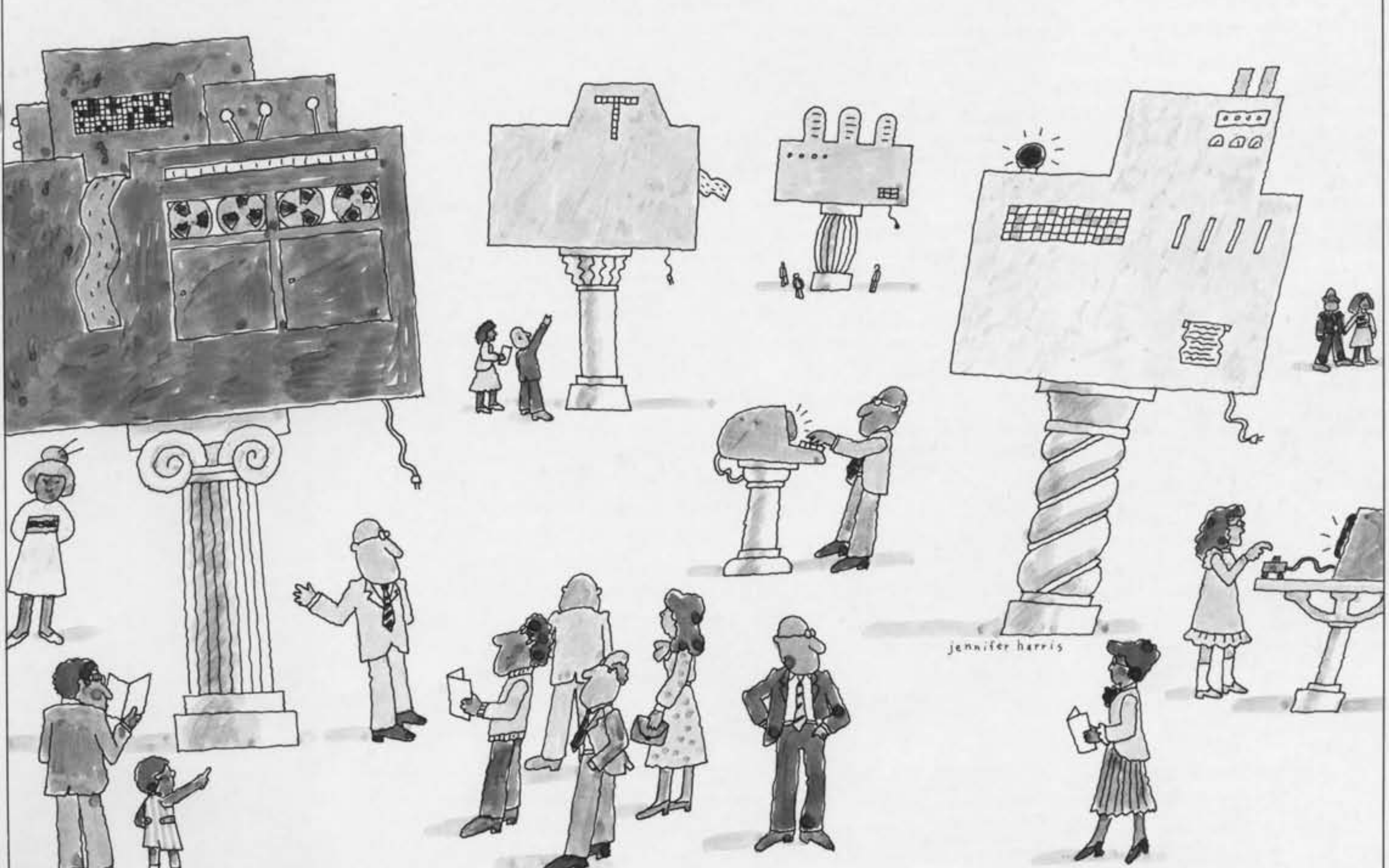
# THE COMPUTER MUSEUM REPORT

VOLUME 14

FALL/WINTER 1985



**The Computer Museum**
300 Congress Street
Boston
Massachusetts
02210

## Contents



# The President's Letter

*"Museums in the modern world exist, we are told, to fulfill a fourfold function: to collect, conserve, exhibit and elucidate. There is rarely any mention of the balance between them, and the stress is always on the first, irrespective of whether the other three can be fulfilled in terms of resouces. Collect or die. . . . What we should be doing instead is assessing our collections, refining some (dare I mention disposal, embodied in that emotive word 'de-accessioning'?), closing others, and, even more important, putting what we have got into good order."*

Sir Roy Strong
Director, Victoria & Albert Museum
*The Listener* 25 July 1985

Collecting was the original goal of the Museum, and is our sine qua non. But as our collections increase, selection, conservation, and elucidation become more and more important. This issue of the *Report* lists the artifacts acquired in the last year and provides a time to assess our holdings.

The table on page 2 enumerates the Museum's computer-era artifact and film collections characterized by the levels of integration from the manufacturing base through applications and even including ephemera. The heart of the collection is in the middle: computer subassemblies and computers themselves. Subassemblies are the largest single collection of artifacts because they include transducer systems, secondary memories, and other major components. The 106 computers are all different, second or third copies of the same machine are not counted here. Why not stop here? Components are often the only remnants of early machines or are sufficient to show a given technology, such as the Atlas "toothbrush memory" or the Intel 4004 microprocessor. Since the goal of the museum is to document all aspects of computer technology, which includes manufacture. The process of how things are made are best recorded on film, hence this becomes a critical form of collecting.

Software, applications, and ephemera overlay the hardware technology levels. The way that software artifacts are counted here is highly misleading: the three items are all historical artifacts, such as Bill Gates' original paper tape of the BASIC assembler for the Altair. Operating systems and software in use have not been entered into "the collection." On their retirement from active use, a judgment will be made as to whether they should be placed in the permanent collections. The largest collection of software that we have is in the form of written documentation, such as the original handwritten Brooker Morris Compiler-compiler. Much of the paper documentation has been accepted, categorized by the box-load and set aside. However, we are sufficiently familiar with the material to find the sets of cartons that researchers need; we have recently supplied lawyers with documents required for several different cases of litigation. The material has not been properly sorted or cataloged and this is on the Museum's agenda. Our collection of applications also appears small, because these are often in the form of documents. The development of the Image Gallery led to the rapid expansion of materials that use computer graphics. Examples include early computer-generated pictures, film and objects designed or manufactured using computers.

Ephemera are intriguing and can be especially important to museums. Old buttons, t-shirts, coffee cups, posters, promotional material, video-tape spoofs, commercials and other objects recreate the spirit of the past as well as the technology. Professor Brian Randell, Chairman of the Museum's Exhibits and Collections Committee, recently wrote to us saying, "I can't stress the importance of collecting ephemera enough. When I was preparing a lecture on computing in the sixties, the advertisements triggered more memories about the era than did the technical articles." Without ephemera the 1950–69 timeline case would be less lively, and the IBM 1401 room would not have any semblance to reality. If anyone has a button

The Computer Museum

The Computer Museum is a non-profit 501(c)3 foundation that chronicles the evolution of information processing through exhibitions, archives, publications, research, and programs.

**Museum Hours:** The Museum hours are 10 AM–6 PM, Tuesday, Wednesday, Saturday, and Sunday and 10 AM–9 PM, Thursday and Friday. It is closed Mondays, Christmas, New Years, and Thanksgiving.

**Membership:** All members receive a membership card, free subscription to The Computer Museum Report, a 10% discount on merchandise from The Computer Museum Store, free admission and invitations to Museum previews. For more information, contact Membership Coordinator at The Computer Museum, 300 Congress Street, Boston, MA 02210, (617) 426-2800.

## THE COMPUTER COLLECTIONS

(calculators, card equipment and other pre-computing devices are omitted)

| | Number of Artifacts | Films |
|---|---|---|
| Ephemera | 10 | 3 |
| Applications | 22 | 105 |
| Software (historical) | 3 | 22 |
| Computers | 106 | 64 |
| Sub-assemblies | 329 | 20 |
| Components | 85 | 1 |
| Manufacturing | 16 | 7 |

collection (and some one out there must have one), we would love to have the "..... .... Memorial Collection of Computer Buttons," or any other special collection or individual items.

This year, the Museum is undertaking a special search for artifacts relating to the history of personal computers. Computerland's President Bill Millard clearly saw that the Museum needed a more comprehensive collection of early personal computers and the materials that went with them in order to create a better exhibit. He convinced Pat McGovern of ComputerWorld to run a series of advertisements publicising our collecting effort and encouraging donations of early personal computing artifacts. As an extra inducement, donors of the "best" finds will be brought to the Museum for the grand opening party of the new personal computer exhibit. The Curator, Oliver Strimpel will be accepting nominees for acquisition until April 1, 1986. Judging will be based on when and where the machine or software was developed, completeness of the artifact, uniqueness, and importance to the history of personal computing.

In this way, the Museum hopes to add many objects to the permanent collection to provide primary source material for history. Even though the book shelves are beginning to groan under the weight of published accounts of personal computing, none begin to be comprehensive, and many are inaccurate. I recently talked to an author who was trying to describe the early days of using the model 33 teletypes with their paper tape readers. He described them as being "kludges" because he had heard they didn't work very well. I asked, "Have you ever seen one working?" He had not even seen one working or not—or talked to anyone who had used one.

The Museum is also trying to establish an international collection and an international view of the history of computing. The article by Dr. Koji Kobayashi of NEC describes his personal involvement in computing in Japan and their early machines. He is regretful when he remembers that the NEAC 2201, NEC's first transistorized computer was junked! And we are both pleased that he is sending the NEAC 2203, a 1958 machine, to The Computer Museum.

This issue of the Report is made possible by all of the people who have donated all of these artifacts to the collection. We all wish to thank them for entrusting their "memories" to us.

Gwen Bell

**P.S.** I wanted to update everyone on the museum's 1985 Attic Sale. On September 22nd, a number of companies, individuals, and volunteers joined museum staff in an old-fashioned attic sale of surplus and donated items, museum store merchandise, and retired photomurals from old exhibits that generated more than $2000 to support the museum. Collecting museums approach attic sales the way porcupines make love—very gingerly—to be sure that no one confuses a museum selling donations or duplicate items unsuited for its collections with deaccessioning—the formal process of separating a collected artifact from a museum collection. In our case, the Attic Sale has benefitted donors, buyers, and the museum itself. We're planning to do it again next year, and are looking for both volunteers to make it a great event and for donations for resale. Just give me a call.

# The Evolution of "C & C"
## A Japanese Aspect

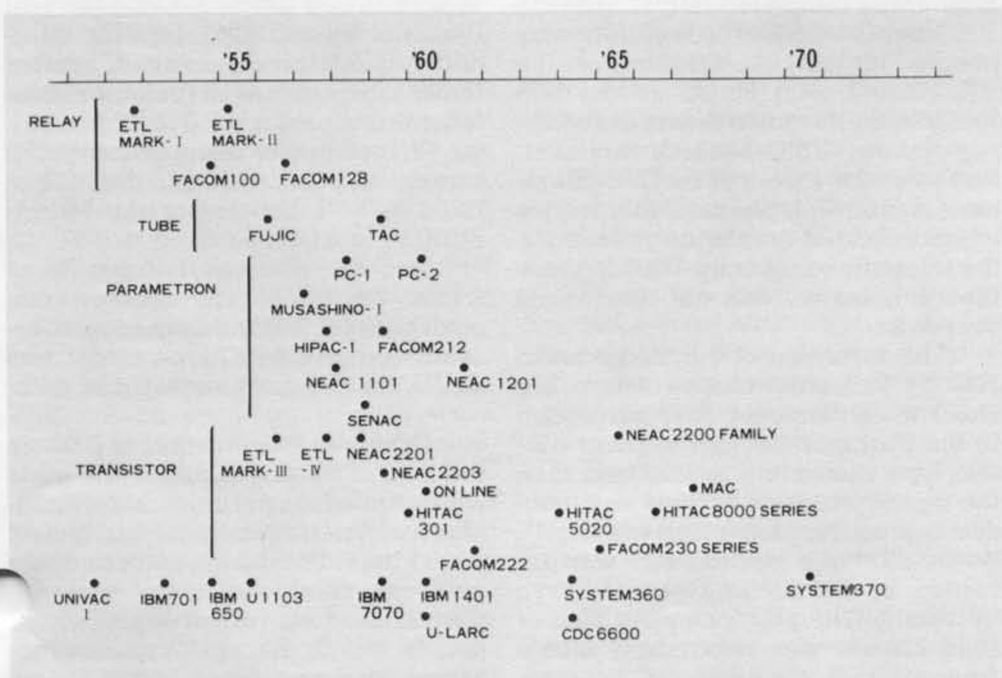
**The United States and Japan have both been involved in the progress of telephony and computing from the very beginning. Now, the advances are spreading throughout the world and can lead to a new era in mutual understanding.**

**Dr. Koji Kobayashi**

In 1876, two Japanese students, Shuji Izawa and Kentaro Kaneko, participated in Bell's experiments with early telephony. Japanese was the second language to be spoken over the telephone set. The very next year, Japan imported two telephone sets that served as a trigger for the establishment of the Ministry of Communications in 1885, and subsequently the nationwide telephone system.

Twenty-three years later in 1899, NEC Corporation was incorporated as a joint venture with what was then the Western Electric Company to implement this telephone system. NEC started by manufacturing telephone sets and switchboards. One of the epoch-making events in the communications technology in the 1930's was the development of the non-loaded cable carrier transmission system. The 1,900 mile system between Japan and China, completed in 1939, was produced entirely with Japanese technology, components and materials. I consider this to have served as the basis of establishing Japan's telecommunications technology.

With the advent of electronics technology, based on the invention of the transistor at AT&T Bell Laboratories, NEC proceeded to manufacture transistors and enter the computer field. In 1959 NEC exhibited the NEAC 2201 computer at the AUTOMATH in Paris. This was one of the first transistorized commercial computers to be publicly operated.

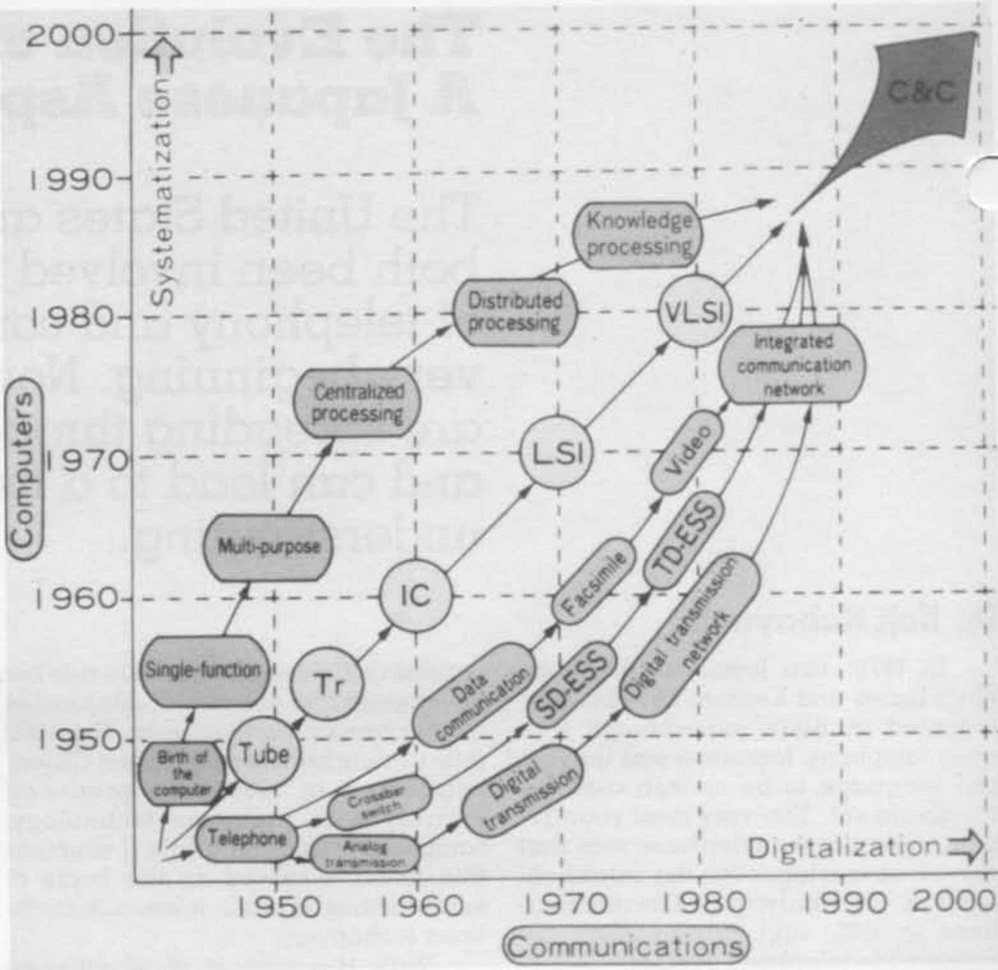



*Roots of Japanese Computers*

In November 1964 when I became President of NEC, half of NEC's total sales were accounted for by Nippon Telegraph and Telephone (NTT), a semi-public corporation, and other government agencies. Although NTT had several 5 year plans for domestic communications networks, I thought that NEC should not rely only on the demand for domestic communications equipment, but that the company should expand and develop new business. Therefore, NEC went into overseas market. In 1964 total sales were 270 million dollars. In 1984 sales grew 30 times in 20 years to 8 billion dollars. Today, NEC's overseas business amounts to 3 billion dollars or 35% of total sales.

NEC has had business dealings with 144 countries, operating 20 manufacturing companies in 13 countries, 23 plants in 13 countries, and 23 sales and service companies in 13 countries. NEC employs 90,000 people, 11,000 outside Japan.

**1930's: Desire to Develop Original Technology** When I joined NEC in 1929, 90% of the telecommunications patents were owned by foreign countries. Japan's material and component industry was very small with most of the important materials imported from abroad. Young engineers including myself tried hard to find ways to change this. From 1930 a trend emerged that a nation's telecommunications infrastructure should not rely on imported technologies, and that equipment should be supplied based on domestic requirements and proprietary technologies. Thus, developing technology became a goal of Japanese engineers.




At that time, Dr. Shigeyoshi Matsumae and Dr. Noboru Shinohara of the Ministry of Communications proposed the first non-loaded cable carrier transmission system in the world. I was selected to participate in this development project to lay 1,900 miles of cable circuits between Japan and China. In 1939, after 7 years of work, the project was completed based on the original technology of Japan. I learned that to accomplish a project, whether it may take 10 years or 20 years, if the team settles down to work and uses their own abilities without relying on a quick fix of borrowing things, the road will open up in due course.

**The Forerunner of Japan's Computer Development** It is said that Japan's computer industry started about 10 years behind the United States. In 1946 when the world's first electronic calculator, ENIAC, was unveiled at the University of Pennsylvania, Japan was in a period of turmoil. After the conclusion of the peace treaty in 1952, communications led to the reinvigoration of technology. The development of radar during the war brought progress in pulse technology, and led to the development of digital multiplex systems using pulse-time and pulse-code modulation. Later, this digital technology came to form the basis of computer development. FM radio and television broadcasting began and consumer markets were born. The new word "electronics" presaged the birth of new industries. As research and development intensified, computers and semiconductors came to be considered major products for the future.

**Japanese Computers** In 1951, a computer project started under the leadership of Professor Hideo Yamashita of Tokyo University with the cooperation of Toshiba Corporation. This was called TAC, Tokyo University Automatic Computer, and is a Japanese vacuum tube computer. After much effort, the 7,000 vacuum tube machine was completed in 1959.

In 1949, Mr. Bunji Okazaki of Fuji Photo Film Co. began the development of FUJIC. Working almost alone, he completed it in 1956. This computer, used for the design of camera lenses, was the very first machine ever manufactured and put into practical use in Japan. It is exhibited at the Science Museum at Ueno in Tokyo. Mr. Okazaki later moved to NEC and participated in the development of computers.

Before FUJIC was developed, relay type mechanical calculators were studied by the Electro-Technical Laboratory of the Ministry of International Trade and Industry. The resulting ETL Mark I was completed in 1952, and the ETL Mark II, in 1955. The logic formulas adopted for the circuit designs for the ETL Mark I were based on the 1935 Nakashima-Hanzawa theory of switching systems. This research was similar to the 1938 theory of Dr. C. E. Shannon of Bell Telephone Laboratories which attracted worldwide attention in the scientific community. The Japanese theory, however, was not announced overseas.

The invention of the transistor in 1948 by Bell Laboratories was a big shock to us. However, NEC succeeded in the trial manufacture of point contact type transistors in 1953 and then the development of various semiconductor products progressed rapidly.

In 1954 the parametron was invented by Dr. Eiichi Gōto of Tokyo University. The parametron, a kind of solid circuit, was remarkably stable compared to conventional vacuum tubes and was far less expensive than transistors, which were expensive at that time. Because of these merits, the possibility of using this new element was eagerly discussed because it was an original invention from Japan.

The leading developers of the parametron were the faculty of Tokyo University, engineers at the Electrical Communication Laboratory of Nippon Telegraph and Telephone, and Kokusai Denshin Denwa Co., Japan's international telecommunications carrier. Under the guidance of Professor Hidetoshi Takahashi at Tokyo University, the PC-1 computer using parametrons was developed in 1958 and the PC-2 in 1960. At NTT Laboratory the MUSASHINO-1 started operation in 1957.

The late Professor Kenzo Jo of Osaka University was another computer pioneer. Under his guidance, research on an ENIAC type model was started in 1947 and completed in 1952.

**Computer Development at NEC** In the field of communications the parts which limted the performance of multiplex carrier transmission equipment were filters. The design of these filters was extremely difficult, and the method used was direct experimentation. In 1955 Dr. Hitoshi Watanabe conceived of a new filter design theory that required calculations beyond the capacity of existing computers. As a

sult, NEC decided to build a computer using the newly invented parametrons. In 1955, research and development was started on the NEAC-1101 followed by prototype manufacture in 1958. This first computer was used not only for the design of filters but also for the development of new technology and products. Figure 1 shows boards that are on display at The Computer Museum. Based on this technology, NEC developed the SENAC-1 jointly with Tohoku University, and named it the NEAC-1102. Later, NEC delivered the NEAC-1103 to the Defense Agency Research Laboratory.

With the success of the NEAC-1101, I determined that NEC would develop computers as a new business. This led to the introduction of small-size computers for business use, called the NEAC-1200 series.

**Transistor Computers** In 1954, Dr. Hiroshi Wada, director of the electronics department of the Electro-Technical Laboratory of the Ministry of International Trade and Industry, began developing computers using transistors. The ETL Mark III using point-contact transistors was completed in 1956, followed in 1957 by ETL Mark IV using junction-type transistors.

When I saw the ETL Mark IV, I immediately decided to commercialize it at NEC and introduced this computer one year later in 1958, thanks to energetic efforts of the company's engineers. This computer, the NEAC-2201, was exhibited at the Paris AUTOMATH in June 1959. Soon after that, the IBM 1401 was put on the market, and the age of the second generation of computers, which used transistors, began.

**Computer Systems** NEC further improved the NEAC-2201 by adding additional memory and input and output equipment to create an "electronic data processing system," the NEAC-2203. Programming efforts were greatly reduced by the early development of a compiler, named NARC. NEC proceeded with the development of complicated numerical calculation routines, such as programs for solving transportation problems, optimum path calculations, and linear programming. Through these experiences I came to fully realize the vital importance of software.

Japan's first on-line real-time seat reservation system, based on NEAC-2203 technology, was put into use at the Kinki Nippon Railways in 1960.

In 1967, NEC developed Japan's first time-sharing system using a large-scale NEAC-2200 model 500 as the main computer. This was the end result of a long process starting with the NEAC-2202, which could be shared by 7 terminals based on the time division principle. Understanding the value of timesharing, NEC followed MIT's project MAC closely and used it as a model. NEC also called it the MAC system. With the first delivery to Osaka University, NEC's computer business evolved from small-scale, to medium-scale, then to large-scale, and from off-line to on-line systems.

**Japan's Computer Development** Three unique features have channeled the direction of computer development in Japan.

First, Japan's commercial computer industry started with transistor machines jumping over the first generation of vacuum tube-based computers.

Second, Japan's computer industry grew from communications technology utilizing technology, components, and elements which were developed for communications equipment. Thus communications and computers have developed a technologically close relationship in such things as circuit designs, analog to digital conversion, and adoption of solid-state circuitry.

In contrast, most American and European computer manufacturers began as office equipment makers supplying such products as punch-card systems. In their development processes, they converted their machines to electronic systems, and became computer producers.

Third, the Japanese government exerted helpful efforts during the formative period of the electronics industry, promoting telecommunications, consumer electronics, computers, and semiconductor products.

Through the first half of the 1960's, single purpose machines were classified into scientific use and office use. Then the trend shifted to multipurpose computers for general use.

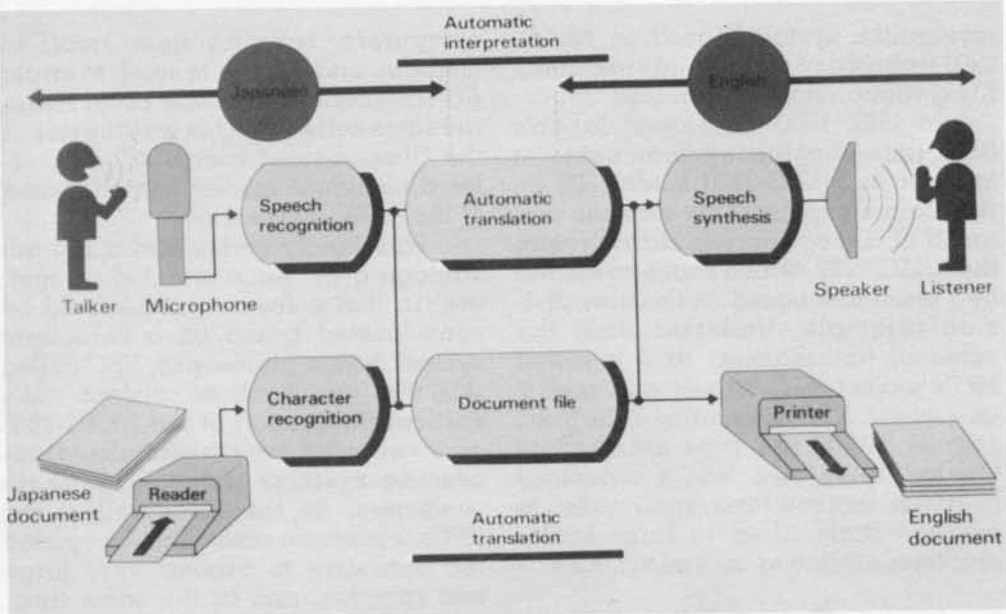
In the mid-1960's, along with the increase in processing volume and diversification of usage, the family series machines became dominant. Manufacturers provided various scales of computers, ranging from small to medium, and later from small to large. All members of a family could share the same software. This was the age of the "line-oriented computer." NEC offered numerous models with the name of the NEAC-2200 series.

This family series had a big advantage over "point-oriented computers" in that software assets could be consolidated based on a consistent system design philosophy. NEC called this the "one machine concept." The vertical integration of the NEAC-2200 series oriented itself to centralized processing systems using large-scale computers. By the latter half of the 1970's, excessive centralization caused the hardware to become very large and complex, and at the same time, made it inevitable that software too must become voluminous and complicated. As a result, system flexibility and reliability were reduced and a remarkable amount of manpower was required for maintenance.

A distributed processing system was conceived to overcome these problems by processing information at the site of its generation and usage. In place of single super large computer, a number of comparatively small-scale computers and intelligent terminals incorporating computer functions are integrated through communications lines. This offsets the demerits of vertical integration and makes systems more economical. The "area-oriented computer" has both vertical and horizontal integration.

Based on this concept, NEC developed "DINA", Distributed Information processing Network Architecture, the architecture that incorporates the knowledge and experience gained from NEC's original communications technologies.

**"C & C"** As computers approach communications, communications is beginning to approach computers. Communications equipment has become digitalized and communications services have developed from the simple transfer of information to higher level services including processing and storage of information. In 1977, succeeding the announcement of "DINA" in the previous year, NEC announced the NEAX-61, the first digital switching system for telephone offices. In that year, I announced the concept




*An Image of Automatic Interpretation Systems*

of the merger of computers and communications at the Atlanta INTELCOM 77. Then in 1978, at the third U.S.A.-Japan Computer Conference held in San Francisco, I announced this concept by using the phrase "C&C," which stands for the integration of computers and communications. Since then I have made "C&C" NEC's corporate identity.

From the technological viewpoint, "C&C" is the integration of computers and communications technologies. From the view point of "C&C"'s influence in social and economical world, it can be summarized in three points.

First, "C&C" can become an information-related infrastructure of worldwide scale.

Second, the constituent elements of this infrastructure will serve as valuable tools for solving various social problems, promoting economic and cultural development, and contributing to international mutual understanding.

Third, the effective use of information resources can overcome the limitations that restrict the optimum utilization of the world's natural resources.

**"Man and 'C & C'"** In the 1980's, "C&C" entered a new phase. The realizable ideal is that anyone, not just experts, can fully and easily utilize information systems in order to obtain a richer social and cultural life.

Human effort is facilitated by software. Due to the rapid increase in the amount of software required, a software crisis exists. "C&C" can only produce desirable benefits for humanity if software is produced efficiently.

**"'C & C' and the World"** The activities of AT&T and IBM show that the convergence of Computers and Communications is indeed the actual trend of the industry. AT&T, the world's largest telecommunications company, has entered the computer business. And IBM, the giant of the computer industry, is aggressively trying to enter the communications field.

Even now, the world's industrial map is in the process of being reorganized, centering around information and knowledge and equipment for handling them. NEC has been in the telecommunications business since its establishment over 86 years ago, and in the computer and semiconductor businesses for some 30 years. Because of this, NEC has been able to perceive and respond to major market shifts precisely.

**Automatic Interpretation Telephones** Throughout my 56 year career at NEC, I have believed it is my mission to create conditions by which anyone can talk to anyone else, at any place and any time. In the world today, mutual understanding between nations is terribly insufficient, and it can only be overcome through the unrestricted flow of information.

I have always thought that automatic interpreting telephone systems would be one of the keys to fully realizing "C&C." When this system is actualized, if the other party speaks to me in English, I can hear those words in Japanese, and vice versa, my words in Japanese will be conveyed to the other party in English.

If this automatic interpretation telephone system comes into wide use, it will not only make daily business extremely convenient, but it also will contribute greatly to the maintenance of world peace. Because of the development of tranportation and communications, people throughout the world have become able to communicate with each other at the grass roots level like never before in history. This means that people of one nation are coming to understand the ways of thinking and life styles of peoples of other nations. As a result, all the people of the world are beginning to recognize that they are all part of one humankind. If the barriers of language are removed by this automatic interpretation telephone system, communications and exchange at the grass roots level will further expand, and world peace may be realized.

# The Collection

## New acquisitions during the period June 15, 1984 to August 31, 1985

Prior acquisitions are listed in Computer Museum Report numbers 1,5 and 10

### Computers

Amdahl Corporation,
Amdahl 470V/6 Computing System, (X436.84)
*Gift of Major Computer, Inc.*

Apollo Computer, Inc.,
Apollo DN100 Workstations, 2 nodes, (X533.84)
*Gift of Apollo Computer, Inc.*

Apollo Computer, Inc.,
Apollo Domain DN300-1MB Workstation, (X424.84 (A-D))
*Gift of Apollo Computer, Inc.*

Apple Computer, Inc.,
Apple II Plus Computer, (X539.84)
*Gift of Katherine Schwartz*

Apple Computer, Inc.,
Apple Lisa, (X496.84) (X497.84) (X498.84)
*Gift of Apple Computer, Inc.*

Apple Computer, Inc.,
Apple Macintosh, (X499.84) (X500.84) (X501.84)
*Gift of Apple Computer, Inc.*

Autographix, Inc.,
Autographix 200 System, (X590.85)
*Gift of Autographix, Inc.*

Commodore Business Machines, Inc.,
Commodore 64 Personal Computer, (X366.84 (A-E))
*Gift of Commodore Business Machines, Inc.*

Commodore Business Machines, Inc.,
Commodore PET 2001 Personal Computer, (X364.84)
*Gift of Commodore Business Machines, Inc.*

Commodore Business Machines, Inc.,
Commodore PET 2001 Personal Computer, (X445.84)
*Gift of Microsoft Corporation*

Commodore Business Machines, Inc.,
Commodore VIC-20 Computer, (X367.84)
*Gift of Commodore Business Machines, Inc.*

Compaq Computer Corporation,
Compaq DeskPro Computer, (X481.84) (X482.84) (X483.84)
*Gift of Compaq Computer Corporation*

Compaq Computer Corporation,
Compaq Portable Computer, (X484.84) (X485.84) (X486.84)
*Gift of Compaq Computer Corporation*

Computer Controls Corporation,
DDP-116 General Purpose Computer, (X578.85)
*Gift of Boudreau Computer Services, Ltd.*

Computer Products Corporation,
CP 10/50 General Purpose Analog Computer, (X552.85)
*Gift of Per A. Holst*

Control Data Corporation,
Little Character, (X437.84)
*Loan from Control Data Corporation*

Data General Corporation,
Data General Desktop Model 10, (X479.84) (X480.84)
*Gift of Data General Corporation*

Data General Corporation,
Data General Eclipse, (X502.84)
*Gift of Data General Corporation*

Digital Equipment Corporation,
Digital PRO 350 Computer, (X435.84)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation,
Rainbow, (X478.84); Rainbow 100, (X477.84); Rainbow 100+, (X476.84)
*Gift of Digital Equipment Corporation*

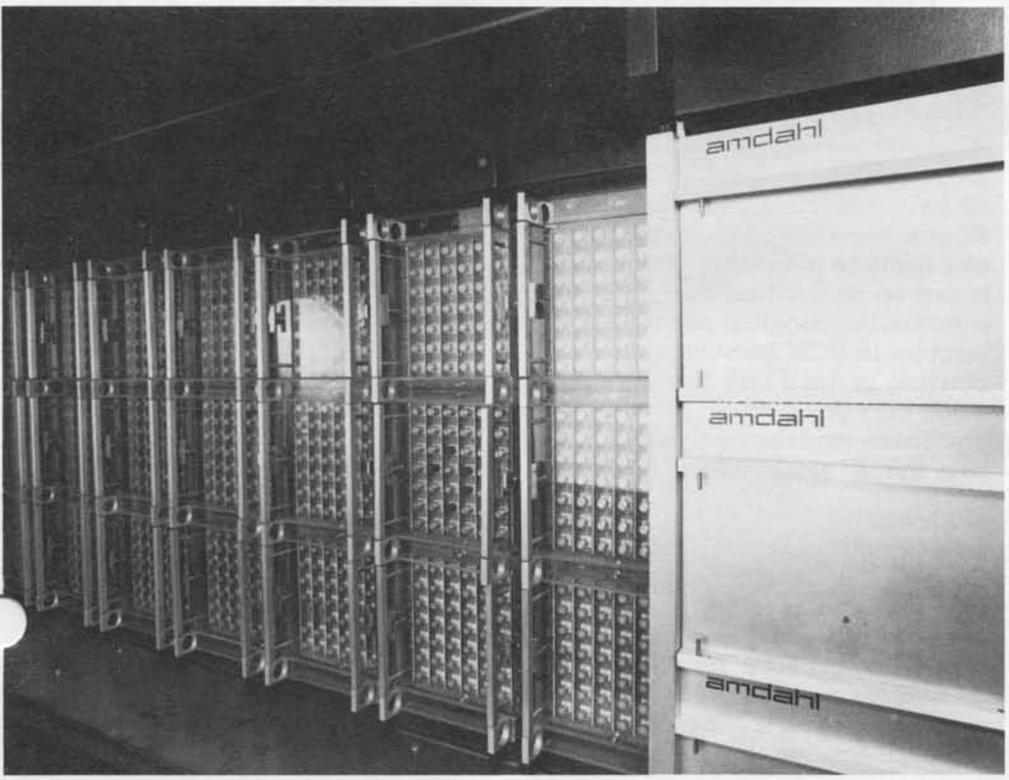
Digital Group, The,
Digital Group System 2, 26K Computer, (X555.85)
*Gift of St. George's School, Newport RI*

Evans and Sutherland Computer Corporation,
Evans and Sutherland Line Drawing System 2, (X540.84)
*Gift of Case Western University*

Gould, Inc.,
Gould 32/55 Computer System, (X529.84); Gould 8600 II Computer System, (X528.84)
*Gift of Gould, Inc.*

Hewlett-Packard Company,
HP150 Personal Computer, (X432.84) (X433.84) (X435.84)
*Gift of Hewlett-Packard Company*

Honeywell, Computer Control Division,
Honeywell H316 General Purpose Digital Computer [Kitchen Computer], (X579.85)
*Gift of Boudreau Computer Services, Ltd.*




**Amdahl 470V/6, by Amdahl Corporation, 1975.** In 1975 Gene Amdahl, a major contributor to the design of the IBM System 360, announced his own company's first computer, the 470V/6. Amdahl's strategy was to produce computers which would out-perform IBM's top systems, but be completely compatible with them. In this the V/6 was successful, competing with the IBM 370/165 and 168. While selling for approximately the same amount ($4 million), the V/6 was rated at 3.6 million instructions per second with memory expandable up to 16 megabytes, making it almost twice as powerful as the 370/168.

The Museum's machine is serial number 2, the second machine produced by the Amdahl Corporation. Originally installed at the University of Michigan, the unit was later bought by American Cyanamid of New Jersey, and then by Major Computer, Inc.

*Donated by Major Computer Inc., Minnetonka, Minnesota*

IBM,
IBM Personal Computer XT,
(X430.84) (X431.84) (X562.85)
*Loan from IBM*

IMSAI Manufacturing Corporation,
IMSAI 8080 Microcomputer System,
(X589.85)
*Loan from Mike Miller*

Kaypro Corporation,
Kaypro 10 Computer, (X487.84)
*Gift of Kaypro Corporation*

MASSCOMP, Inc.,
MASSCOMP MC-500 Computer,
(X515.84)
*Gift of MASSCOMP, Inc.*

Microdata Corporation,
Microdata EXPRESS Computer
Prototype, (X377.84 (A-D))
*Gift of Ing. C. Olivetti C. S.p. A.*

MOS Technology, Inc.,
KIM-1 Microcomputer, (X365.84)
*Gift of Commodore Business Machines, Inc.*

National Cash Register Company,
NCR 399 Computer, (X451.84)
*Gift of Bay State York Company*

National Semiconductor Corporation,
SC/MP Development System
Mother Board, (X386.84); SC/MP
Development System Mother Board
mounted on box, (X383.84)
*Gift of National Semiconductor Corporation*

NEC Corporation,
NEC APC III Personal Computer,
(X494.84) (X495.84)
*Gift of NEC Systems Laboratory*

NEC Corporation,
NEC PC-8000 Computer, (X446.84)
*Gift of Microsoft Corporation*

NEC Corporation,
NEC TK-80, (X447.84)
*Gift of Microsoft Corporation*

Osborne Computer Corporation,
Osborne 1 Computer,
(X362.84) (X363.84)
*Gift of Osborne Computer Corporation*

Packard-Bell Company,
Packard-Bell 250 Computer,
(X463.84)
*Gift of Dr. Claude Kagan*

Philips Business Systems,
Philips P359 Computer, (X594.85)
*Gift of New England Provision Company*

Polymorphic Systems,
Polymorphic System 8813
Computer, (X614.85)
*Gift of Robert and Margaret Wesley*

SCELBI Computer Consulting, Inc.,
SCELBI-8H Mini-computer,
(X574.85)
*Gift of Carlton B. Hensley*

Sinclair Research Limited,
Sinclair ZX80 Personal Computer,
(X513.84); Sinclair ZX81 Personal
Computer, (X514.84)
*Gift of Sinclair Research Limited*

Spiras Systems, Inc.,
Spiras-65 Computer, (X549.85)
*Gift of Dartmouth College Radiophysics Laboratory*

Sutherland, James,
ECHO IV Home Computer,
(X509.84)
*Gift of James Sutherland*

Univac Division, Sperry Rand Corporation,
Univac Phoenix Computer,
(X563.85)
*Gift of Herbert Teager*

Wang Laboratories,
Wang 2200 System, (X602.85)
*Gift of Martin Levine*

Wang Laboratories,
Wang PIC (Professional Image
Computer) System, (X566.85)
*Gift of Wang Laboratories*

**Scelbi 8H, by Scelbi Computer Consulting Inc., 1974.** The Scelbi 8H (pronounced Sel-bee) was the first commercially-advertised computer based on a microprocessor. The first advertisement for the Scelbi appeared in March 1974, seven months before the debut of the Altair in January 1975. Nat Wadsworth, the Scelbi's chief designer, thought the computer would be used in scientific, electronic, and biological applications; hence, the abbreviated name Scelbi.

Designed for the hobbyist, the Scelbi 8H was based on the Intel 8008 microprocessor and was available both in kit form and fully assembled. It had 4K of internal memory, cassette tape and teletype interfaces, and a CRT based on an oscilloscope. Later on a combination monitor, editor, and assembler in ROM became available. Starting in April 1975, the company made versions with up to 16K of memory. These models were called Scelbi 8B's, the "B" standing for "business."

Wadsworth, an engineer for General DataComm Industries of Danbury, Connecticut, became interested in the idea of a small computer for personal use after attending a seminar given by Intel on the 8008. He and several co-workers decided to build such a computer and in 1973 he left his job to work full-time on the computer. Scelbi Computer Consulting, Inc. of Milford, Connecticut was incorporated in August of that year. The development of the computer suffered a severe setback when Wadsworth suffered a heart attack in November 1973. The company persisted, however, and announced their product in April 1974. The 8H was first advertised in the ham radio magazine *QST* because Wadsworth realized that many amateur radio hobbyists were "dyed-in-the-wool electronic enthusiasts." Just as orders started to roll in, Wadsworth had a second heart attack. In all, Scelbi Computer Consulting sold roughly 200 computers, losing $500 per unit.

From his hospital bed Wadsworth wrote a book to accompany the Scelbi 8H, *Machine Language Programming for the 8008*. The company published the book by offset printing a teletype output. The book was a hit; thousands were ordered. This success prompted Scelbi to concentrate on software for 8008- and 8080-based computers, such as the Altair. This shift in emphasis ultimately made the the company a profitable concern, but meant the early demise of the Scelbi 8's.

*Donated by Carlton B. Hensley*

[Based on "The Early Days of Personal Computer," by Stephen B. Gray in *Creative Computing*, November 1984.]

## Subassemblies and Components

Burroughs Corporation,
Electrodata division,
Burroughs 205 Modules, (X524.84);
Burroughs 205 Magtape Hybrid
Read Amplifier Modules, (X525.84)
*Gift of James Williams*

Computer Image Corporation,
Scanimate Video/Pulse Distribution
Amplifier Module, (X401.84)
*Gift of Peter Sorensen*

Control Data Corporation,
CDC 6600 "Cordwood" Module,
(X402.84)
*Gift of Control Data Corporation*

Cray Research, Inc.,
Slice of Cray I, (X438.84)
*Gift of Cray Research, Inc.*

Digital Communications
Associates, Inc.,
IRMA board: First coaxial cable
interface for micro-to-mainframe
communications, (X580.85)
*Loan from Dr. W. Waverly Graham, III, Digital Communications Associates, Inc.*

Digital Equipment Corporation,
MicroVax II: Central processor and
floating point integrated circuits,
mounted and unmounted, (X581.85)
*Gift of Digital Equipment Corporation*

Eckert-Mauchly Computer
Corporation,
Univac I Arithmetic Unit, (X491.84)
*Loan from the Smithsonian Institute, National Museum of American History*

Harris Semiconductor,
Harris 6120 Microprocessor
(PDP-8 on a chip), (X439.84)
*Gift of John Clarke*

IBM,
IBM 360/30 Console, (X461.84)
*Loan from IBM*

Minneapolis Honeywell Regulator
Company, DATAmatic Division,
Datamatic 1000 module, (X597.85)
*Gift of Alvin Landsman*

National Semiconductor
Corporation,
SC/MP CPU Boards, (X384.85)
(X385.84) (X388.84) (X389.84);
IMP-16C CPU Board, (X380.84);
IMP-8C CPU Board, (X379.84);
DP8350 Chip mounted in Carrier,
(X397.84); PACE CPU Board,
(X390.84); PACE Application CPU
Card, (X391.84); SO2321 Wafer,
(X393.84); SO3001 Wafer, (X395.84);
SO1603 Wafer, (X394.84); DP8350
Wafer, (X396.84)
*Gift of National Semiconductor Corporation*

NEC Corporation,
NEAC-1101 Parametron subunit,
(X417.84); NEAC-2203 Gate
Package, (X415.84); NEAC-2203
Dynamic Flip-Flop Package,
(X414.84)
*Gift of NEC Corporation*

Philbrick Researches Inc.,
George A.,
Vacuum Tube OP Amplifier
(model K2-W), (X375.84)
*Gift of Michael Callahan*

Potter Instrument Company, Inc.,
Potter Tape Control Unit logic
cards, (X545.85 (A-C))
*Gift of Keith Gobeski*

Remington Rand Corporation,
LARC Power Supply Regulator
Module, (X455.84); LARC Servo
Thyratron, (X456.84)
*Loan from Lawrence Livermore National Laboratory*

Texas Instruments, Inc.,
Texas Instruments Microminature
Computer integrated circuits,
(X464.84)
*Gift of Texas Instruments, Inc.*


**Sinclair ZX80 and ZX81, by Sinclair Research Ltd, 1980.** Sinclair Research Limited, founded by Sir Clive Sinclair, announced the ZX80 in February of 1980. Based on the Zilog Z80A microprocessor it had an internal RAM of 1K. A 4K integer version of BASIC was also available in ROM. The machine used a membrane keyboard for input and a domestic TV as its display device. Programs and data could be stored on standard cassette tapes.

The ZX80 sold for under 100 pounds in the UK, $199 in the US—a major price break-through. This compared to about $500 for the TRS-80 and about $1100 for an Apple II with 16k of RAM. Manufacturing cost was kept low by use of the membrane keyboard and the single board design, in which all the circuitry including memory, ROM, CPU, a total of 22 chips were mounted on just one printed circuit board.

The ZX81, also introduced in late 1980, had only 5 chips including the ROM, microprocessor, two 512 byte RAM's and the uncommitted logic array (ULA). The use of the largely untried ULA's (also known as gate-arrays) was a novel and bold move. The ULA performed all the functions not carried out by the processor, RAM or ROM, earning it the nickname "dogsbody." It replaced nearly 20 of the ZX80's chips. The ROM had a floating point Basic and, in contrast to the ZX80, the ZX81 could maintain a display on the screen while the processor was performing another task. This made animation possible, a major factor for game-playing users. In 1981 a 16k RAM became available for the ZX81 for just under $100.

At the end of 1981, Timex took over the US marketing of Sinclair's machines. The ZX81 was renamed Timex/Sinclair 1000 and sold for $99.95.

These models brought the computer well within the mass retail consumer market for the first time. Hundreds of thousands of ZX80's and ZX81's were sold–more than any other computer at the time.

*Donated by Sinclair Research Limited of Boston.*

## Memories

AT&T Bell Laboratories,
AT&T 1K & 4K RAM wafer and chips, (X577.85)
*Loan from AT&T Bell Laboratories*

AT&T Technology, Inc.,
AT&T 256K wafer, (X467.84); AT&T 64K RAM chip, (X468.84)
*Gift of AT&T Technology, Inc.*

Commodore Business Machines, Inc.,
Commodore 1541 Disk Drive, (X425.84)
*Gift of Commodore Business Machines, Inc.*

Data Disc, Inc.,
Data Disc 7200 Series Disc Memory, (X449.84)
*Gift of Houghton Mifflin Company, TSC Division*

Digital Equipment Corporation,
DECTAPE, (X601.85)
*Gift of Ivan E. Sutherland*

Digital Equipment Corporation,
Digital Core Memory Stack, (X470.84)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation
Reader Head from 25,000th Winchester Disk Drive, (X404.84)
*Gift of Digital Equipment Corporation, Colorado Springs*

Fabri-tek, Inc.,
Core Memory Stack (36-bit) from MA10 Memory used on KA10, (X452.84)
*Gift of University of Queensland, Australia*

Hewlett-Packard Company,
HP 9100A ROM layer pre-chip, (X471.84)
*Gift of Hewlett-Packard Company*

Hitachi, Ltd.,
Hitachi 256K DRAM (unpacked chip package), (X569.85)
*Gift of Hitachi America*

Honeywell Information Systems,
Honeywell Model 58 miscellaneous circuit boards, Read-Only-Memory and Magnetic Core Memory, (X598.85)
*Gift of Thermo Electron Corporation*

IBM,
IBM 64K-bit RAM chips, unmounted and w/mounting double layer package, (X543.85)
*Gift of IBM*

IBM,
IBM 729 Tape Drive, (X460.84)
*Loan from IBM*

IBM,
IBM System 3 96-column punched cards, (X428.84)
*Gift of Allied Plywood Corporation*

Intel Corporation,
Intel chip collection, (X462.84)
*Gift of Intel Corporation*

MIT,
Whirlwind Electrostatic Storage Tube, (X412.84)
*Loan from Robert R. Everett*

Mostek, Inc.,
Mostek 4096 2-inch wafer, (X582.85)
*Gift of Mostek, Inc.*

Mostek, Inc.,
Mostek 4K memory chips, (X561.85)
*Gift of Mostek, Carrolton, TX*

Mostek, Inc.,
Mostek MK4096 masks, rubylith, and MK4096 wafer, (X444.84)
*Gift of Howard Sussman*

National Semiconductor Corporation,
PACE memory card, (X392.84); SC/MP memory board, (X387.84); IMP memory board, 16 bit, (X382.84); IMP-16L memory board, (X381.84)
*Gift of National Semiconductor Corporation*

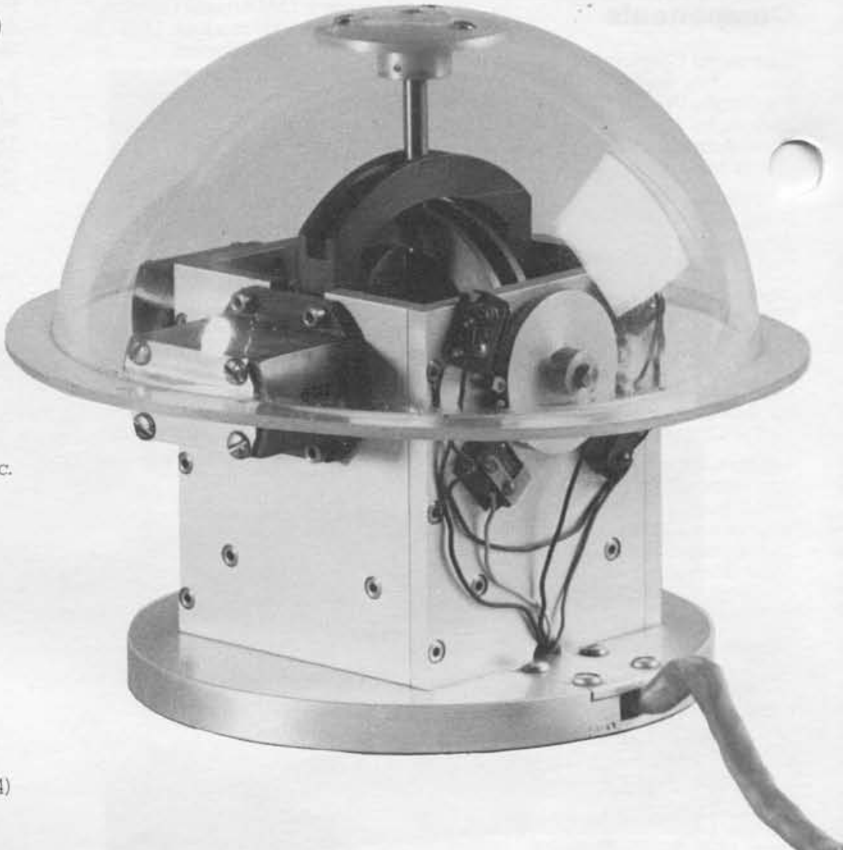
NEC Corporation,
NEC 64K & 256K DRAM chips, unmounted and mounting pins, (X583.85)
*Gift of NEC Information Systems, Inc.*

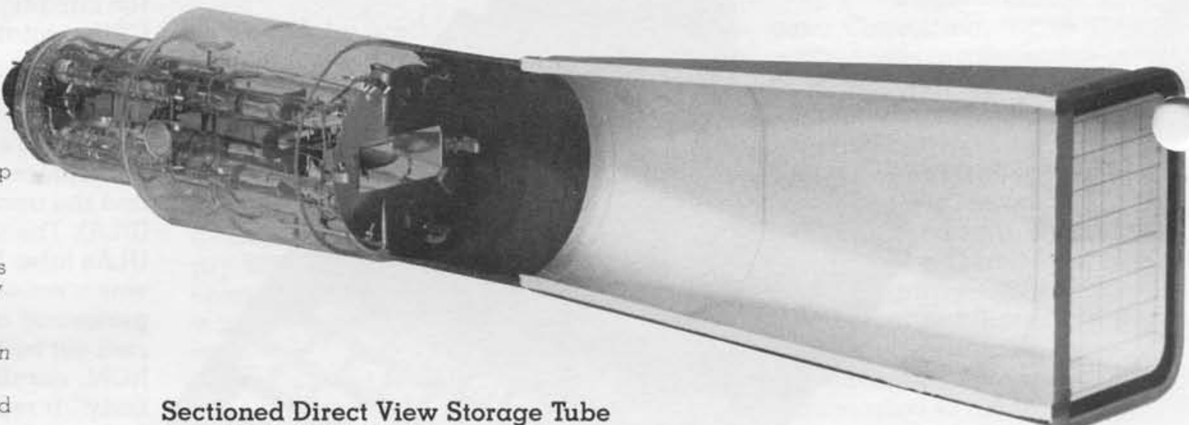
Nixdorf Computer Corporation,
Nixdorf 820/23 Rod Cell Memory Board, (hardwired insurance program), (X613.85)
*Gift of Richard S. Beers*

Tektronix, Inc.,
Tektronix 564 storage tube cross section, (X411.84)
*Gift of Tektronix, Inc.*

**Sub-Category: Pre-computing or Non-Computer Related Memories**

Valenta, Jerry & Sons, Inc.,
Jacquard Punched Cards, (X519.84)
*Gift of Jerry Valenta & Sons, Inc.*





**Sectioned Direct View Storage Tube from Model 564 Oscilloscope by Tektronix Inc., 1962.** The direct view storage tube (DVST) was invented by Robert H. Anderson in the late 1950's. First introduced in the Tektronix model 564 oscilloscope, it enabled the display of transient electrical signals. It was soon realised that DVST's could be used as display terminals with computers, and by 1969 Computer Displays Inc., Computek Inc. and Tektronix Inc. were all selling DVST terminals based on Tektronix tubes.

The key feature of the DVST is its ability to store a vector image without the need for constant refreshing. This brought down the price of computer graphic displays from, say $80,000 for the IBM 2250, to under $10,000, causing a vast expansion in the availability and use of computer graphics.

A DVST contains a writing gun, flood guns and a phosphor storage screen. The storage screen has an outer transparent conducting layer and an inner phosphor layer. When the write gun's beam is switched on it creates a postive charge where it strikes the phosphor as a result of secondary electron emission. This attracts the electrons from the flood guns which are on continuously, and causes the areas struck by the write gun's beam to luminesce without the need for refresh. The screen is erased by making the whole target more positive, effectively writing the whole screen and then lowering the potential, erasing the screen.

*Donated by Tektronix Inc., Beaverton, Oregon*

**Crystal Globe, MIT Electronic Systems Laboratory, 1963.** In 1964 researchers at MIT's Electronic Systems Laboratory (ESL) first demonstrated a system capable of online graphical input and output to a computer. They used a modified DEC 330 scope connected under the Project MAC Compatible Time-Sharing System to an IBM 7094. The goal was to improve man-machine interaction to the point where computer-aided design became feasible. A key development was the devising of 'natural' methods of input to the computer; the crystal globe epitomises this effort.

"... since individual knobs are inconvenient when two or more actions must be coordinated, such as rotating about more than one axis simultaneously, a three-dimensional input device has been devised. This unit, called the 'globe', has spring-loaded limited rotation about three mutually perpendicular axes. Each axis has a simple cam and microswitch encoder, with three discrete codes each side of neutral. The globe is used as a three-step rate control, with the rate scaling entirely under program control. [The globe is] read only by the computer, and [has] no wired console function. Programmed interpretation of [the globe] . . . gives maximum flexibility at the cost of a very small amount of computer time."

John Ward, project member,
1966 AFCEA Convention

*On loan from John Ward, MIT*

## Transducers

Adage, Inc.,
Adage 3006 Display Processor, (X504.84)
*Gift of Adage, Inc.*

ALTEK Corporation,
APACHE Digitizing Cursor Prototype, (X454.84)
*Gift of ALTEK Corporation*

Bolt Beranek and Newman, Inc.,
Grafacon 1010A Digitizing Tablet, (X550.85)
*Gift of Dartmouth College Radiophysics Laboratory*

California Computer Products, Inc.,
Calcomp Model 560R Drum Plotter, (X565.85)
*Gift of Herbert Teager*

Control Data Corporation,
Plato Terminal, (X458.84)
*Loan from Control Data Corporation*

Dataproducts Corporation,
Dataproducts Matrix Printer, Model M100, (X537.84); Dataproducts BP-1500 Band Printer, (X505.84)
*Gift of Dataproducts Corporation*

Digital Equipment Corporation,
Dectalk, (X472.84) (X473.84) (X474.84) (X475.84)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation,
GIGI, (X541.85)
*Gift of Digital Equipment Corporation*

Grinnell Systems Corporation,
Grinnell GMR 27-20 Display System, (X508.84)
*Gift of Grinnell Systems Corporation*

Hewlett-Packard Company,
Hewlett-Packard 7586B pen plotter, (X503.84)
*Gift of Hewlett-Packard Company*

IBM,
IBM Model 016 Keypunch, (X595.85)
*Gift of Greydon Carl Freeman*

IBM,
IBM Plasma Display, (X493.84)
*Loan from IBM*

Lexidata, Inc.,
Lexidata LEX 90/35 graphics display system, (X510.85)
*Gift of Lexidata, Inc.*

Micro Control Systems, Inc.
Space Tablet, (X512.84)
*Gift of Micro Control Systems, Inc.*

MIT Electronic Systems Laboratory,
Crystal Ball from ESL Display Console, (X405.84)
*Loan from John E. Ward*

MIT Electronic Systems Laboratory,
Focusing Light Pen from ESL Display Console, (X406.84)
*Loan from John E. Ward*

Pencept, Inc.,
Penpad Tablet, (X488.84)
*Gift of Pencept, Inc.*

Polaroid Corporation,
Polaroid Video Printer, Model 8, (X593.85)
*Gift of Polaroid Corporation*

Rand Corporation,
Stylus for the Rand Tablet, (X413.84 A-B); Rand Graphic Input Tablet, (X450.84)
*Gift of Rand Corporation*

Rand Corporation,
Rand Graphic Input Tablet and Stylus, (X564.85)
*Gift of Herbert Teager*

Rand Corporation,
Rand Tablet Mesh of Copper Wire, (X544.85)
*Gift of Ivan E. Sutherland*

Remington Rand Corporation,
Univac I Unityper, (X490.84)
*Loan from the Smithsonian Institute, National Museum of American History*

Scriptel Corporation,
Scriptel Transparent Digitizing Tablet, (X506.84)
*Gift of Scriptel Corporation*

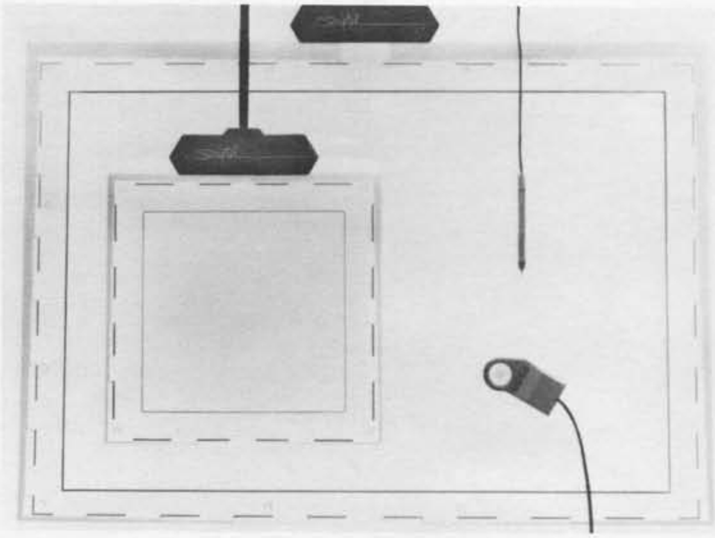
Summagraphics Corporation,
BitPad One, (X511.84)
*Gift of Summagraphics Corporation*

Tektronix, Inc.,
Oscilloscope Type 564B, (X410.84); Tektronix 4115B Terminal, (X459.84)
*Gift of Tektronix, Inc.*

Teletype Corporation,
Teletype Model 35, ASR, (X368.84); Teletype, (X369.84) (X370.84); Teletype 15AA Typing Unit w/ Stand, (X372.84); Teletype Transmitter/Distributor, (X373.84 A-B)
*Gift of Matthew Reilley*

Teletype Corporation,
Teletype ASR 33 w/ stand, (X448.84)
*Gift of Houghton Mifflin Company, TSC Division*

Teletype Corporation,
Teletype Model 33, (X429.84)
*Gift of Michael Tardiff and Stephen Russell*



**Transparent Digitizing Tablet, by Scriptel Corporation, 1984.** A transparent tablet allows original artwork or photographs to be placed underneath the tablet—protected from scratching or staining. The tablet can be mounted onto a flat display screen enabling video images to be digitized. With a frosted glass finish, a slide could be back-projected onto the tablet for digitizing. A major application is the digitization of medical images, particularly X-rays.

The rear of the glass tablet is coated with a continuous layer of resistive material, indium tin oxide. One edge of the tablet is grounded while an AC voltage is applied to the opposite edge. The puck contains a receiver which produces a signal through capacitative coupling when placed on the tablet. The strength of the signal yields the coordinate along one axis which is checked by reversing the grounded and live edges. The process is repeated for the complementary pair of edges, yielding the second coordinate. 150 coordinate pair measurements are made per second.

*Donated by Scriptel Corporation, Columbus, Ohio*

Teletype Corportion,
Teletype Model 5, (X567.85)
*Gift of Stephen Dum*

Unknown,
Keyboard from unidentified machine, (X609.85)
*Gift of Gordon and Gwen Bell*

Visual Technology, Inc.,
Visual 550 Monitor, (X489.84)
*Loan from Visual Technology, Inc.*

Wright Line, Inc., The,
Wright Portable Punch, Model 2600, (X584.85)
*Gift of Allan Sadoski*

## Calculators

Commodore Business Machines, Inc.,
Commodore 500E Calculator, (X554.85)
*Gift of Baynes Electric Supply Company*

Comptometer Corporation,
Comptometer, (X465.84)
*Gift of Gordon and Gwen Bell*

Faber-Castell Company,
CASTELL-Addiator DRP Slide Rule, (X361.84)
*Gift of Joseph Santangelo*

FUN Incorporated,
Hokey's Secret Code Maker and Decoder, (X588.85)
*Gift of Edward Dillon*

Friden Corporation,
Friden Model 132 Calculator, (XB23.78)
*Gift of Gordon and Gwen Bell*

IBM,
IBM 632 Electronic Typing Calculator, (X571.85)
*Loan from Joseph Keller*

IBM,
IBM Hexadecimal Adder, (X557.85)
*Gift of Fred Macchio*

IBM,
IBM Machine Load "Computer" Slide Rule, (X612.85)
*Gift of Richard S. Beers*

IBM,
IBM Non-Listing Tabulator, (X591.85)
*Gift of Mr. and Mrs. William Dobratz*

Keuffel & Esser Company,
Log Log Duplex Slide Rule, (X360.84)
*Gift of Joseph Santangelo*

Layton, C & E,
Tates Arithmometer, (X559.85)
*Gift of Mrs. David G. Stone*

Marchant Calculating Machine Company,
Marchant Calculator, (X399.84)
*Gift of Dick Rubinstein*

Monroe Calculating Machine Company,
Mechanical Calculating Machine, by Monroe, black with keys of varying height, (X592.85)
*Gift of Warren J. Buck and Arthur Milinowski*

Monroe Calculating Machine Company,
Monroe 326 Scientist, (X547.85)
*Gift of Henry C. Thacher and University of Kentucky*

Monroe Calculating Machine Company,
Monroe #1 Adding Machine, (XB90.79)
*Gift of Gordon and Gwen Bell*

Odhner,
Original Odhner Calculator, (XB135.80)
*Gift of Gordon and Gwen Bell*

Odhner,
Original Odhner Calculator, (X546.85)
*Gift of Henry C. Thacher and University of Kentucky*

Olivetti, Inc.,
Olivetti Summa Quanta 20 Calculator, (XB86.79)
*Gift of Gordon and Gwen Bell*

Science Spectrum, Inc.,
Hexadecimal-Decimal Slide Rule Calculator, (X586.85);
Octal-Decimal Slide Rule Calculator, (X585.85)
*Gift of Edward Dillon*

Sharp Corporation,
Elsi MATE El-8048 Electronic Calculator Soroban 1, (X538.84)
*Anonymous Gift*

Sinclair Radionics Limited,
Sinclair Cambridge Memory Calculator, (X359.84)
*Loan from Jeremy Barker*

Sumlock Anita Electronics Ltd.,
Anita 1000 LSI, (X553.85)
*Gift of Brian Randell*

Unknown,
Circular Slide Rule, (X587.85)
*Gift of Edward Dillon*

Unknown,
Resulta-9 calculator, (X536.84);
Resulta-BS7 calculator, (X535.84)
*Gift of Lou Goodman*

Von Reppert, R.,
Von Reppert Calculating Machine, (X568.85)
*Gift of Erwin J. and Richard W. Reppert*

Walker, R.H.,
Addist, The, (X523.84)
*Gift of Ernst Halberstadt*

Wang Laboratories,
Wang 320SE Calculator, (X576.85)
*Gift of Kirtland Olsen*

Wang Laboratories,
Wang 370 Programmable Calculator, (X575.85)
*Gift of Lorraine Olsen*

Wang Laboratories,
Wang LOCI-2, (X520.84)
*Loan from Wang Laboratories*

Webb, C.H.,
Webb Adder, The, (X522.84)
*Gift of Ernst Halberstadt*


**Prototype Von Reppert Calculating Machine.** This artifact is truly one of a kind. It is a prototype of a calculating machine built by its inventor Richard von Reppert. Patented in 1918, the von Reppert calculator could perform "the four fundamental calculations, addition, subtraction, multiplication, and division, as well as other useful commercial work, in a practical manner." Von Reppert sold this and several other patents relating to mechanical office machines to the Underwood Company in 1920.

Over the course of his career von Reppert received over 40 patents either in conjunction with others or on his own. These include two patents issued by the German and French governments, and 8 for floating point arithmetic mechanisms for mechanical calculators. In addition to being a solo inventor, von Reppert also worked for the Underwood Company and IBM for many years.

*Donated by Erwin J. and Richard W. Reppert*

## Miscellaneous Artifacts

Advance Watch Company,
Mini "Put Up" LCD Digital Clocks, (X443.84 A-B)
*Gift of J. Carberry*

[Be]nton, Stephen,
[H]ologram Generated by Computer, (X516.84)
*Gift of Stephen Benton*

Boeing Commercial Airplane Company,
Carrier Wing Fitting Assembly–Off Wing Escape Slide System: computerized engineering model used on Boeing 757, (X409.84); Horizontal Tail–H5 from Boeing wind tunnel model, (X407.84); Splice Rib–Wing Tip: computerized engineering model used on Boeing 727, (X408.84)
*Gift of Boeing Commercial Airplane Company*

Celestron Associates, Inc.,
Fortran Infograph, (X556.85)
*Gift of J.A.N. Lee*

Cummins Corporation,
Cummins Carditioner, (X400.84)
*Gift of Dick Rubinstein*

Data General Corporation,
Data General Manufacture Exhibit Collection, (X466.84)
*Gift of Data General Corporation*

Digital Equipment Corporation,
Glass Plates: Artwork for Agate or VaxStation 300 PC board, (X548.85)
*Gift of Digital Equipment Corporation*

Digital Equipment Corporation,
Micro T11 plot on mylar, (X603.85); Micro T11 silicon wafers, (X604.85); [Mi]cro T11 Engineering masks [–] metal layer interconnect, [p]olysilicon layer and diffusion layer, (X606.85)
*Gift of Digital Equipment Corporation,*

Duckworth, Dr. Gregory,
IC clock (3 boards), (X441.84); IC clock (1 board), (X442.84)
*Loan from Dr. Gregory Duckworth*

Dutton, Geoffery,
Hologram: Computer Animated Population Density Map, (X517.84)
*Loan from Geoffrey Dutton*

Honeywell, Inc.,
Sculptures composed of electronic components: Buffalo, Fish, Dragon, Grasshopper, Fox, and Rider on Horseback, (X573.85)
*Loan from Honeywell Information Systems, Inc.*

IBM,
IBM 1403 Printer Control Tape Rack, (X608.85)
*Gift of American Computer Group*

IBM,
IBM Book of General Purpose Card Samples, (X611.85); Paperweight containing IBM transistor & 4 varying size ferrite cores encased in clear lucite, (X610.85)
*Gift of Richard S. Beers*

Lester Associates, Inc.,
Univac I Model, (X492.84)
*Loan from the Smithsonian [In]stitute, National Museum of [A]merican History*

Lockheed-Georgia Company,
Rudder Control Wheel of C141A Transport Aircraft, (X542.85)
*Gift of Lockheed-Georgia Company*

Melitta,
Teapot used for computer graphics rendering, (X398.84)
*Gift of Martin Newell*

National Cash Register Company,
Flow Chart Template and Cards used to program NCR390, (X469.84)
*Gift of Antonia Oliver*

NEC Corporation,
Keychain containing 1 Megabyte NEC DRAM mounted & unmounted, (X551.85)
*Gift of Howard Sussman and NEC Electronics, Inc.*

Nike, Inc.,
Molds for casting rubber sole, rubber soles and Nike Air running shoes, (X530.84)
*Gift of Nike, Inc.*

Nolan, Jack,
Lunar Scan Reflectivity Model, (X596.85)
*Loan from Jack Nolan*

Ohio Art, Inc.,
Etch-A-Sketch Screen, (X453.84)

Reeves and Sons, London,
Drawing Instrument Set of John Heard, (X457.84)
*Loan of MIT Museum*

Resch, Ron,
Computer Art: "Van Leer Model," (X532.84); Computer Art: White folded paper screen, (X420.84); Computer Art: "Folded Triform," (X422.84); Computer Art: "Double Yellow," (X421.84); Computer Art: White folded paper screen, (X419.84); Computer Art: White folded paper screen, (X418.84); Computer Art: "Folded Screen of blue wool," (X423.84); Computer Art: "Folded Metal Bird," (X531.84)
*Loan from Ron Resch*

Strangio, Christopher,
Transistor digital clock, (X440.84)
*Loan from Christopher Strangio*

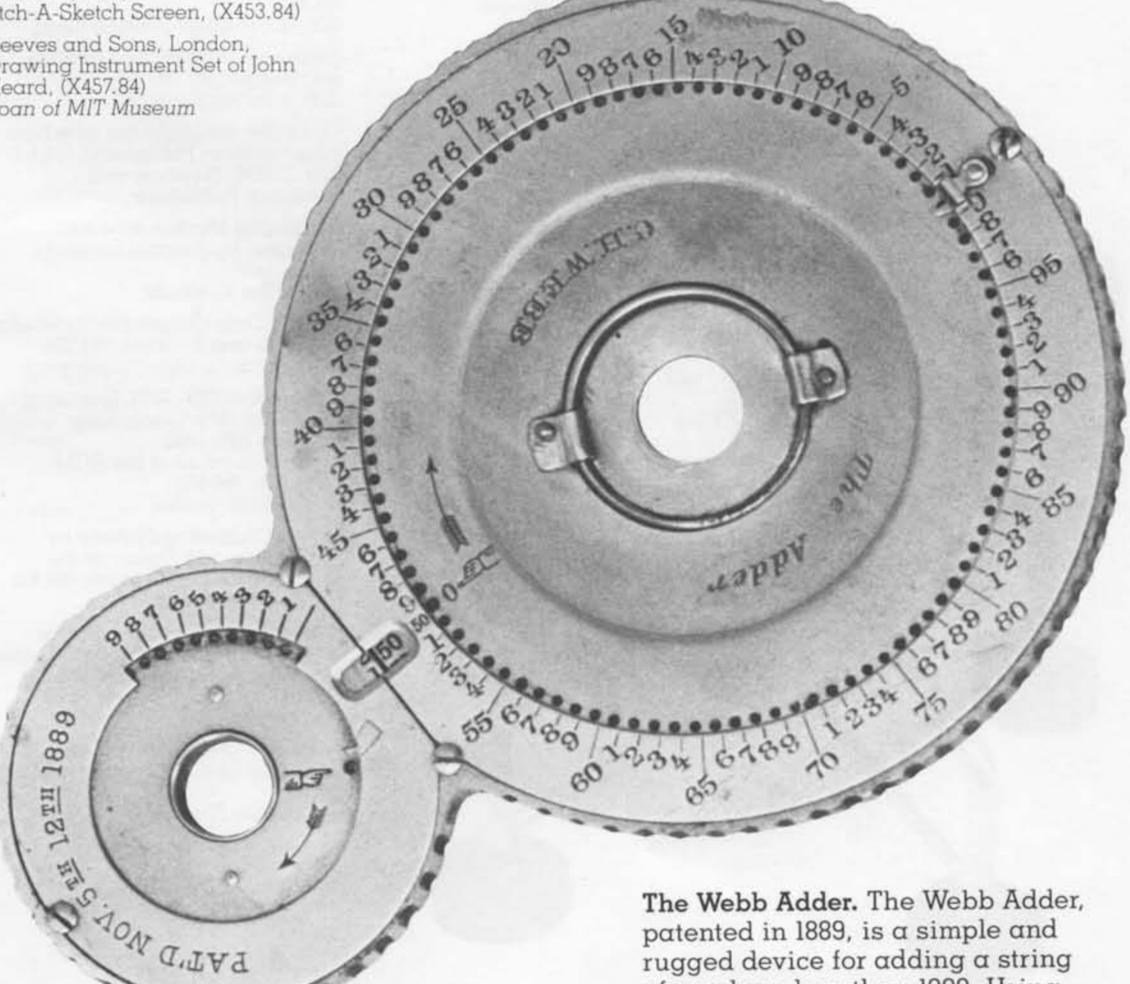
Texas Instruments, Inc. and IDEA Corporation,
Regency Radio–First commercial transistor radio, (X374.84)
*Gift of Roger Webster and Texas Instruments*

Unknown,
Button: "I Am A Human Being: Do Not Fold, Spindle or Mutilate," (X427.84)
*Loan from Jana Buchholz*

Unknown,
COBOL Tombstone, (X572.85)
*Gift of Charles A. Phillips, CODASYL*

Unknown,
Travelers 1401 Exhibit Collection, (X376.84)
*Gift of Travelers Insurance Company*

Xynetics, Inc.,
Xynetics Automatic Drafting System 1100, (X518.84)




**The Webb Adder.** The Webb Adder, patented in 1889, is a simple and rugged device for adding a string of numbers less than 1000. Using a stylus in the appropriate hole on the larger wheel the user enters an addend in much the same way as a single digit is dialed on a telephone. When the sum of 100 is reached the larger wheel completes one revolution and advances the smaller hundreds wheel one unit by means of a simple rachet. Results are displayed in the small window between the two wheels. The machine can add up to a sum of 4999.

*Donated by Ernst Halberstadt*

## Special Purpose Microprocessor-based Devices

Axlon, Inc.,
Compurobot, (X600.85)
*Gift of Axlon, Inc.*

Centurion Industries, Inc.,
Digitor Learning Arithmetic Module, (X558.85)
*Gift of Centurion Industries, Inc.*

Ritam Corporation,
Monty (plays SCRABBLE crossword game), (X599.85)
*Gift of Ritam Corporation*


**Digitor, by Centurion Industries, 1974.** This is not a UFO or a highly advanced computer for space exploration. It is digitor, probably the first educational tool based on a microprocessor. Built around the Intel 4004 processor in 1974 digitor claimed to be a "flexible and challenging means of testing the arithmetic abilities of elementary school children." By adjusting the two side knobs the teacher or student can set the difficulty and length of a series of problems. Students answer problems posed to them on the display panel by entering a number on the keypad. Correct answers are rewarded by a happy face, incorrect ones by a sad face, and at the end of the exercise digitor displays the number of problems correctly answered.

Over 100,000 have been sold worldwide.

*Donated by Centurion Industries, Inc., Redwood City, California*

## Manuals and Documentation

Altair documentation, DEC manuals and other documentation, (85.4)
*Gift of Peter Senn*

Analogic Data-Conversion Systems Digest and copies of six patents, (X84.29)
*Gift of Bernard M. Gordon*

Annals of the History of Computing, vols 6, numbers 3 & 4, (85.3)
*Gift of ACM*

Assorted DEC manuals (given long ago but finally recorded), (84.67)
*Gift of Gordon Bell*

Atlas I documentation, (84.69)
*Gift of F.R.A. Hopgood*

*Automatic Language Translation* and *A Study for the Design of an Automatic Dictionary*, (84.47)
*Gift of Anthony Oettinger*

Bell System documentation related to the SAGE system, (84.77)
*Gift of James Dresbach*

BIT quarterly journal (1961-1984), (84.49)
*Gift of Carl-Erik Froberg*

Burroughs, Bendix, CDC, IBM, NCR, RCA, et. al. manuals and documentation, (84.72)
*Gift of Mario Barbacci*

Collection of papers, documentation and manuals related to Computers in the Utilities Industry, (84.76)
*Gift of S.J. McMurray*

Computer books (ca. 1950's), (84.37)
*Gift of Nancy Stern*

Computer books and manuals (ca. 1950-1970) for use in the Timeline exhibit, (84.39)
*Loan from Dick Rubinstein*

Computer Science Press recent publications (11 library books), (84.81)
*Gift of Computer Science Press*

Computer Security and Privacy documentation, (85.16)
*Gift of Jeffrey Bergart*

Computer textbooks (six new titles from Freeman Publishers), (84.63)
*Gift of W.H. Freeman and Company Publishers*

*Computing Mechanisms and Linkages*, by Antonin Svoboda, (85.2)
*Gift of Ted Kuklinski*

Control Data Corporation reference manuals and booklets, (84.55)
*Gift of Control Data Corporation*

Datamation 1960-1979, Journal of ACM 1959-1979, Computing Reviews 1965-1980, Communications of the ACM 1965-1976, (84.66)
*Gift of Kathryn Erat*

*Digital Computing Systems* by S. Williams and *Theory of the Flexagon* by A.S. Conrad, (84.82)
*Gift of Shag Graetz*

Digital Equipment Corporation manuals, documentation and other computer related papers, (85.22)
*Gift of Digital Equipment Corporation*

Early IBM Computers: Edited Testimony by Cuthbert C. Hurd, (84.44)
*Gift of Lore Shaper*

EDP Industry and Market Report (nineteen bound volumes), (84.36)
*Gift of Patrick W. McGovern*

Electronic Design, "Electro-Technology," "EDN," "EEE," "Electronic Industries" magazines (near complete sets), (85.14)
*Gift of Kirtland Olsen*

*Electrons and Holes in Semiconductors* by Willam Shockley, (84.57)
*Gift of Tony Crugnola*

Ferranti documentation and manuals, (84.33)
*Gift of F.R.A. Hopgood*

FORTRAN, COBOL & Whirlwind xeroxed copies of documentation, (84.41)
*Gift of Jean E. Sammet*

GE 225 documentation and other manuals, (85.7)
*Gift of Woods Hole Oceanagraphic Institution*

General Electric 1984 Press Kit, (84.54)
*Gift of General Electric Information Services*

Guide to Fortran Programming, (84.35)
*Loan from Dick Rubinstein*

Harvard Newsletter on Computer Graphics, vols 1, #1–6, #11, (84.84)
*Gift of Stanley Klein*

Herman Hollerith related documents, (85.10)
*Gift of Geoffrey Austrian*

HP-65 Calculator documentation, (85.1)
*Gift of Stephen Gross*

IBM 1360 Photo-digital Storage System Manuals, (85.15)
*Gift of Clarence Badger*

IBM 610 manual of Operation and programming sheets, (84.59),
*Gift of W. Bruce Blattenberger*

IBM 701 Thirtieth Anniversary Issue of the Annals, (85.11)
*Gift of Lore and Hans Shaper*

IBM, NCR et. al. documentation and ephemera, (85.21)
*Gift of Richard S. Beers*

IEEE Micro February 1984 issue, (84.43)
*Gift of Robert L. Morris*

Illiac IV documentation, (84.70)
*Gift of John Day*

Lawrence Livermore National Laboratory Press Kits, (85.8)
*Gift of Lawrence Livermore National Laboratory*

Microdata EXPRESS Computer documentation, (84.32)
*Gift of Olivetti, Inc.*

MIT ESL Crystal Ball and Focusing Light Pen documentation, (84.45)
*Loan from John E. Ward*

*Mr. Babbage's Secret—The Tale of a Cypher—and APL*, (84.43A)
*Gift of Ole Immanuel Franksen*

NEC computer documentation and brochures, (84.53)
*Gift of NEC Corporation*

Neiman-Marcus Honeywell Kitchen Computer Advertisement, (85.17)
*Gift of Alan Frisbie*

Princeton University Library Chronicle (w/ article on Pierce Electrical Design), (84.42)
*Gift of Ken Ketner*

Programmer's card, manuals and other documentation for various machines, (84.50)
*Gift of Geoff Feldman*

Programmer's reference cards for AN/FSQ-7, IBM 704, 709, 1401, et. al., (84.78)
*Gift of Philip H. Dorn*

*Programs for an Electronic Digital Computer* by Wilkes, Wheeler, and Gill and *Arithmetic Operations in Digital Computers* by R.K. Richards, (84.61)
*Gift of Gordon Bell*

Proximity fuse and Project Tinkertoy documentation, (84.48)
*Gift of National Bureau of Standards*

Radio Electronics Mark-8 microcomputer manual, SCELBI-8H user's manual, (84.74)
*Gift of David Mallory*

Rand Tablet documentation, (84.52)
*Gift of The Rand Corporation*

SAGE documentation, (84.79)
*Anonymous Gift*

SAGE System documentation, (84.38)
*Gift of USAF Griffiss Air Force Base*

Shakey the Robot, technical report, (84.40)
*Gift of SRI International*

Soft*Letter newsletter (complete set), (85.20)
*Gift of Soft*Letter*

Systems Development Corporation SAGE recruiting advertisements, Mental Abilities Test and SDC magazines, (84.58)
*Gift of System Development Corporation*

*Travels in Computerland* (signed by the author), (85.12)
*Gift of Ben Schneider*

UAIDE Computer Animation Committee 1969 Year-end Report, (85.18)
*Gift of Carl Machover*

Viatron ad Wall Street Journal 10/22/68 and *As A Man Thinks* by Thomas Watson, Sr., (84.62)
*Gift of Charles Jortberg*

## Audio-Visual Material

**Audio:**

BBC "Chip Shop" audio cassette tape of interview wih Oliver Strimpel, (85.4)
*Gift of the British Broadcasting Corporation*

**Film and Video:**

*Automatic Teaching Project* and *425/L Norad* 16 mm films, (84.75)
*Gift of Herb Willman*

BIOMOD-2: 16mm film and photograph of Rand Tablet, (84.52)
*Gift of The Rand Corporation*

Boeing CAD/CAM film segments, (84.46)
*Gift of Boeing Commercial Airplane Company*

Computer Animation films (12 films), (84.86)
*Gift of Ken Knowlton*

Computer-assisted data Processing 16mm films, (four), (84.62)
*Gift of Charles Jortberg*

Design of Large Computers lecture by Seymour Cray on 3/4" video, (84.30)
*Gift of Lawrence Livermore National Laboratory*

Information Machine, Systems Technology, and the STP Story: 3 16mm films, (84.64)
*Gift of Herb Willman*

LEO: 16mm film of the LEO computer in England, (84.51)
*Gift of Martin Campbell-Kelly*

Live at 4 television coverage of The Computer Museum Opening on 11/13/84 (VHS videotape), (84.73)
*Gift of Ian MacLennan*

Rutherford Appleton Laboratory films (six), (84.33)
*Gift of F.R.A. Hopgood*

VHS videotapes of computers introduced at Boston Computer Society meetings (13 tapes), (85.9)
*Anonymous Gift*

VHS videotapes of computers introduced at Boston Computer Society meetings (4 tapes), (85.19)
*Anonymous Gift*

**Photographs:**

Ace to G-15 Lecture slides, (84.85)
*Gift of Harry Huskey*

Control Data Corporation photographs of 6600, 160, and 1604, (84.55)
*Gift of Control Data Corporation*

Dartmouth Timesharing photographs (5 photos), (84.90)
*Gift of Dartmouth College*

General Electric UNIVAC installation being discussed by Lillian Gilbreth and William Short, (84.60)
*Gift of General Electric Company*

IBM 7030, LARC, IBM CPC and Univac-1 photographs, (84.68)
*Gift of Lawrence Livermore National Laboratory*

LINC, Whirlwind, the Memory Test Computer, and TX-2 photographs, (84.71)
*Gift of Lou Hirshberg*

NEC photographs of Japanese computers, (84.53)
*Gift of NEC Corporation*

Printed circuit process photographs, (84.48)
*Gift of National Bureau of Standards*

RCA computer photographs, (84.56)
*Gift of RCA Corporation*

SAGE transparencies (20 positives), (84.38)
*Gift of USAF Griffiss Air Force Base*

SAGE, UNIVAC IBM 650 and Burroughs E-102 photographs, (84.34)
*Purchased from DAVA Still Photography Depository*

Teradyne photographs relating to the early days of that company (3 photos), (85.13)
*Gift of Teradyne, Inc.*

## Historical Software

Digital Equipment Corporation, SpaceWar! program, (X607.85)
*Gift of Digital Equipment Corporation*

Gates, William, First BASIC written for the Altair, (X507.84)
*Gift of William Gates and Microsoft Corporation*

Software Arts, Inc., VisiCalc Beta Test Version 0.1, (X570.85)
*Gift of Ben Rosen*

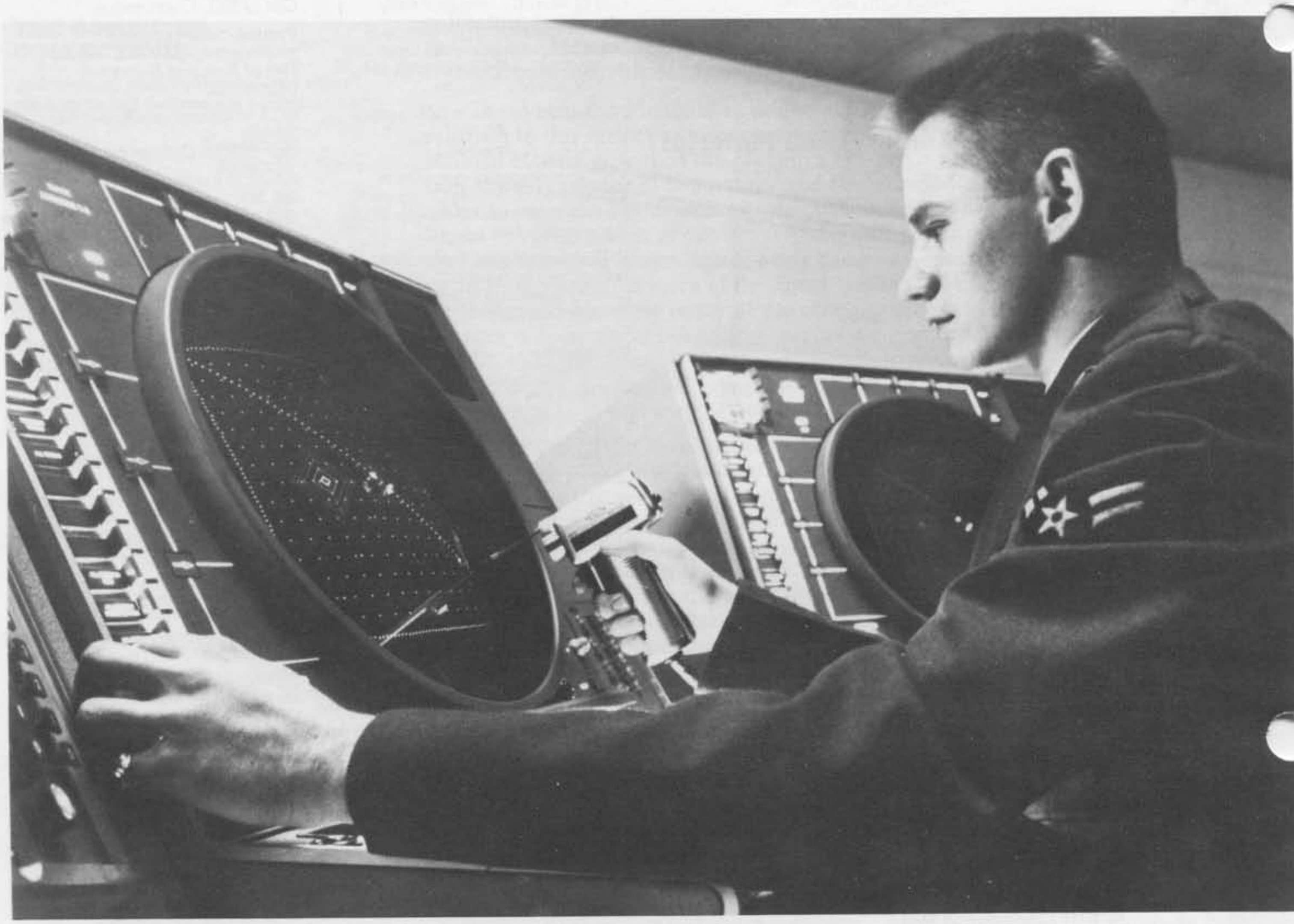

**Bill Gates' Teletype tape to input the BASIC interpreter for the Altair.** When Harvard students Bill Gates and Paul Allen read about the Altair in the January *Popular Electronics,* they decided that they might make some money by creating an intrepreter for BASIC on this new microcomputer. With the 8080 instruction manual and the Altair schematics, they produced the code, fitting in less than 4K of memory, within two months. They called Ed Roberts in Albuquerque and he said, that he'd buy from the first person that showed up with one. Paul Allen took the tape to MITS where he found only one machine that had 4K of memory. When he loaded it the teletype replied with "READY." Everyone at MITS was excited: they had never seen the machine do anything. Shortly thereafter Ed Roberts arranged to bring Bill Gates from Harvard to complete the implementation and Bill never returned to school.

The Allen-Gates Altair BASIC was listed in the MITS catalog like everything else it sold, and each purchase earned the authors royalties. Nevertheless even before the first release a pirated version of Altair BASIC was in free-flowing circulation. Gates, then nineteen, wrote a letter to the *Altair Users' Newsletter* entitled an "Open Letter to Hobbyists." Gates noted that while he and Allen had received lots of good feedback about the interpreter, most of the people praising it hadn't bought it. Gates asked:

> *Why is this? As the majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid?*

Eventually the widespread use of the BASIC interpreter was to help Gates. When other computer companies came on line and needed a BASIC, they went to Gates' company. He had created a de facto standard for microcomputers.

# Blue Room Blues



Imagine you worked down a two-mile-long tunnel half a mile underground. There you were expected to sit for eight hours a day studying the blinking yellow screen of a spotless grey machine in a cement room devoid of decoration and lit only dimly by blue lights. Once you arrived you were not allowed to leave until the end of your shift, when you took a bus back to the barracks you called home, miles from civilization.

This environment was the workplace for radar operators of the Air Force's North Bay, Canada SAGE installation. Here operators monitored the atmosphere of the northern hemisphere, on the lookout for Russian bombers and missiles. "The Blue Room," as the radar center was called, was studiously designed to minimize the fatigue of the operators: the lighting was indirect blue flourescent, to cut down on eye strain from the blinking yellow radar scopes; electric lighters and ash trays were built into the consoles; and the color of the equipment was a neutral battleship grey. To ensure efficiency, personnel were required to keep their consoles clear of clutter. In fact, the only extraneous object visible in the room was a large cardboard vampire bat attached to the ceiling, in deference to the room's cave-like qualities. However, as the Museum later discovered, this was not the only individual expression the operators allowed themselves.

When the equipment from the North Bay SAGE installation arrived at The Computer Museum, cleaning revealed interesting evidence of how the operators viewed their job. Each console has several knobs covering recessed switches. When these knobs were unscrewed the backs were found to be covered with graffiti written by the operators. The hidden messages ranged from the banal to the unpublishable. While ostensibly observing the rigid regulations regarding a spotless work area, the operators still managed to express themselves clandestinely.

Here is a selection of the messages left by the operators hidden in their consoles:

**"Put this back"**
**"HELP"**
**"Art Clark 1979"**
**"Bravo Crew is the pits"**
**"Look on the other knob"**
**"Superbowl XXII"**
**"Send the Cowboys to the superbowl"**
**"Don't you feel useless"**
**"$25"**
**"Hi Jack"**
**"Help I'm trapped in here"**
**"No step take off Hey"**
**"1 May '79"**
**"I can't stand it"**

# Fall/Winter Program Series

## Sundays at 4 pm

**January 19**
I. Bernard Cohen, Professor Emeritus, History of Science, Harvard University
**Computing at Harvard in the Forties: The Story of Howard Aiken and the Incredible Harvard Mark I**
*Robert Campbell and Richard Bloch, programmers on the Harvard Mark I will join Professor Cohen for the question and answer session.*

**January 26**
Dan Bricklin, co-inventor of microcomputer spreadsheets
**VisiCalc—From Idea to Realization and Dissemination**

**February 2**
Danny Hillis, Chief Engineer, Thinking Machines Inc & Builder of The Tinker Toy Computer
**The Connection Machine: What Will a Computer with Thousands of Processors Do?**

**February 9**
Carl Machover, Computer Graphics Pioneer
**Behind the Screens: Computer Graphics From 1960 to the Year 2000**

**March 2**
A.K. Dewdney, columnist Scientific American
**Computer Recreations in Science: A PC-TREK into Uncharted Worlds**

**March 9**
Peggy Brightman, Artistic Director, CHOREO
**Computer Dance**

**March 16**
John Kemeny, Professor of Mathematics and Past President, Dartmouth College
**BASIC: From Birth in the Sixties to Rebirth of a New True Basic for Contemporary Computing**

**February 13**
**ENIAC's Fortieth Birthday Party**
On February 13th 1946, at 10:30 AM the ENIAC was first switched on. This event signalled the birth of the electronic digital computer.

In celebration of this very special occasion, J. Prespert Eckert, Chief Engineer of ENIAC and co-inventor with the late John Mauchley, will present a lecture. The official birthday party will follow. . . . Watch for your invitation in the mail.

**February 15–23**
**A Special Week of Computer Activities and Games For Children of All Ages**
Call our talking computer for details: 423-6758

**Friday March 14 at 7:30 pm**
**Computer Dance Performance by CHOREO**
*"Boston's Computer-Friendly Dance Company"*—DANCE UMBRELLA
Members Admitted Free.

## Thursdays at 7 pm

### Film and Video Screenings

**February 20th and February 27th**
**Computers in the Movies:**
Two feature films that starred computers will be shown.

**March 6**
**The Early Years of Computer-Generated Video: 1973 to 1983.**

**March 13**
**Current Computer-Generated Video and Animation:**
The Best from the SIGGRAPH Video Shows of 1984 and 1985

**For more information call 423-6758.**

All programs will take place in The Computer Museum Auditorium. Admission to the programs is free for Computer Museum members, and free to others with admission to the Museum: $4 for adults; $3 for students and senior citizens. Reserved seats are available to members by sending $2 per seat per program to Programs Coordinator, The Computer Museum, 300 Congress Street, Boston, MA 02210. Please make checks payable to The Computer Museum and clearly indicate which program(s) you plan to attend. Seats may also be reserved by paying $2 at the door up to one half hour before the program begins.

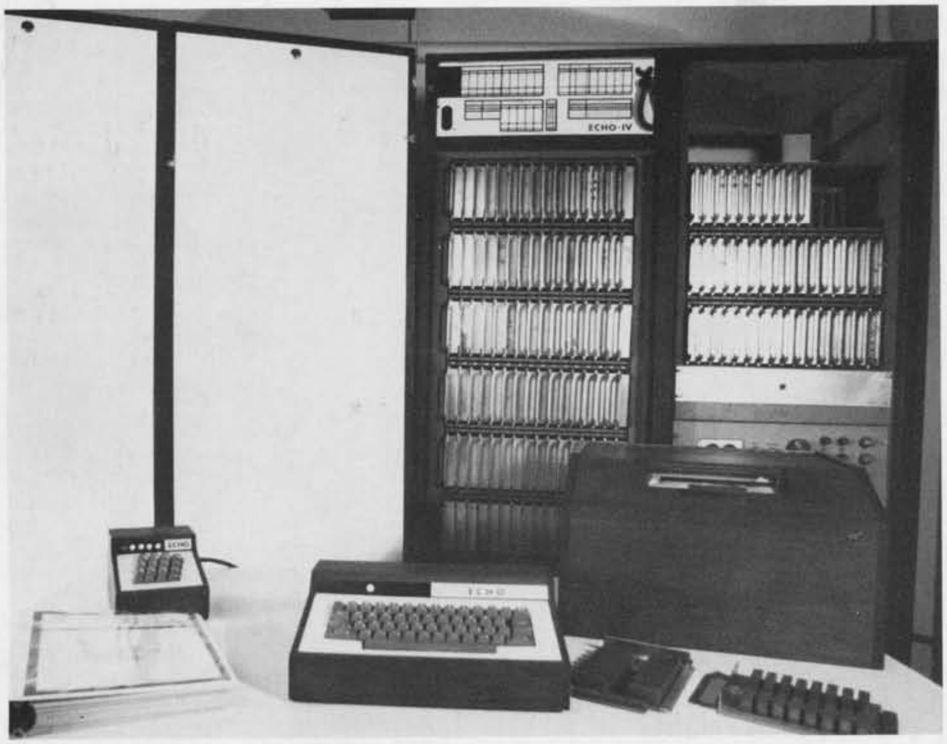
Sponsored in part by grants from the Bank of Boston and Digital Equipment Corporation.

# The Computer Museum

## ECHO IV

In June, 1965 Jim Sutherland, a computer systems engineer with Westinghouse Electric Corporation, carted some scrap computer components from work to his home outside Pittsburgh. In less than a year he had constructed a working computer in his basement. The ECHO IV, short for Electronic Computer for Home Operation composed of four parts, caused quite a stir as it heralded the age of the home computer.

Initially publicized in 1966 by the public relations department at Westinghouse, word of Sutherland's computer began to spread with the appearance of an article in Popular Mechanics and several television and radio interviews in 1968. The aspect of the ECHO IV which the popular media harped upon most was its integration into Sutherland's home. The ECHO IV was a home computer in more than the sense that it occupied a room in his basement; it was connected to various terminals and systems throughout the house. Sutherland explained how one day he hoped to have the computer control many aspects of his household, such as the heating system, an alarm system, the garage door, the inventory of household items, and storage of the family's diet and budget information. At a point when there was great uncertainty as to how the computer boom would affect the average household, Sutherland's computer seemed a concrete indication of what the future might hold.




Sutherland's accomplishments were perceived to be so prophetic that he and his wife, Ruth, received many invitations to speak to Home Economic associations across the country on the computerized household of the future. Sutherland concentrated on a brief, and not very technical description of the ECHO IV and its potential uses, while his wife focused on what it was like to have a computer in the household. She allayed any fears that a computer might replace a housewife, stressing its advantages as a time saver and limitations resulting from only being able to follow instructions. She expressed excitement at the new challenge which programming the computer presented to her life. The Sutherlands' talks culminated in an address at the IEEE meeting in Pittsburgh on February 16, 1971.

The ECHO IV was contained in four units housing the memory, arithmetic, CPU, and input/output units respectively. Along with the four cabinets, a programmer's console including a printer, paper tape reader, and keyboard, was installed in the basement. In addition there was a control console in the kitchen, and digital clocks which the computer controlled throughout the house. Most of the components were finished in mahogany.

The ECHO IV was nearly a member of the Sutherland family. As Sutherland told Datamation in 1970, "The sleepless nights I've spent with that stupid machine. For a while there, I'd have given it to you. I'd hear it running in the middle of the night when it wasn't supposed to. So there I'd be, standing at the workbench in my pj's, groping for bugs."

Sutherland finally decided it was time to send this member of the family off to face the wide world on its own, and in 1984 he donated the ECHO IV to The Computer Museum.

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