. Its storage capacity was 256 signals. J. Rajchman's article in the RCA Review of 1951 states that "The storage is obtained by two stable potentials which tiny floating metallic elements, located in the register with the windows, assume under continuous electron bombardment. The signal to be stored is applied by capacitive coupling to all elements and brings the selected one to the desired stable potential. The reading signals are sizeable electron currents passing through a hole in the storing elements under the control of the element's potential. A visual display of the stored information is obtained also." The tube, a gift of Keith Uncapher and Tom Ellis, will be added to the memory exhibit.

Ampex Corporation, 64K Core Memory Module (X135.82)
*Gift of Rick Jevon*

Ampex Corporation, Core Memory Planes (X118.82)
*Gift of David Sager*

Atanasoff-Berry Computer Memory Drum (X11.80)
*Loan from Dr. Clair Maple*

Autonetics, Minuteman Fixed Head Desk Memory (XD107.80)
*Gift of Aron Insinga*

Bryant Computer Products, RM-10 Drum (X51.82)
*Gift of Nigel Webb*

Bubble Memory System (D8.81)
*Gift of Nick Warchol*

Richard Stevens Burrington, "Handbook of Mathematical Tables and Formulas" (B44.79)
*Gift of William B. Lehmann*

CCD Memory Board (D7.81)
*Gift of Nick Warchol*

Chemical Rubber Publishing Company, "Handbook of Chemistry and Physics, 31st Edition" (B28.79)
*Gift of Gordon and Gwen Bell*

Computer Controls Corporation, Delay Line Memory/Logic Module (D108.80)

Control Data Corporation, CDC 38500 Cartridge (XD222.80)
*Gift of Lawrence Livermore National Laboratory*

Digital Equipment Corporation, Core Memory (D200.80); 18 mil Planar Memory (D198.80); Experimental Ferrite Memory Stack (D160.80); PDP-11 Planar Structured Core Memory (D241.80); 64K Byte Memory Module (D34.80); VAX SBI Memory Board (D164.80); VAX Star 64K MOS Memory Array (D165.80)
*Gifts of Digital Equipment Corporation*

Disk Drive Prototypes (X52.82)
*Gift of Steve Lambert*

The Emeloid Company, Inc., "Transmission Line Calculator" (X29.81)
*Gift of Cliff Hafen Jr.*

English Electric Company, Deuce Mercury Delay-line (XD3.75); Deuce Memory Drum (X65.82)
*Gifts of Murray Allen, University of Sydney*

Ferranti Ltd., Atlas 1 Fixed Memory (XD129.80); Atlas 1 Memory "The Supervisor" (XD130.80)
*Gift of Rutherford Laboratories*

Ferranti Ltd., Magneto-strictive Delay-line (XD230.80)

Ferranti Ltd., Pegasus Short Acoustic Delay-line (X54.82); Williams Tube (X67.82)
*Gifts of Computer Science Department, Manchester University*

Ferroxcube Corporation of America, Ferroxcube Core Memory (D195.80)

FUJITSU Ltd., Hollerith Read Only Card Reader and Cards (XD74-5.79); Paper Tape for FACOM (XD76.79)
*Gifts of FUJITSU Ltd.*

Harvard University, Mark IV 64-bit Magnetic Shift Register (XD6.75)
*Gift of Bob Trocchi*

Hertrich Development Inc., RL01 Disk Drive Prototype (XD163.80)
*Gift of Fred Hertrich*

Honeywell Memory Sense Amplifier (X22.81)
*Gift of Phil Goldman*

Honeywell Plated Wire Memory (D114.80)

Charles Hutton, "Table of the Products and Numbers" (B2.76)
*Loan from Gordon and Gwen Bell*

International Business Machines Corporation, IBM 650 Drum (X179.83)
*Gift of Timothy E. Leonard*

International Business Machines Corporation, 2321 Data Cell Drive (X46.82); 2321 Data Strips (XD219.80); Data Cell (XD220.80); 1360 Photo-digital Storage System (XD221.80)
*Gifts of Lawrence Livermore National Laboratory*

Los Alamos Scientific Laboratory, MANIAC Electrostatic Memory and Williams Tube (XD214.80)
*Gift of Los Alamos Scientific Laboratory*

Mermod Freres, Piano Disk (XD136.80)
*Gift of Marv Horovitz*

MITS, Altair 4K RAM Board (X7.80)
*Gift of Ed Luwish*

"Model Ready Reckoner" (X57.80)
*Gift of McLaren Harris*

Napier's Bones (B27.79)
*Loan from Gordon and Gwen Bell*

NASA Apollo Guidance Computer Read Only Rope Memory (XD115.76)
*Gift of Albert Hopkins*

National Physical Laboratory, Pilot ACE Long Delay Line Memory (X160.82)
*Gift of Donald Davies, NPL*

G.A. Philbrick Researchers, GAP/R Computer Tube (X91.82)
*Gift of Thomas Turano. (9/82)*

Phillips, Ferroxcube FFI (D204.80)

RCA, Core Memory Board (XD197.80)
*Gift of Gary Papazian*

RCA, Experimental Ferrite Core Memory (D161.80); Thin Film Memory (D112.80); Non-destructive Read-out (D162.80)

RCA, Ferrite Core Memory Cube (D169.80)
*Gift of Cliff Granger*

RCA, JOHNNIAC Selectron Tube (XD215.80)
*Gift of John Postley*

RCA, Selective Electrostatic Storage Tube (X168.83)
*Gift of Keith Uncapher*

Sperry Rand, Mated Film Memory Array (X93.82)
*Gift of Ted Bonn*

Sperry Univac, LARC Memory Plane (X94.82)
*Gift of Ted Bonn*

"Sumador Chino" (X10.80)
*Gift of Jim Rogers*

Tektronix,
Core Memory Test Equipment (X183.83)
MIT Instrumentation Laboratory, Apollo Memory Stack Module (X183.83)
*Gift of Boguslaw Frackiewicz*

3M Corporation, Telex Disk (D80.80)
*Gift of Don Sordillo*

Univac, Metal Tape (X82.82)
*Gift of Lawrence Livermore Laboratories*

University of Illinois, ILLIAC II 48-bit Register, Mesa Transistor (XD120.80)
*Gift of Los Alamos Scientific Laboratory*

Freiherrn von Vega, Logarithmisch-Trigonometrisches Handbuch
*Gift of George Valley. (82.2)*

**The Computer Museum solicits material to add to our archives and library from various sources: donors of artifacts, who often have boxes of related documentation, libraries and associations cleaning out duplicated materials, and individual collectors. Study collection material is treated in the same manner Exhibit Collections acquisitions are—numbered and acknowledged, and made available for research. The collection is arranged by computer company, representing about 65, with manuals and documentation on the machines and components the Museum has managed to acquire over the years. Audio-visual material is collected with an eye to integrating it into our exhibits. Recent acquisitions to the Archives and Library are listed below.**

### Manuals and Documentation

Air Force Magazine reprint, "The Bombardier and His Bombsight," September, 1981.
*Gift of Norden Systems. (83.9)*

Ampex Corporation, 3DM—2000 Magnetic Core Memory System.
*Gift of Rick Jevon. (82.3)*

Association of Computing Machinery, *Journal of the ACM*, vol. 1, no. 1; ACM National Conference, 1962, Advance Program; ACM Roster of Members, 1957; Report to the ACM, First Glossary of Programming Terminology, 1954.
*Gifts of Mary Hardell. (82.15);*
Journals and Computing Reviews.
*Gifts of Massachusetts Computer Associates, Inc. (83.1)*

Aberdeen Proving Ground. Reports from Ballistic Research Laboratories.
*Gift of Richard Clippinger. (82.13)*

Bell Laboratories, "A History of Engineering and Science in the Bell System—Switching Technology 1925–1975." Prepared by A.E. Joel Jr. and Technical Staff, Bell Telephone Laboratories.
*Gift of Bell Laboratories. (83.12)*

Bendix Computer, G-15 Reports.
*Gift of Ramon C. Scott.*

Burroughs Corporation, Burroughs E101 materials.
*Gift of James Rogers. (82.4)*

Computer Design Magazine 20th Anniversary Issue, December 1982.
*Gift of Bob Evans. (83.7)*

Davies, Donald. Papers on digital communications.
*Gift of Donald Davies. (82.12)*

Digital Equipment Corporation. PDP-1 Operating Manuals, 1969–70.
*Gift of Paul Karger. (83.16);*
PDP-8 Manuals and Documentation.
*Gift of The MITRE Corporation. (83.3);*
PDP-8/L Manuals and Documentation.
*Gift of Robert G. Miller. (83.5)*

Gilmore, John T. Jr. "The Digigraphic Display Program for the DX-1 Computer System," Charles W. Adams Associates, Inc.; "Operational Procedure on the Whirlwind Computer," Digital Computer Laboratory, MIT; "The Photoelectric Conversion Program," Project Whirlwind Servomechanisms Laboratory, MIT; "The Lincoln Writer" (with R.E. Savell), MIT Lincoln Laboratory. (83.13)

Honeywell Inc. Datamatic 1000 manuals.
*Gift of Robert F. Trocchi. (82.10)*

Institute of Electronic and Electrical Engineers, Transactions.
*Gifts of Massachusetts Computer Associates, Inc. (83.1)*

IBM, 610 and 1620 Manuals, Programmer's Reference Manual "FORTRAN, Automatic Coding System for the IBM 704."
*Gift of Ramon C. Scott.*

International Business Machines Córporation. Journal of Research and Development.
*Gifts of Massachusetts Computer Associates, Inc. (83.1);*
IBM 1130 Manuals and Documentation.
*Gift of John R. Richards. (83.2);*
IBM 7030 Manuals and Documentation.
*Gift of Brigham Young University. (83.6);*
Operating and Maintenance Manuals for IBM 402, 403, 409, 419, 1231, 1232.
*Gifts of Michael Weisbard. (83.8)*

*350 Jahr Rechenmaschinen Vortrage eines Festkalloquiums.*
*Gift of Hermann Kassubek. (82.1)*

Kartran 800 Manuals.
*Gifts of Frank Feigin.*

LGP-30 Floating Point Interpretive System.
*Gift of Ron Ginger. (82.9)*

Massachusetts Institute of Technology. Department of Civil Engineering, "Engineer's Guide to ICES COGO I", 1967.
*Gift of Mary Hardell. (82.15);*
"How the SAGE Development Began".
*Gift of George Valley. (83.15);*
SAGE Press Kit, June 1958.
*Gift of Ed Townsend. (82.6);*
Whirlwind I Computer Report R-127, September 1947.
*Gift of Tim Leonard. (83.14)*

Norden Systems, "PDP-11/34M, A Fully Militarized Computer."
*Gift of Norden Systems. (83.9)*

RCA Review, March 1951, Vol. XII, No. 1, reprint: "The Selective Electrostatic Storage Tube" by J. Rajchman.
*Gift of Tom Ellis and Keith Uncapher. (83.11)*

Rand Corporation. JOSS Manuals and Documentation.
*Gift of Willis H. Ware. (83.17)*

Remington Rand Inc. "Programming Univac Systems: Instruction Manual I", 1953.
*Gift of David V. Cossey. (83.10)*

Sperry Rand Corporation, UNIVAC DAS Documentation.
*Gift of Ramon C. Scott.*

Texas Instruments, Inc. Advanced Scientific Computer Manuals and Documentation.
*Gift of Texas Instruments. (83.4)*

*Theory of Operation of Display System for AN/ESQ-7 Combat Direction Control.*
*Gift of the MITRE Corporation Archives. (82.8)*

### Audio-Visual Material

Robert Bonifield, photographs of D.H. Lehmer's number sieves.
*Gift of Robert Bonifield. (82.7)*

Burroughs E101, original photographs.
*Gifts of Bill Smith.*

The Computer Era Calendar, original photographs.
*Gifts of Dick Eckhouse and Ruth Maulucci. (82.5)*

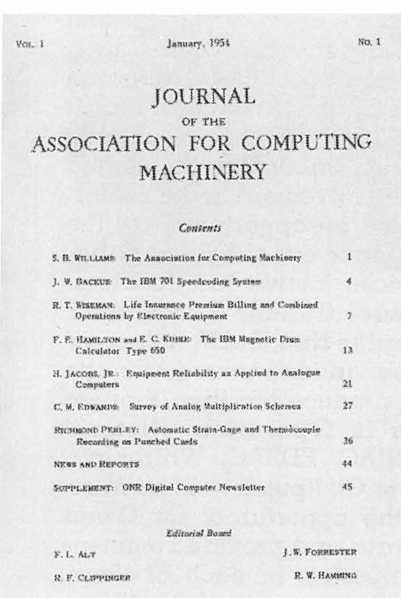
IBM, Photos of System 360.
*Gift of Ramon C. Scott.*

International Research Conference on the History of Computing. Audio and video tapes, volumes.
*Gift of William F. Luebbert. (82.14)*

Johnniac Computer, original photographs.
*Gifts of Keith Uncapher and Tom Ellis. (83.11)*

RCA, Photos of BIZMAC, 301, 501.
*Gift of Ramon C. Scott.*

Sperry, Photos of Univac 9400.
*Gift of Ramon C. Scott.*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JOURNAL
OF THE
ASSOCIATION FOR COMPUTING
MACHINERY

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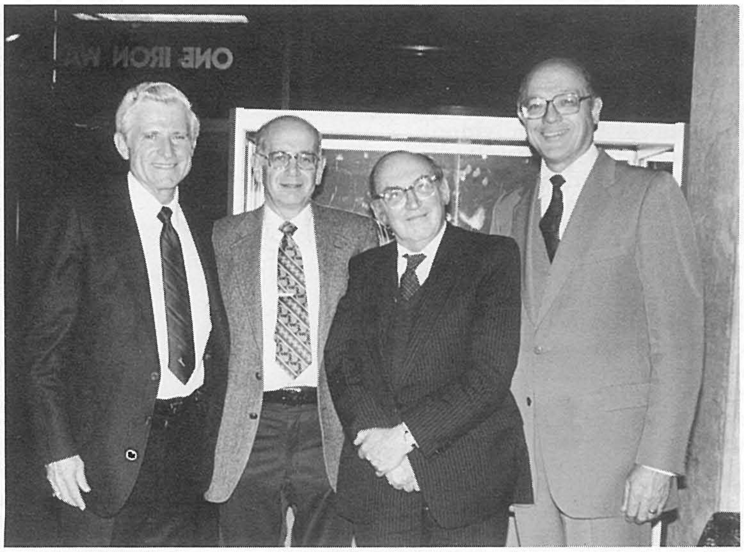



*Charles Bashe (second from left), who occupied an office across from Gene Amdahl (left) during the design of the IBM 701 and 704, came for Gene Amdahl's lecture and is joined by Maurice Wilkes (second from right) and Charles Bachman (right).*

*Oliver Selfridge's talk on the past and future of Artificial intelligence attracted over 150 people to the first "Bits and Bites" program of the Spring season.*

Exhibits, by virtue of the themes they represent, the artifacts they exhibit, and the scholarship necessary to both, are The Computer Museum's most eloquent form of communication. But in order for an exhibit to communicate its message, it must have an audience that not only receives and benefits from the message, but who ultimately become advocates for the Museum. Special programming, developed to complement exhibits and archives, plays a special role. The Museum's Lecture Series, "Bits and Bites", symposia, excursions, and special events like the Babbage play, reflect or amplify exhibits and actively promote the Museum in its role as the world's only Museum dedicated to the preservation of computer history. They function as a conduit between the substantive areas of the collection, and the public's understanding of and access to those areas.

The past year at The Computer Museum has seen a number of parallel efforts designed to expand audiences and increase visibility. The six major lectures are the most prominent of these. These lectures focus upon significant machines, applications, languages or contributors. In the past year, The Computer Museum has sponsored lectures by Derreck Lehmer on The History of the Sieve Machines, Herbert Grosch about work done at the Watson Scientific Laboratory from 1945–50, Harry Huskey on the Pilot ACE to the G-15, Gene Amdahl, and Captain Grace Hopper.

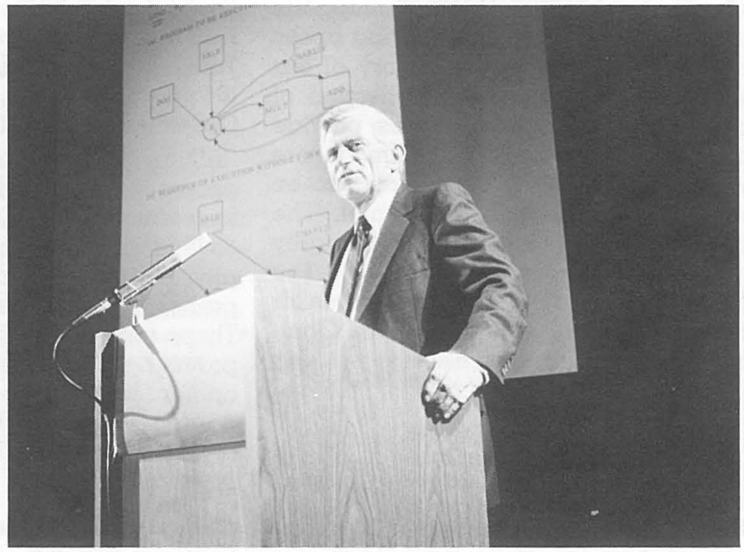
Not every presentation can have the import of a major lecture, but the sixteen "Bits and Bites" talks help present a balanced program on the history of computing by covering a wide variety of issues. Topics include everyday descriptions of computing, contemporary uses of computers in the arts, and the effect of cryptography on computing. From the first talks with thirty to forty people in attendance, they now average over 100 people per week—drawing a wide variety of interested participants.

Guided tours at The Computer Museum are another public educational program that made great strides in the past year. In an eight-month period, over 135 tours were scheduled, with one-third being organized by volunteers. With advanced booking and a fee of $25.00, it is still possible to tailor the tour to the audience. The nature of a tour depends on the background of the group requesting the service—offering either deeper insights into specific exhibits or providing a brief overview of the collection. Guided tours, in effect, can be adapted to changing audiences or changing exhibits—something that the more high-tech forms of interpretation, such as personal cassette recorders, have difficulty doing.

As part of the effort to introduce the Museum to as many people as possible, we have also made the gallery and lecture space available to outside groups sponsoring meetings and functions. For instance, at a recent meeting of the Worcester Chapter of the IEEE, a "film night" was arranged, featuring historic films in the Museum's collection. In addition, staff members were on hand to guide IEEE members through the collection and answer questions about exhibits and programs.

The Museum has supplemented these in-house programs with an outreach service. A mini-travelling exhibit was developed to take the Museum "on the road" to national conferences and trade shows and now reaches an even broader cross-section of audiences and markets. Digital's Educational Computer Systems Group made the first request for display and paid for the exhibit's design and construction.

In February, the ACM (Association for Computing Machinery) donated booth space to the Museum at a conference of 2,100 computer science educators from throughout the United States. Our involvement in the conference provided an opportunity for the Museum to make our slide and publication services known to educators. The "Computer Culture" Conference, organized by the New York Academy of Sciences, provided resources for the Museum to produce the film "Pioneer Computers in Operation: Historic Films of ENIAC, EDSAC, Whirlwind, and the First Computer-written Western," and the opportunity for Gwen Bell to narrate and provide commentary. Participation in each of these conferences has benefitted the Muse-



*Gene Amdahl speaking about his work on the WISC, Stretch, the Amdahl series, and the soon-to-be-released Trilogy computer.*

um in terms of visibility within the computer community, increased membership, and in some cases, new acquisitions. At the same time the image and appeal of the conference is enhanced by the exhibits and or program participation of the Museum.

With over 70 books available (including computer history reference texts, children's books or lighter recreational reading), the Museum Store provides a convenient clearinghouse for information relating to books available on the history of computing. Out-of-press titles and rare books are frequently in stock for the benefit of researchers and bibliophiles alike. Antique calculating devices are available to collectors through the Store's fleamarket section and slide sets of the Museum's collection are excellent resources for the classroom.

*The Museum Store, with its ever-expanding inventory of books and computer memorabilia, attracts visitors every day.*

The Museum's expanded repertoire of programs is a function of their popularity and effectiveness, as well as a function of the support of our volunteers. It would simply be impossible to organize these efforts without additional assistance in these areas. To that end, local members meet quarterly to help the staff with ideas and react to proposals. Kitty Selfridge, Chairperson, and Ed Galvin, Secretary, organize and record suggestions for programs, store products, and development of volunteer activities.

Increased press coverage has been created or inspired by program activities. Since June, major features on the Museum have appeared in over twenty publications including the November *OMNI*, and February *Discover* magazines, plus various computer publications. These, in turn, have generated further visibility through television and radio coverage. This media attention has been both national and international: live radio interviews have been carried on by telephone to Spokane, Louisville, Chicago, and even the BBC in Manchester. The Museum was featured on Boston's Evening Magazine and the Museum provided materials for the Grace Hopper interview on the 60 Minutes program.

More is planned for the future; we are already planning for a full schedule of programs this fall. Lecture speakers are being finalized, a preliminary "Bits and Bites" roster has been established and an itinerary of convention shows is being organized for the travelling exhibit. And, as in the past, all programs will be designed to complement our ever-growing slate of exhibit activities.

Christine Rudomin
*Programs Coordinator*

# The Computer Historian's Bookshelf

The Computer Museum Store supports the Museum exhibits by offering books that further explain the history of our exhibited machines. Our collection of books, and videotaped lectures, provide a great opportunity for Museum visitors who desire to know more than can be recorded in a single text panel. The books range in presentation from highly technical to purely recreational. The Museum store is open to suggestions for new books that will interest the Computer Museum audience.

**Illiac IV**, by R. Michael Hord, 1982, Computer Science Press, Rockville, 350 pp.
Order: HOR82 $29.95 (members $26.95)

"The Illiac IV—conceived as a massive breakthrough in computer technology—succeeded so well that it defined a new category of processors and gave rise to the term 'supercomputer.' Both the computer professional and the educated layman will share the sense of majesty in the recounting of this exciting project." *Computer Science Press*

**Hut Six**, by Gordon Welchman, 1982, McGraw-Hill Book Company, New York, 326 pp.
Order: WEL82 $12.95 (members $11.65)

"A fascinating account of the breaking of the German 'Enigma' code which took place at Bletchley Park in England. The author was deeply involved in the cryptanalysis project, and thus presents a very personal history of the events leading up to the codebreaking. The book offers an excellent insight into the personalities involved in the project. The last section of the book is devoted to an analysis of the current state of the communications systems in the U.S. defense program, a scathing critique." *Ben Goldberg*

**The Enigma War**, by Jozef Garlinski, 1980, Scribner, New York, 211 pp.
Order: GAR80 $6.95 (members $6.25)

"Historians of WW II and specialists in intelligence cryptanalysis will find Garlinski's study indispensible; it is the most detailed, corroborated account of the development and perfection of the 'Enigma' machine by which the Allies were able to decipher a great portion of the strategically important Nazi and Japanese radio messages from 1940 onward." *Choice Magazine*

**Early Scientific Instruments**, by Nigel Hawkes, 1981, Abbeville Press, Inc., New York, 73 full page color illustrations, 164 pp.
Order: HAW81 $35.00 (members $31.50)

"In this book are illustrated important examples from the diverse range of artifacts with which man has tried to discover and explain the complexities of the physical world, and, through this comprehension, use nature for his own ends. These early instruments, in addition to providing a tangible record of the development of scientific knowledge, vividly demonstrate the technical ingenuity of former times." *D.J. Bryden in the Introduction*

**Antique Scientific Instruments**, by Gerard L'E Turner, 1980, Blanford Press Ltd., Dorset, 69 color plates, 168 pp.
Order: TUR80s $7.50 (members $6.75)

"The author, Senior Assistant Curator of the Museum of the History of Science, Oxford University, has collected his illustrations and materials from a variety of European museums and collections. The first four chapters on astronomy and time-telling, navigational instruments, surveying instruments, and drawing and calculation instruments are particularly relevant to the pre-history of computers. The last chapter, 'Practical Advice on Collecting,' will be especially useful to collectors." *Gwen Bell*

**Early British Computers:** The Story of Vintage Computers and the People Who Built Them, by Simon Lavington, 1980, Digital Press, Bedford, fully illustrated, appendix, 139 pp.
Order: LAV80 $9.00 (members $8.10)

"This volume, sprinkled with more than 60 photographs, discusses wartime work on Colossus, EDSAC, Pilot ACE, the Manchester Mark I, LEO, and other early British computers." *Henry S. Tropp, Annals of the History of Computing*

**Project Whirlwind:** The History of a Pioneer Computer, by Kent C. Redmond and Thomas M. Smith, 1980, Digital Press, Bedford, 67 illustrations and diagrams, 280 pp.
Order: RED80 $25.00 (members $22.50)

"This book is not a technical engineering account. Instead, it is an attempt to reconstruct the complexity of technical, financial, and administrative problems and the eventual compromises and solutions to these problems." *Henry S. Tropp, Annals of the History of Computing*

**A History of Manchester Computers**, by Simon Lavington, 1975, National Computing Centre, Manchester, England, fully illustrated, 44 pp.
Order: LAV75 $6.50 (members $5.85)

"This very useful booklet summarizes the history of five successive computer projects at Manchester University, during the period 1946–1975. The early pages give information, from primary sources, on the development of the first computer at Manchester, and on the roles of F.C. Williams, T. Kilburn, M.H.A. Newman, A. Turing, and others. Profusely illustrated." *Brian Randell*

**The Origins of Digital Computers:** Selected Papers, edited by Brian Randell, 1975, Berlin, Springer, 580 pp.
Order: RAN75 $35.00 (members $31.50)

"An outstanding collection of excerpts from important nineteenth and twentieth century computer developments, together with background and commentary on each excerpt." *William Aspray*

**A History of Computing in the Twentieth Century**, edited by N. Metropolis, J. Howlett and Gian-Carlo Rota, 1976, Academic Press, Inc., New York, 121 illustrations and photos, 659 pp.
Order: MET76 $29.50 (members $26.55)

"If you've been thinking that some day you should read something on computer history, buy this book! It consists of edited versions of papers presented in 1976 at an invitational conference supported by the Los Alamos Scientific Laboratory and by the National Science Foundation. The authors of the 37 papers include a high percentage of the people who personally did the pioneering work in computing or were firsthand witnesses to it." *D.D. McCracken, Computing Reviews*

**Origins of Modern Calculating Machines**, by J.A.V. Turck, 1972, Arno Press Inc., New York, 38 illustrations, 196 pp.
Order: TUR72 $19.00 (members $17.10)

"This book is a chronicle of the evolution of mechanical calculating and recording machines including machines such as Pascal's adding machine, the Comptometer, the Burrough's machine and the Billing's machine. Written in 1921, the book is of historical interest for its unique perspective, its extreme detail and excellent illustrations." *Allison Stelling*

**Order from The Computer Museum Store, One Iron Way, Marlboro, Massachusetts**

# The Founders Program

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Bolt, Beranek and Newman
Boris Color Labs
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Robert Cipriani Associates
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**During the initial two-year period of the Museum, until June 10, 1984, the Founders Program is in effect. The purpose is to build a strong foundation for The Computer Museum. This provides participants with a unique opportunity to help The Computer Museum become established as an industry-wide Museum that will have enough support to continue its efforts to preserve the history of information processing.**

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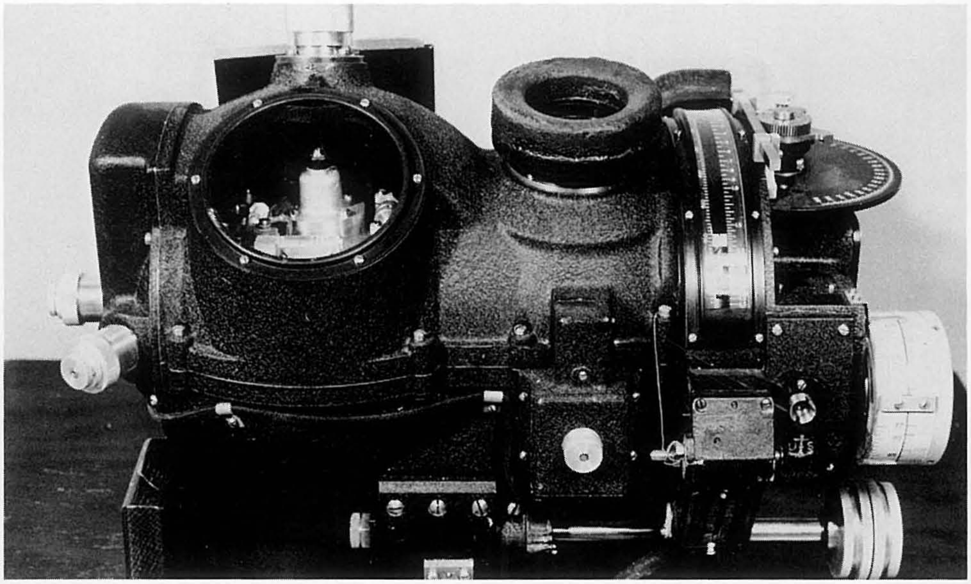
*A newsbrief of the collection*



The Norden Bombsight became famous during World War II for making bombing uncannily precise—it could place a bomb inside a 100-foot circle from four miles up. Bombardiers said that it could put a bomb in a pickle barrel from 20,000 feet. When asked to verify this information, inventor Carl L. Norden replied: "Which pickle would you like to hit?" By the end of the war, more than 25,000 bombsights had been built by Norden and more by Sperry, each costing $25,000. The Computer Museum's bombsight is a gift of Norden Systems.

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