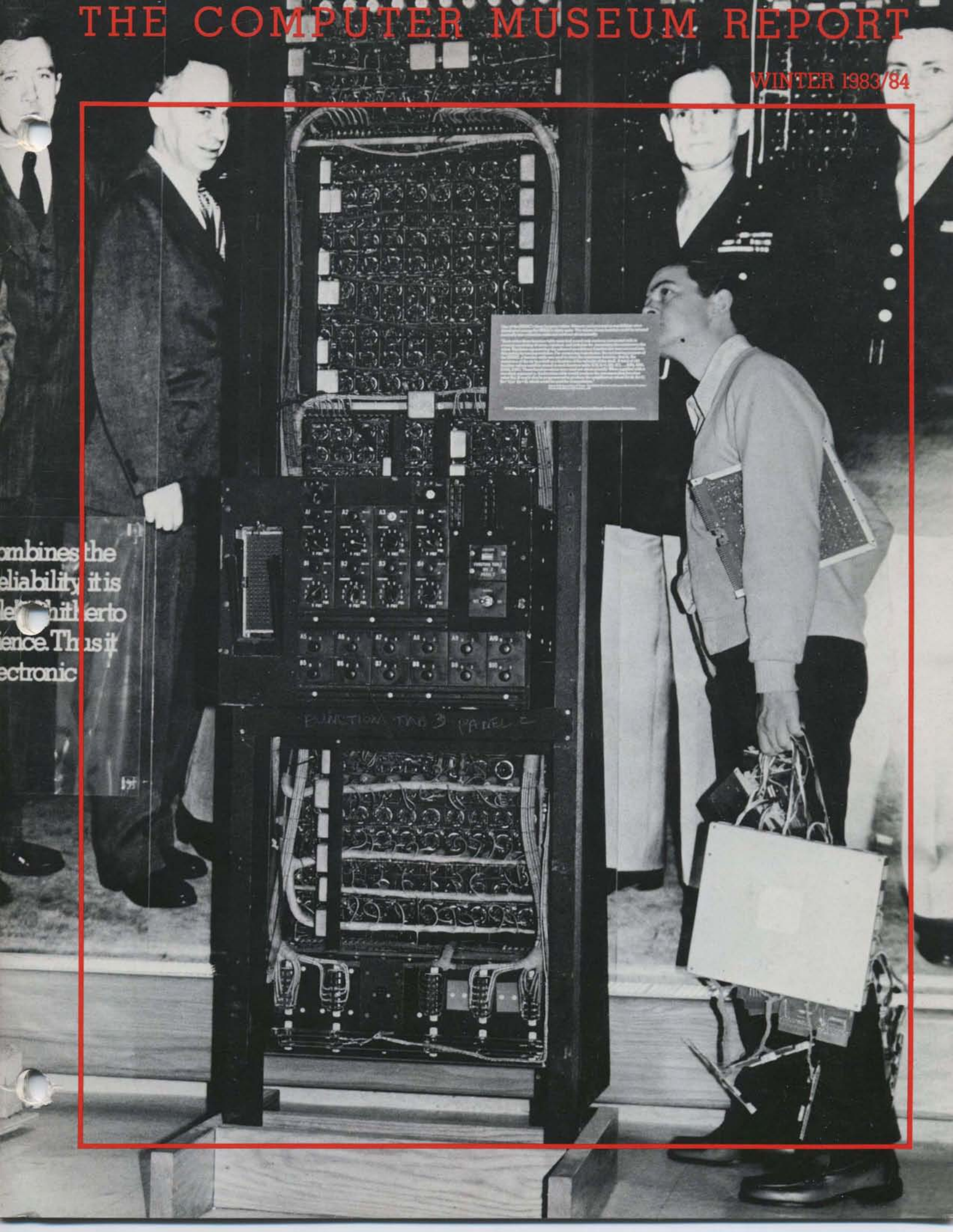
THE COMPUTER MUSEUM REPORT

WINTER 1983/84



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The End Bit

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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.

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 is temporarily closed in preparation for its move to Boston. It will reopen at Museum Wharf in downtown Boston in fall 1984. For more information, call (617) 467-4036.

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The Director's Letter

Jamie Parker

The Museum is in a time of change: location, staff and exhibits. But our plan is to keep this Report in its familiar form enabling us to communicate our activities to you.

One of the greatest changes has been the departure of Jamie Parker, the Museum's first employee and developer of all the exhibits. She left in August to get married and join her husband in Geneva. In her four years with the Museum, she used her photographic memory to conceptualize exhibits. Jamie had an intuitive feeling for the artifacts and how they could be exhibited even though her education was in art history not computer science. While with the Museum, she cataloged and put three times as much in the warehouse as we had on the floor. One of Jamie's last chores was to organize our yard sale.

The yard sale allowed Jamie to weed our "warehouse." In her first years, she accepted everything because that was her job. The Museum ended up warehousing a number PDP-12s, 338 display systems and PDP-6s. Since Jamie knew what was what and what was best, she selected the items to sell, thus cutting down our storage costs and providing the members with a good day of poking through old junk and taking apart computers. The cover photo is a tribute to Jamie: one of the yard sale customers is carrying off his loot and inspecting the display of the ENIAC, an exhibit put together by her.

A new crew of exhibit and archives employees will help us plan the space for Museum Wharf. Meredith Stelling has taken over as the Coordinator. She has been with the Museum for a year handling publications and archives. Meredith, Greg Welch and Bill Wisheart are the main exhibit staff and will be joined in January by Oliver Strimpel, on leave from The Science Museum in London.

In September, the new space at the Wharf seemed vast and barren, except for chalk marks on the floor indicating where the new exhibits would be positioned. But the space is already beginning to fill out with two truck loads of the SAGE (30,000 pounds), an IBM 1401 card system and a collection from the University of Illinois.

Reviews of exhibit plans started in September. Sheila Grinnel, developer of ASTC's travelling "Chips and Changes" exhibit, Bruce McIntosh, a designer, and Paul Tractman, senior editor, *The Smithsonian*, spent a day consulting on the proposed organization. Then on October 13th, board members Brian Randell and consultant Dick Eckhouse reviewed the next iteration.

Successive refinements bring our plans in line with reality. The SAGE system will form the fulcrum of the exhibits leading into the computer generations on one floor, and backward in time to the revolutionary one-of-a-kind computers on the other. The process of moving has now started and the enormity of the task ahead is clear. But the team is together and progress can be seen.

Gwen Bell
Director

Harvard Mark III. *Magnetic drum storage was pioneered on the Harvard Mark III. The drum rotated at about 3,600 rpm and its random access time was 17 microseconds. By modern standards that was quite slow, however, it was the only way to have moderately priced memory in any quantity in the early 1950's. With its tapes and plug boards the Harvard Mark III covered 40 square feet, and was one of the first hard-wired assemblers that transformed mathematical symbols into machine code.*

Computers: A Look at the First Generation

In 1955, Martin Weik compiled a "Survey of Domestic Electronic Digital Computing Systems," providing a remarkable snapshot of the computer population. The survey briefly describes and gives specifications for about 100 different machines in existence as of December 1955.

Weik's inventory supplied the base to compile a fundamental reference for collecting and research at The Computer Museum. Records for each machine were gathered from contemporary historical accounts in recent books and journals, operating manuals, and in some cases the machines themselves. Then the findings were checked against those appearing in Weik's original survey.

This research was done by Paul E. Ceruzzi, assistant Professor of History at Clemson University with the aid of Rod McDonald of Rider College, and Greg Welch of The Computer Museum. Different specifications and descriptions have been given to the same machines over time for various reasons. Rather than arbitrarily selecting one description, the data was collected and explained.

These differences occurred for a variety of reasons. Specifications given in one account often do not agree with those given in another, because a computer's characteristics usually changed from the time of its early design to its final days of operation. The characteristics of some were entered after they had been redesigned and rebuilt, (e.g. SEAC) and others before such redesign (e.g. Johnniac). Nomenclature was also a problem—one manufacturer's "rapid access registers" might be another's "accumulators"—these differences were reconciled through research.

Different metrics were often used for speed: the time it took to fetch a number from memory in a drum machine may have been given as the fastest possible, the slowest possible, the average, or the fetch time using optimum coding techniques. A time frame for each machine was established to provide a subjective though reasonable assessment of its historical significance.

The first phase of the survey is complete: the data is stored on disks, and printouts are available for scholars. The next phase is to build the collection, define additional research topics and to develop a very accurate map of computing up to 1955.

Gwen Bell

What did computing look like during its "first generation"—the time from the dedication of ENIAC in 1946 to the mid-fifties?

The variety was astonishing. Experimental one-of-a-kind computers, each with its own unique character, ruled, even though most incorporated vacuum tubes and drum memories, stored programs and data internally, and communicated via Flexowriters.

While most were built with vacuum tubes, many also used relays and crystal diodes.

For memory, they relied on delay lines, cathode ray tubes, drums, magnetic tape loops, paper tape, punched cards, magnetic wire, and toward the end of the period, magnetic cores.

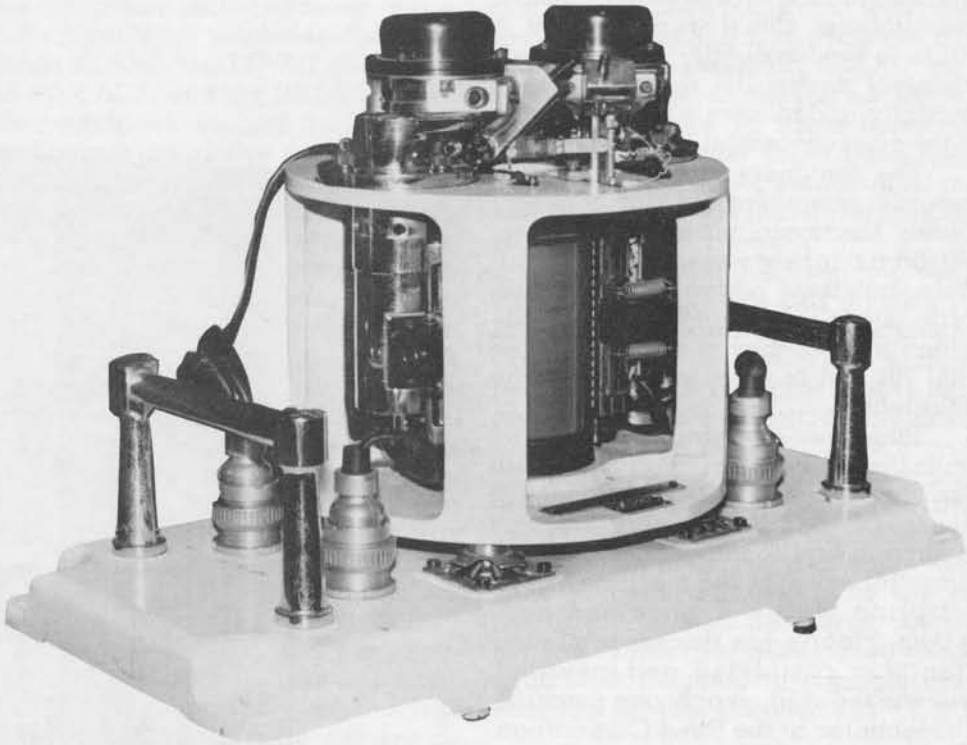
For input and ouput, they used teletypes, punched cards, other paper tape readers, and CRT displays as well as Flexowriters.

Their sizes ranged from that of a small desk to several large rooms full of equipment bays with consoles one could walk into. And their speed ranged from one to tens of thousands of operations per second.

Preliminary Findings: Technology

Most first-generation computers did use vacuum tubes, but not all in the same way. After ENIAC's dedication, designers saw the advantage of tubes for speed, but sought to minimize their number. Those computers used fewer tubes in their circuits, and thus were more reliable and compact. Solid state diodes, not tubes, performed logical operations. This was pioneered in SEAC in 1950, after which only a few computers, such as the Circle and Monrobot, continued to use tubes for logic as ENIAC did.

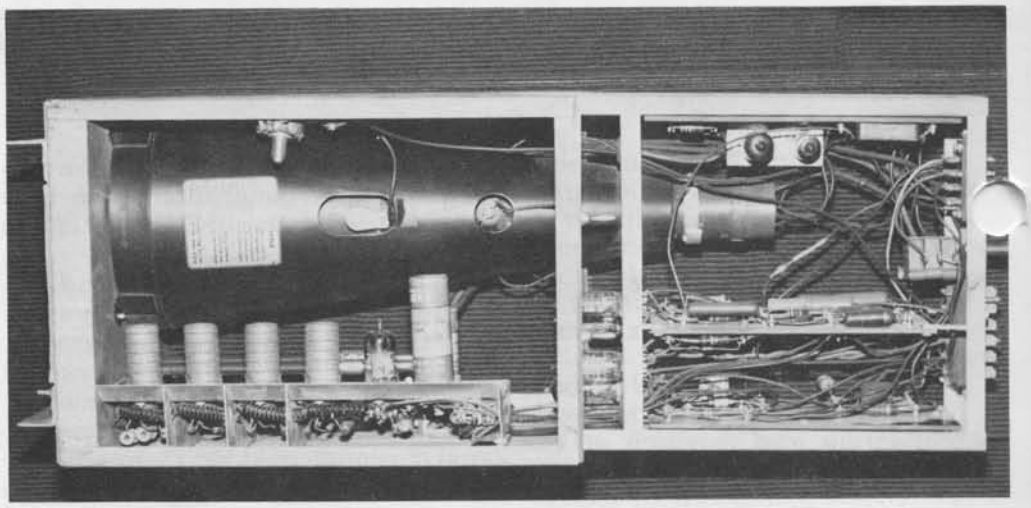
Between 1946 and 1955, at least a dozen relay computers were built, an indication that some designers did not agree with the prevailing view of the superiority of vacuum tubes. One such person was Howard Aiken, who on visits to Continental Europe in the 1950's influenced the choice of relays for several computers. Konrad Zuse's computer company also produced a line of successful relay computers installed mainly in Continental Europe. Some of the relay computers, like the Bell Labs 5 and 6, were based on se-



Drum from the English Electric Deuce. *Built in 1957, the Deuce drum stored 8K × 32-bit words on 256 tracks of 32 words each. It measured four inches by six inches; most first-generation drums were eight to 20 inches in diameter and two to four feet in length. The Deuce drum is on exhibit at The Computer Museum.*

quence calculator designs of a decade earlier. Others, like ERA's "Abel" and the British "ARC," were designed along the lines of stored-program electronic computers, but used relays to save money or to get a prototype working quickly.

By late 1955, a few transistors already were finding their way into computer circuits: in Bell Labs' TRADIC, the IBM 608 Calculator, and perhaps one or two others.



SWAC Williams Tube. *The Williams tube was invented by Sir Frederick Williams at the University of Manchester in 1948. It was the first purely electronic parallel memory, but it was unreliable. Although magnetic-core memories superseded the Williams tube by 1954, the Williams tube was still faster than drum memory and delay lines. Unlike the earlier version of the Williams tube, the Williams tube from the SWAC (Standards Western Automatic Computer) was more compact and featured higher reliability. It enabled the calculator from the SWAC to fully utilize the speed of the Williams tube memory by completing arithmetic operations in a few microseconds. Instead of handling numbers as a train of pulses, there were parallel circuits in the SWAC that transfered numbers almost instantly. This transferring of numbers in parallel made it possible to do computations at many times the speed of serial computers. The SWAC was the first Williams tube computer to be completed in the United States. Its rate of success was also dramatic, producing useful results seventy percent of the time. The Williams tube from the SWAC is on exhibit at The Computer Museum.*

Memory

A wide range of memory devices were used in first-generation computers. None of the mass storage techniques available in the early 1950's was clearly superior; the choice always involved a trade-off of access time versus reliability. This unsettled situation persisted until the end of this period, when the magnetic core memory was perfected.

The drum was by far the most common memory device. A third of the stored-program computers used it for their primary memory, and most of the others used it for secondary storage. The most popular of the early computers, the IBM 650 with several thousand installations, was a drum machine. A drum is fundamentally an electromechanical device; its reliability, high capacity, and relatively low cost made it the most successful medium.

The designers of the first stored-program computers had high hopes for purely electronic, parallel memories. Williams tubes were widely available, but their performance was erratic. Developed in Manchester, England in 1948, they were used on the IBM 701 and in a variant form on the Whirlwind.

John von Neumann, unsatisfied with their reliability, contracted with Jan Rajchman at RCA to produce a electronic, parallel memory, but von Neumann had to make due with Williams tubes on the IAS machine and its offspring in Los Alamos and elsewhere. Finally, Jan Rajchman's Selectron was completed and installed, but worked well on only one machine, the Johnniac at the Rand Corporation.

Some 15 first-generation computers used mercury delay lines for their main memory. The delay line was more reliable but slower than the Williams tube, while it was less reliable but faster than a drum. The UNIVAC's

IBM 650. *The IBM 650 was the most widely used first-generation computer. Hundreds were delivered between 1955 and 1959. Although the 650 was faster than other magnetic drum computers, its high success rate was a result of a well-integrated, punched-card input and output and its adaptability to existing punched-card systems.*

Huskey Lecture. *Harry Huskey giving a lecture next to his Bendix G15 at The Computer Museum in December 1982. He said: "In 1952 and 1953 while at Wayne University (Detroit), I dusted off the ideas and designed a computer which the Bendix Corporation elected to build, the Bendix G15. The memory was a magnetic drum with separate read and write heads. All information was read, erased and rewritten every drum rotation—just like the mercury delay lines. This gave some technical advantages—the read heads and the write heads could each be optimized for their functions."*

delay line memory, for example, could access a number in 400 microseconds, compared to 25 microseconds for IAS's Williams tube store, and 2,500 microseconds for the IBM 650 drum. Delay line computers included many historically significant machines: the Cambridge EDSAC, the EDVAC, the SEAC, the Pilot ACE, and the UNIVAC. A few other machines, such as the Pegasus, used magneto-strictive delay lines.

The development of magnetic core memory finally gave computer designers a memory that was reliable, fast and parallel, but expensive at the outset. In 1953, core memories were installed on the Whirlwind computer at MIT and the ENIAC at the Ballistic Research Lab. By 1955, only two commercial computers, the RCA BIZMAC and ERA 1103A, used core memory. Without the new manufacturing technology to build cores, manufacturers of machines based on drums, delay lines, and other devices continued to plan and build these architectures until the price of core fabrication fell.

Harry Huskey, who designed a superior version of the Bendix G15, says: "Bendix made more than four hundred of the G15's—in fact the fittings on number 400 were gold plated. Bendix did plan a transistor version of the G15 but the declining costs of magnetic cores and their improved reliability marked the end of the cyclic memory computers."

Input/Output

Nearly all first-generation computers used a Flexowriter or comparable electronic typewriter with a paper tape reader attached for both input and output. The Flexowriter was simple and rugged, but slow. Photoelectric readers, pioneered on EDSAC and quickly adopted in the United States, read paper tape 20 times faster. A photoelectric reader could input data at 120 characters per second (cps) instead of the six cps that a mechanical reader could handle.

Other computers used punched cards or teletype. The CRT display, so familiar to modern computer users, first appeared on one or two experimental computers like the Whirlwind, and finally on a commercial computer, the ERA 1103, in 1955.

Almost from the beginning of this era, designers recognized the advantages of magnetic tape as a medium for bulk input/output, but tape was slow in being adopted. The use of metallic tape was pioneered on the UNIVAC while the SEAC used magnetic wire mounted in compact cassettes for off-line storage.

Size

The smallest stored-program computer was probably one built by Hughes Aircraft for aircraft guidance and control. It measured about two feet by one foot, used a drum memory, and

was installed aboard a C-47 airplane in 1953. The largest was perhaps the Whirlwind, which occupied 55,000 square feet. Other large-scale installations that could claim the honor of "biggest" include the IBM 701, the RCA BIZMAC, and the Harvard Mark II, which filled a large room at the Naval Proving Ground in Dahlgreen, Virginia.

Commercial drum computers were generally quite small, ranging in size from that of a small desk to several large cabinets. The cost of development and construction ranged from a few thousand dollars for a prototype Circle Computer (surely the cheapest) to several million for Whirlwind. However, the Whirlwind was more than a single computer, it was an ongoing project involving computers, memories and applications programming.

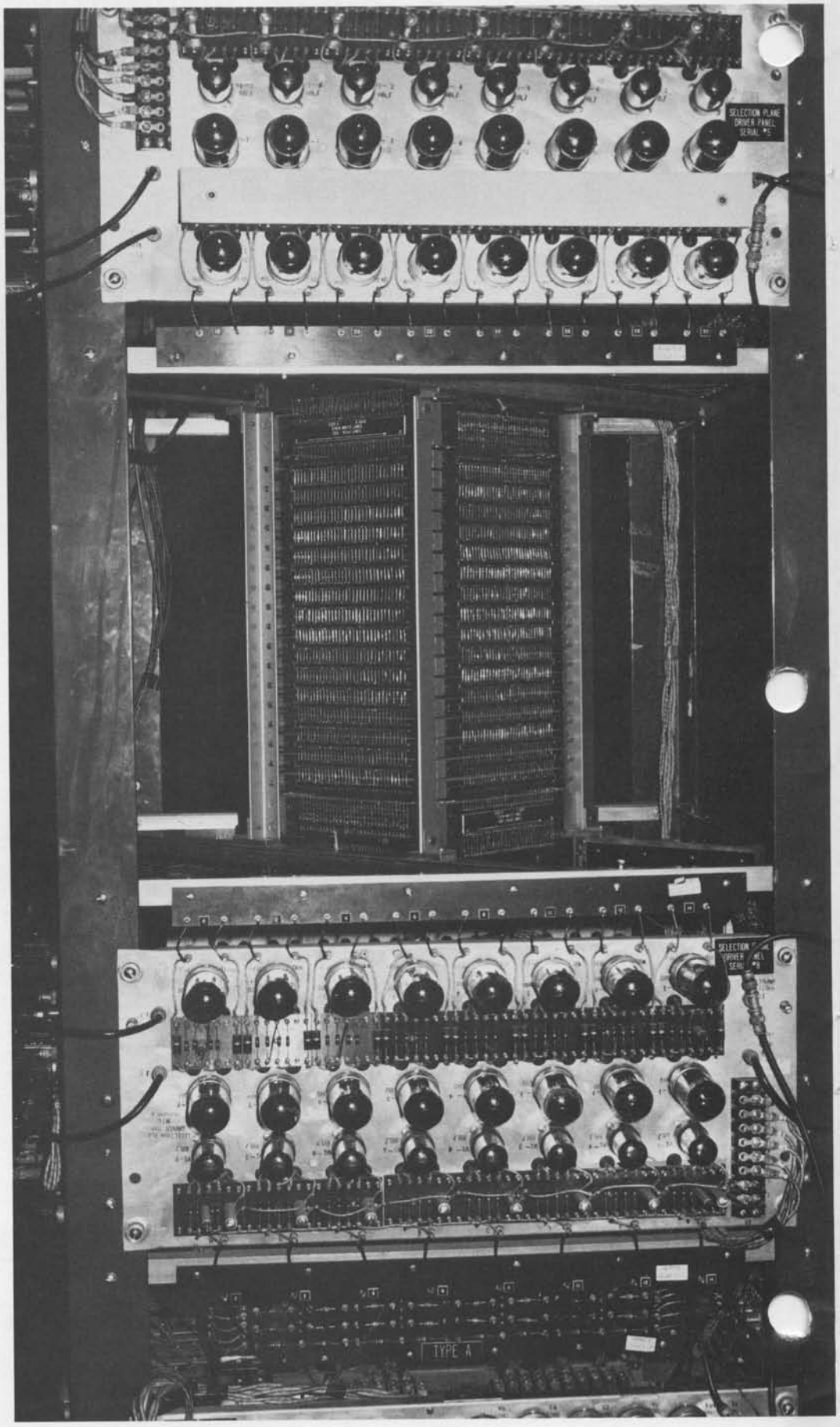
Architecture

Quite a few computers without a stored-program design were produced and sold into the 1950's. The advantages of the stored program design were slow in being accepted, and many companies built computers of both types. ERA, for example, built a "Logistics Computer" in 1952, which incorporated a fixed program for certain types of problems.

Computer Research Corporation built a general-purpose drum computer, the CRC 102, and also produced the popular CRC 101, a special-purpose machine called a Digital Differential Analyzer. The aircraft industry, a big customer for digital differential analyzers, kept the market alive and several companies were the suppliers. Several externally-programmed drum computers installed in Continental Europe reflected the design of Howard Aiken's Harvard Mark III and Mark IV.

Of the stored program computers, about an equal mix handled numbers serially, digit by digit, and in parallel, a word at a time. Similarly, they were equally mixed between binary and decimal machines, with some commercial models like the CRC 102 available either as a binary or a decimal machine.

A wide range of instruction sets also existed, from CALDIC with only a dozen or so instructions, to the RAYDAC with a four-address code and built-in fixed and floating point instructions. When random access core memory re-



placed serially-accessed magnetic drums or delay lines, the "von Neumann" architecture of binary arithmetic, single-address instructions, and parallel memory prevailed.

Reports by Burks, Goldstine, and von Neumann on the IAS computer discussed the stored-program principle in detail, especially with regard to modifying the address field of an instruction during a program's execution. Several first-generation computers used special index registers to accomplish the same thing. These were called "B-lines" on the Ferranti Mark I, the first machine to use them, and the name stuck. In the United States, the Consolidated Engineering 30-201 and its descendents had B-lines. Descriptions of computer architectures nearly always mentioned the stored program in connection with indexing. Some descriptions, including one by Alan Perlis, point out that computers with B-lines were superior in many ways to the simpler IAS design.

Programming

The first generation of computers were programed in machine language, typically by binary digits punched into a paper tape. Activity in higher-level programming was found on both the large-scale machine and on the smaller commercial drum computers.

High-level programming languages have their roots in the mundane. A pressing problem for users of drum computers was placing the program and data on the drum in a way that minimized the waiting time for the computer to fetch them.

It did not take long to realize that the computer could perform the necessary calculations to minimize the so called latency, and out of these routines grew the first rudimentary compilers and interpreters. Indeed, nearly every drum or delay line computer had at least one optimizing compiler. Some of the routines among the serial memory computers include SOAP for the IBM 650, IT for the Datatron, and Magic for the University of Michigan's MIDAC.

Parallel memory machines had less sophisticated and diverse compilers and interpreters. Among the exceptions were SPEEDCODE developed for the IBM 701, JOSS for the Johnniac, and a number of compilers and interpreters for the Whirlwind.

Use

The list of computing installations up to 1955 reveals dominance of the military, followed by laboratory and then business use. In 1954, a Magnefile was installed for inventory control at B. Altman & Co. in New York, and a MODAC 404 was used by *Reader's Digest* for keeping track of subscriptions, but these were exceptions to the rule.

Installations found at air force or army bases often had not just one, but several computers. Though not a "typical" installation, the Ballistic Research Lab at Aberdeen, Maryland illustrates how military agencies commanded the greater fraction of all computing power in the mid-1950's. It included: ENIAC; a Bell Labs Model V Relay Computer; EDVAC (a stored-program, serial computer); ORDVAC (a stored-program, parallel computer); several digital differential analyzers; punched card multipliers; analog computers; desk calculators, and other computing devices of various shapes and sizes.

Conclusion

The "milestones" of the first generation were brought about by many people who continue to be leaders in the field. Grace Hopper worked on the UNIVAC; Maurice Wilkes on the EDSAC; Joe Weizenbaum and Harry Huskey on the Bendix G-15; Gene Amdahl on his dissertation machine, the WISC; Max Palevsky on the Bendix D-12 Digital Differential Analyzer; An Wang on the Wedilog; Ken Olsen on MIT's memory test computer; and Seymour Cray on the ERA 1103.

Computing was about to change rapidly. In the next few years installations jumped to the thousands. Serially-produced, commercially-manufactured, standardized machines became the rule. Over the years, experimentation has continued, but never with the diversity of ideas about the basic architecture of this inaugural era.

Paul Ceruzzi, with Rod McDonald and Gregory Welch.

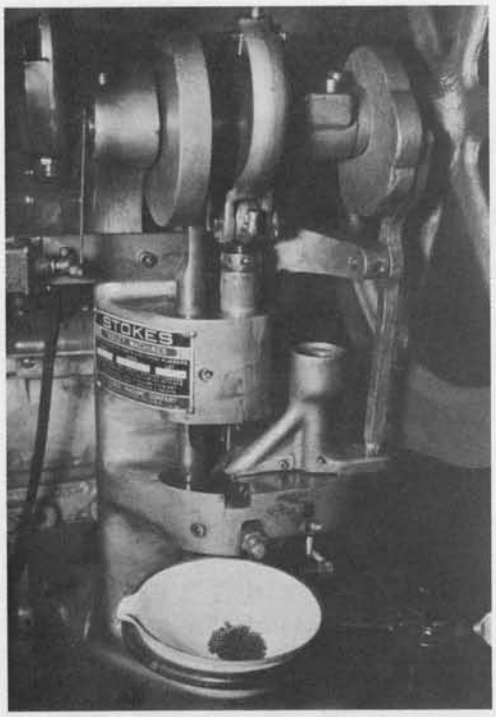
Core Memory Stack. *This core memory stack from the Whirlwind, which is on exhibit at The Computer Museum, measures 17 × 10 × 9 inches. Each core memory plane is arranged in an array of 32 × 32 cores. The first core memories were designed by Jay Forrester for the Whirlwind in 1953 at MIT. Computer access time dropped from twenty-five microseconds for tube storage to nine microseconds for magnetic cores.*

The Core Process: How Ferrite Cores Were Made

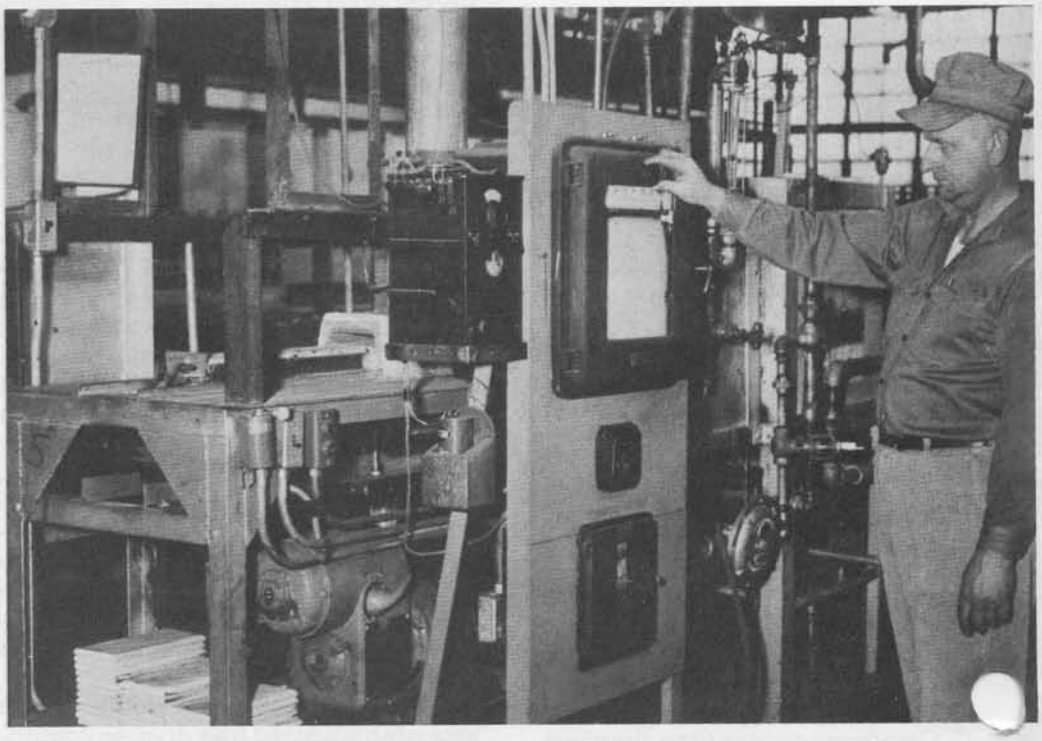
A manufacturing process for core memories was developed by Lincoln Labs in 1952. Core memories were always strung by hand, and production of the first cores was complex and expensive. The following picture story is from the unclassified manual, **Ferrite Cores For Computer Memories.** These cores were used in the Whirlwind and the Memory Test Computer.

Dimensional Check. The machine die and the weight of the pressed cores had to be continually monitored to insure maximum uniformity of core size. Before each press run a dimensional check was made with a toolmaker's microscope in order to assure quality control.

Cooling. After the cores left the tunnel of the kiln, they were still at an elevated temperature of 500 F. Cooling took place quickly in the open air, and then the cores were ready for counting and electrical testing.

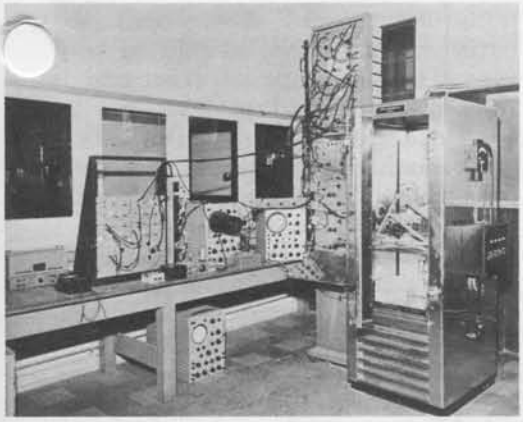


Core Pressing. After five days of getting the material ready for making cores, core pressing was done automatically by a Stokes press which was capable of 60 pressing operations per minute.

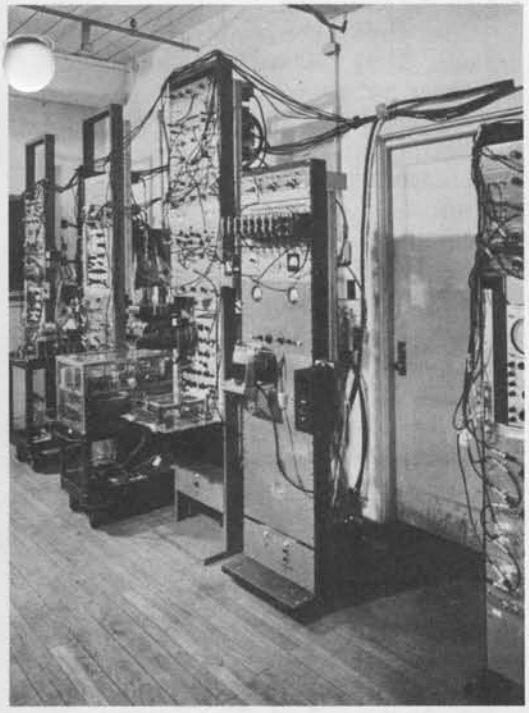


Firing. Firing was the most critical operation of core production. The firing temperature was approximately 2400 F, and elaborate controls were necessary to maintain the correct temperature.

For Computer Memories

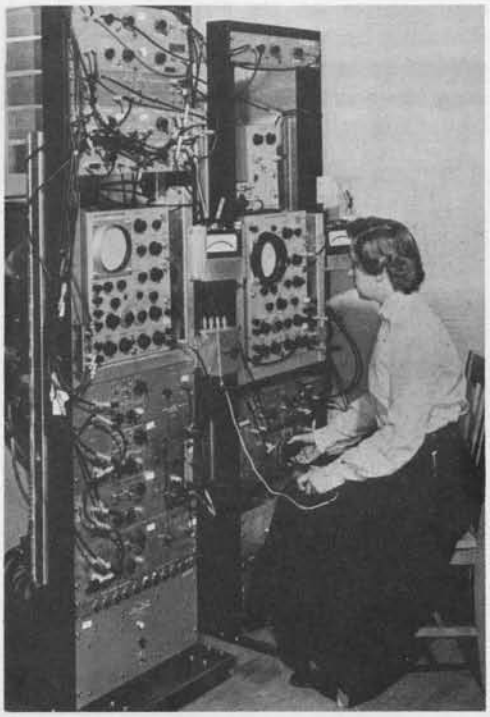


Electrical Testing. Core drivers helped in electrical core testing. The cores, which were temperature sensitive, were tested at a uniform 25 C. The temperature was controlled by core handlers in temperature-regulated boxes or air-conditioned rooms.

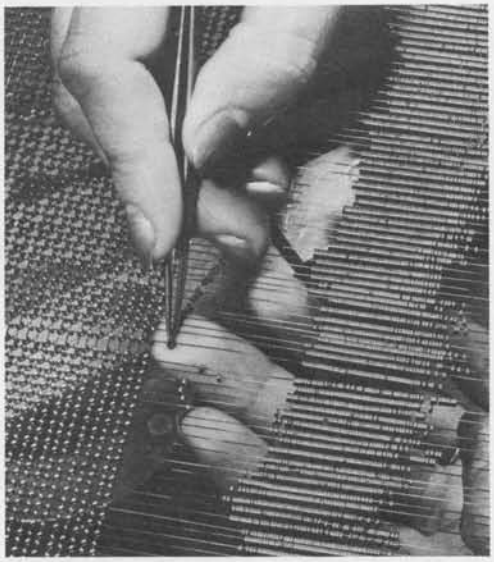


Pulse Testing. A sample of 50 cores from each lot was used for hysteresis-loop measurements. The test equipment for pulse testing and semiautomatic selection testing consisted of an electronic core counter, an evaluation pulse tester, fully automatic and semiautomatic core testers, and a plane tester.

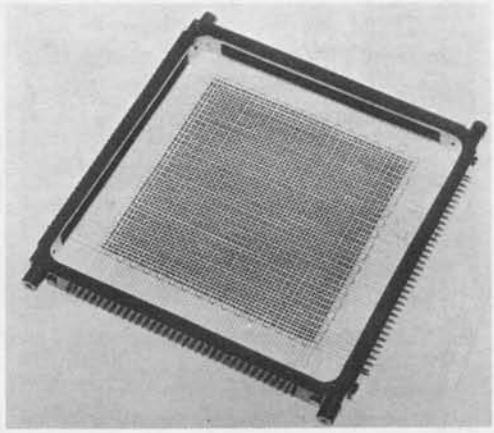
Evaluation Test. Evaluation pulse testing was performed on a sample of 20 cores. The data obtained from the hysteresis-loop tests and the evaluation pulse tests yielded important information concerning the performance of core lots in a memory. It was at this step where lots could be rejected on the basis of the evaluation test.



Stringing. After core testing had been completed, the magnetic cores which had been accepted were hand strung into memory planes of 4096 cores each.



Final Test. The cores in the plane were then given a final pulse-response test in order insure their acceptability. If damaged, removal of defective cores from a plane was easy at this stage.



Finished Product. The final operation in the construction of a plane was the insertion of the inhibit winding and sensing wire which linked all the cores in the plane.

The Evolution of Software

The following excerpts are from a lecture presented at The Computer Museum on September 22, 1983.

The Engineer

He golfs, lectures and writes. He also creates objects, industries, employs, creates choice, has confrontations with nature, capitalizes, invests, manufactures, and markets. Some become wealthy and institutionalize themselves, while others become critics, they then repent, reinvent man, immortalize, and warn us of problems.

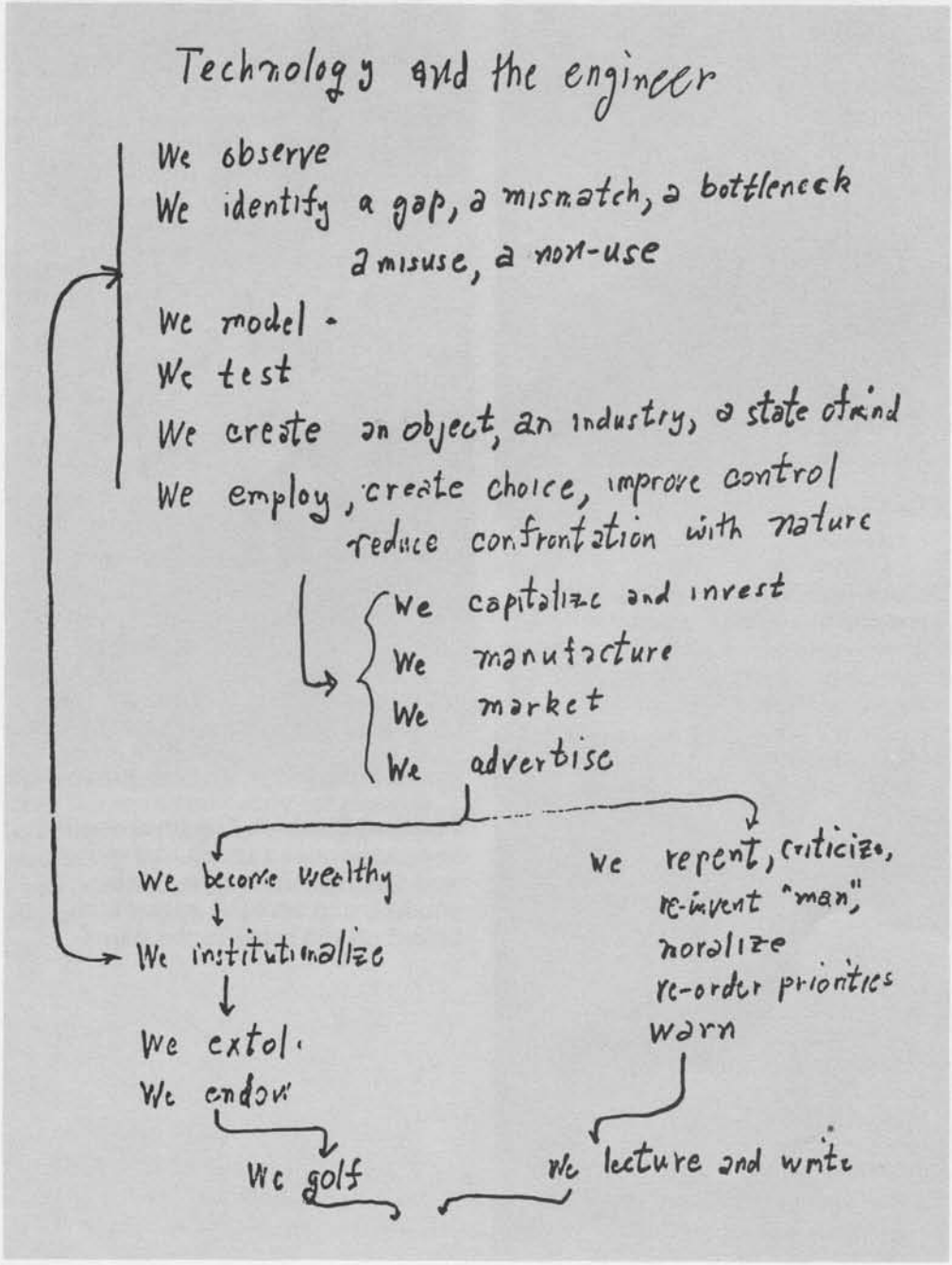
Software

The definition of software is: That which is in the computer and is not hard. The use is not pejorative, but is indicative of plasticity and tendency of change. Some say that software is made up of algorithms, systems, packages, modules, etc. Organithm is another word that could be used to describe software, if one wished to concentrate on its evolutionary and dynamic aspects. Each of these words accent an aspect of software. It is we who have created an enormous number of algorithms. Systems are collections of programs that cooperate to carry out a number of related activities. They have boundaries and inflate, collapse, and reinflate.

Packages accent portability to other machines and places, and sharp boundaries. They also reform specific jobs.

Organithms, dynamic collections of algorithms, modules, etc., evolve, give birth, and perish. They have no inherent stability or solid shape. They flourish in the machine because they exercise the mind.

All these words are found in literature and the press. They accent different aspects of software.



The Computer, Determining Factor

As computers become smaller and more reliable, the problem arises of making software smaller. The only things which we can easily build that work reliably are things which we have already built. One major problem we encounter is that we cannot guarantee to build software which works the first time.

The physical computer and applications drive software. Science and engineering were the source of the first applications. Hence, the first programming languages were designed to fit scientific and engineering calculations.

When seeking the unattainable, simplicity only gets in the way (that is for people who write government contracts).

Everything we do in nature may end up being modeled on the computer, which means that we must find programs that do the things we think about.

Important factors are the people who are doing the computing, who ought to be doing it, and who will be doing it in the future.

In the mind of the programmer, software is a mirror of what a collective mind wishes to think about and process. Computers will fail us in the most critical way, unless almost everything in our mind can be captured in programming, and hence in executable programs. We must keep in mind that whereas the arts interpret our dreams, computers execute them,

thereby changing the boundaries of our dream worlds, irrevocably.

Perfection in synthesis, software included, defines monuments, but is an encumbrance in tools. APL is an example of such a synthesis. It was designed, not by a committee, but by one person, which is a rarity in programming languages. Not only was it designed by one person, but it also resisted evolution because of its initial perfection. The only thing APL compares favorably to is the statue of Moses in Rome by Michaelangelo. It has few rough edges and is made out of stone. Perfection has no need for change and growth. For languages and software this is the kiss of death.

You can not pass from the informal to the formal by formal means.

Two Issues Which Govern Software: Function and the Way Things Will Fit

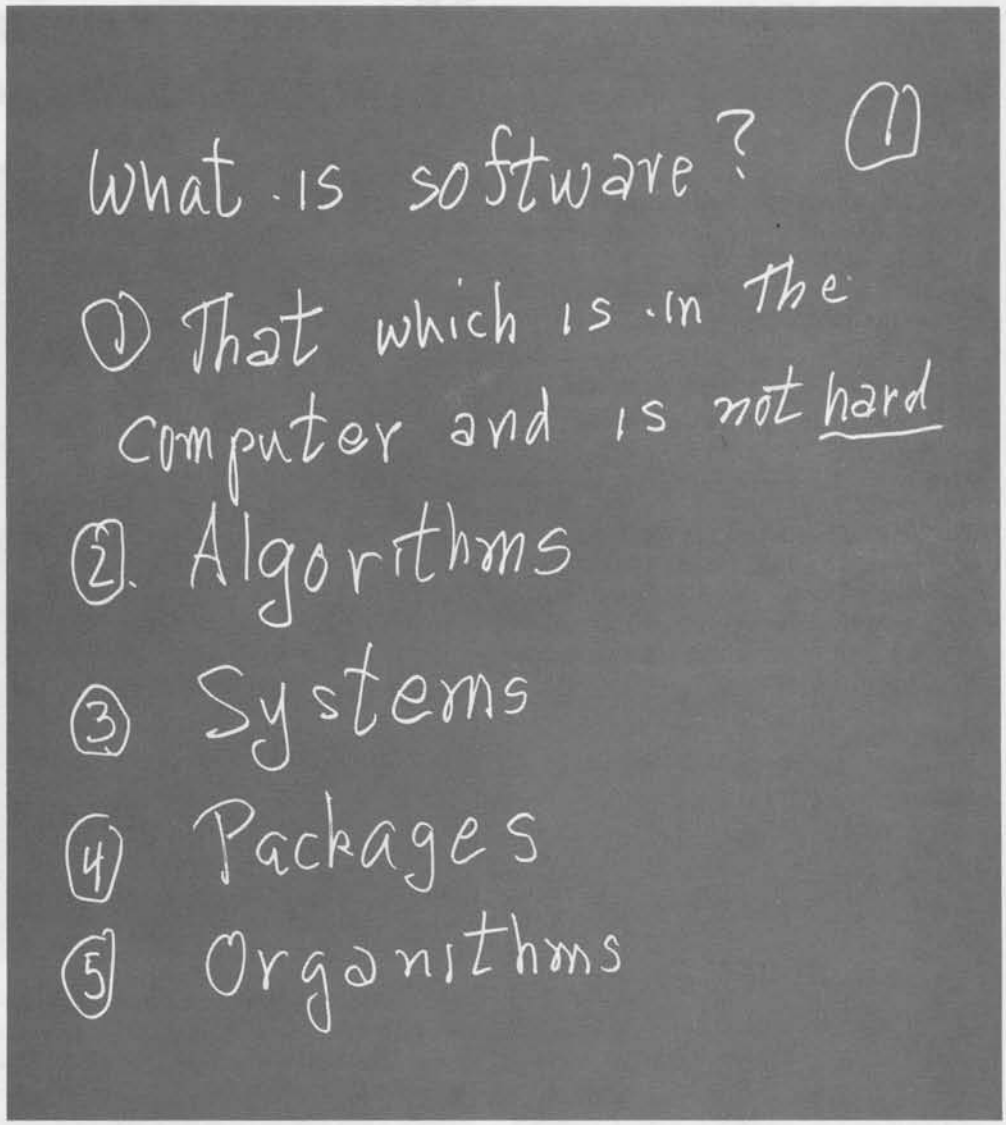
The concept of the procedure or function is a driving force behind software organization. After you write two programs you begin to worry about how they fit together. A great deal of design time is spent on making things fit together well.

Binding time is another important factor: When do things become constant and more concrete? It is software that gives us choices in variable binding time where hardware does not.

Driving Forces of Software

Communication is a major factor in computation. We partition tasks and save the results of computation to the degree that communication is available. It is networks that will have the next revolutionary effect on software. A current concern is computer mail over a network. Who is going to process the mail? Only another program can read and process mail when the networks get large. Human beings will drift away from the interfacing with networks and more things will be done by surrogate humans (programs).

Evolution tells us that everything we build is wrong, or, at best, temporary. Thus, the main purpose of software tools is to improve the rate at which we can evolve software. Software, like life itself, is subject to evolution.



The Major Tension in Software is Commerce vs Perception

Commerce enables programs to create traffic on computers, and we must get to know what keeps it bound. Yet with perception, every program we write impels us to realize that we should have written something else. Since commerce and perception dominates software, when you write a successful program you want to get it used.

As soon as a program gets large, consequences arise. It becomes so large that people have difficulty changing it from one purpose to another nearby, or grasping its potential.

Effects of dispersion are important because you automatically are beholden to a large anonymous population. Then processing complaints has an enormous cost of dispersion.

Pascal owes its importance to the minicomputer and the microcomputer.

For man, immortality can only be achieved posthumously.

Concerning the past proceduring of software, only when you have executed a system can you determine what the real procedures are.

What is the role of language? Languages are important because they shape the way we think and communicate to human and machine.

If you teach people BASIC first, they will be crippled when they attempt to master APL. We appreciate how narrow our computer languages are, but do not know how to expand them graciously. It is not that we are reinventing the wheel, but that we do not know how to invent wheels of every appropriate size.

Size of Machines

Tools, automatic programming and cooperation are essential to the reduction of machine size. But it is important for us to also create large machines of low efficiency and high

utility because we need systems for understanding natural languages, processing vision, etc. It is their imperfections which will spark the work that will lead to better, more useful, and more economical systems.

In programming, the search for brevity is the search for survival.

What is The Measure for Success?

The ratio of how little we can put into a machine to how much we can get out of it measures success. Put another way, the cost of the future is the delay in utilizing the past.

Alan J. Perlis
Eugene Higgins Professor of Computer Science, Yale University

貴方のコンピュータが
英語を話すなら
多分日本製である

"If your computer speaks English, it was probably made in Japan."
Alan J. Perlis

Museum Receives University of Illinois Collection

University of Illinois Collection. *Professor James N. Snyder, head of the Computer Science Department at the University of Illinois, hands Gordon Bell a sense amplifier from the ILLIAC II while Daniel C. Drucker, dean of engineering, looks on.*

A collection of computing components and calculating instruments from the University of Illinois was recently given to The Computer Museum. This collection includes significant components from ILLIACs I, II, and III, as well as calculating and drawing instruments from the university's Department of Mathematics and Engineering. Included was a motorized Millionaire calculator with a keyboard which completes the Museum's collection on the evolution of this instrument.

Museum board member Gordon Bell, who gave a series of lectures at the University of Illinois, formally accepted the collection for the Museum. The collection was delivered to the Museum's new location at Museum Wharf in downtown Boston and will be integrated into new exhibits.

UNISERVO. A typographical error in the last Report led to the renaming of Uniservo, the tape handler for Univac's plated thin film metal recording tape. Its correct name is Uniservo not "Universo" as printed on page 13 of the Fall Report.

Kurzweil Reading Machine Speaks at Bits and Bites Presentation

"It sounds like an Irishman with a Mexican accent," says one listener. "No, I think it sounds like a German version of Speak and Spell," argues another onlooker.

Oblivious to the spectators, the reader continues: "Oh say can you see by the dawn's ear-ly light, what bright stars and . . ."

The Kurzweil Reading Machine recited the "Star Spangled Banner" to a rapt audience of thirty at the first talk of the fall "Bits and Bites" series on September 18th.

Sounding out the words phonetically, the Kurzweil machine also read the poster promoting itself. "The great est thing since Braille." The Kurz-weil Read-ing Ma-chine reads print-ed ma-te-ri-al a-loud.

Assisting the machine in the demonstration were Gail Yarnell and Randy Stern of Kurzweil Computer Products.

The Kurzweil Reading Machine reads everything from newspapers to books and original manuscripts. Designed in 1974 by Raymond Kurzweil, the machine uses an electronic scanner with a speech synthesizer to read printed material aloud.

It can read 200 different typefaces at up to 255 words-per-minute. The machine is programmed for one thousand linguistic rules and two thousand exceptions.

Both its cost and size have dropped dramatically since its introduction. Initially it filled half a room and could only read print typed on Kurzweil's personal typewriter. Today, it comes as a desk-top model and costs $29,000 ($20,000 less than its original price in 1974).

Hundreds of libraries and universities throughout the country now have Kurzweil Reading Machines, and a number of blind people also have them in their offices.

Currently, the machines only read English, but the company is working on programs to have it read several European languages.

The early Kurzweil machine with its Nova 3 interior on exhibit at The Computer Museum was a gift of Kurzweil Computer Products, a division of Xerox Corporation. More advanced versions speak without a "foreign accent."

Kurzweil Machine Reads. *An attentive audience listens to the Kurzweil Reading Machine read aloud at a fall Bits and Bites presentation. Standing by the machine is Gail Yarnell of Kurzweil Computer Products, who demonstrated the unique device.*

Explaining. *Gail Yarnell describes how the Kurzweil Reading Machine works to a visitor at the Bits and Bites fall gallery talk about the new machine.*

Bits and Bites on Multiwire

Joe Hammond. *Hammond, vice president, Discrete Wiring Technology, PCK Technology Division, Kollmorgen Corporation, explains the evolution, development and use of the Multiwire Wiring Machine, on view in the Third Generation Gallery at The Computer Museum. Ken Fisher, board member of Kollmorgen, and his wife, Barbara, are sitting just in front of the machine. Hammond's presentation on September 18th was the second of eight fall Bits and Bites gallery talks.*

Members Visit Museum Wharf

On Sunday, September 11th, with record breaking temperatures of over 95 degrees in downtown Boston, about 100 members explored our new empty, but cool place. While the space is bare of any furnishings, it has all the basics: a heat pump for each of the major galleries, sprinkler systems, proper emergency fire stairs, and facilities to meet the needs of the handicapped.

Scenic View. *A slow elevator ride from the ground floor up to The Computer Museum's space on floors five and six gave visiting members a chance to see Fort Point Channel, the Tea Party Ship and downtown Boston.*

Wharf Interior. *Greg Welch, from the Museum exhibits department, shows a group of members through the new environment. Red tape and chalk on the floor indicate divider walls and exhibit areas respectively. Members touring the facilities had to rely on their memories and imaginations to visualize the new exhibits.*

Yard Sale

On Sunday October 2nd, The Computer Museum held its first cash and carry indoor yard sale to sell duplicate items from the Museum's collection. With the help of many volunteers, the sale was a success as well as a day of hard work for those involved.

After the first hour, it became clear that the buyers did not want the big old machines, just their parts. Members, Don Gaubatz, Bill Ricker, Ian MacLennan, Dave Koogler, Armando Stettner, and Dick Rubinstein, along with the staff went to work with screwdrivers and pliers and took everything apart. Every core memory stack that could be salvaged was sold; along with every old name plate and console panel.

It was the hackers version of "Let's make a Deal." Members set prices and made deals all day. Susan Kaelin, the cashier, sold more than a thousand dollars worth of bits and pieces and one whole PDP-8.

A number of children came with their parents and went off with piles of components: clearly the next engineers tinkering at home—perhaps to the consternation of a parent—but also getting a feeling for the technology.

The yard sale brought the staff and some members closer together. At the suggestion of the participants, the Museum now plans to have some work parties in order to prepare for the move to Boston.

Checking It Out

Rummaging

Making a Sale

Membership Coupon

Join the Museum or Give a Gift Membership

Membership

Name _____

Address _____

City/Town _____

State _____ Zip _____

Gift Membership

Name _____

Address _____

City/Town _____

State _____ Zip _____

Enclose card from:

_____

Please enter a membership in the following category:

- ☐ *Member $25*
- ☐ *Founder $250*
- ☐ *Corporate Founder $2500*

All members receive the quarterly Museum Report, a 10% discount on Museum Store purchases, and announcements of Museum programs and events. All membership contributions are tax-deductible within the limits provided by law.

To become a Member or Founder fill out this coupon and return it with your check or money order to:

Membership Coordinator
The Computer Museum
One Iron Way
Marlboro, Massachusetts 01752

Order Form

The Computer Museum has added integrated circuits to its Slide Collection. The slides are from the Museum's 1984 Computer Era Calendar. The calendar and the slides are available now.

To order the calendar or slides from the collection return this coupon with a check or money order to:

The Computer Museum Store
One Iron Way
Marlboro, Massachusetts
01752

☐	1984 Computer Era Calendar	$ 6.95
☐	Set 9	$10.00
☐	Set 1–8	$25.00
☐	Set 1	$ 3.50
☐	Set 2	$ 3.50
☐	Set 3	$ 3.50
☐	Set 4	$ 3.50
☐	Set 5	$ 3.50
☐	Set 6	$ 3.50
☐	Set 7	$ 3.50
☐	Set 8	$ 3.50
☐	Singles	$ 2.00 each

Subtotal

Add 5% Sales Tax if Mass. resident

Add Shipping cost of $1.50

TOTAL

Name:

Address:

Tel:

Date:

Museum Slides and 1984 Computer Era Calendar

Set 1: Information Processing History Graphs and Charts
1.1 Theory of Computer Generations.
1.2 Tree of Computer Evolution from 1950 to the 1980's.
1.3 The Pioneer Computers: Memory Size versus Computation Speed.
1.4 Speed of Calculations versus Generation for Manual through ULSI Technology.

Set 2: Early Calculating Devices
2.1 Napier's Bones: 17th Century Mechanical Aid to Multiplication.
2.2 Pascaline: Mechanical Adding Machine invented by Blaise Pascal (1645).
2.3 Thomas Arithmometer: First Four-Function Practical Mechanical Calculator (1820).
2.4 Thacher's Cylindrical Slide Rule: Achieved the Equivalence of a Sixty Foot Slide Rule (1881).

Set 3: Hollerith's Tabulator and Sorter for the 1890 U.S. Census
3.1 The Computer Museum's Exhibit of Herman Hollerith's Tabulating and Sorting Machine.
3.2 Pantograph: Manual Device used to Punch Blank Census Cards.
3.3 Punched Card Reader.
3.4 Punched Card Sorter.

Set 4: MIT's Whirlwind Computer (1945–1953)
4.1 16K Core Memory Stack, Fixed Head Drum and Roomsized Console.
4.2 Fixed Head Drum for Secondary Memory.
4.3 A few of Whirlwind's 5000 Vacuum Tubes.
4.4 Arithmetic Elements of the 32-foot Long, 16-Bit Word.

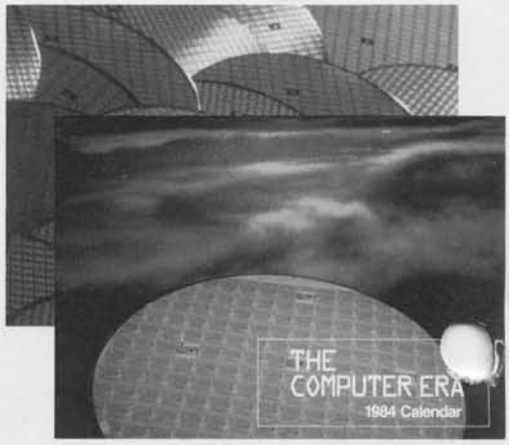
Set 5: Early Computers
5.1 SAGE: AN/FSQ-7 Vacuum Tube Computer for Air Defense (1957).
5.2 TX-0: MIT's Full-scale, Transistorized Computer (1956).
5.3 PDP-1: Second Generation Computer, First Video Game "Space War" (1960).
5.4 PDP-8: First Mini-Computer (1965).

Set 6: Super Computers
6.1 IBM 7030: "Stretch" Console (1961).
6.2 CDC 6600: Console and Processing Cabinet, designed by Seymour Cray (1964).
6.3 Texas Instrument's ASC (Advanced Scientific Computer): Chassis Harness Interconnect of a Processing Unit (1971).
6.4 Burrough's ILLIAC IV: Burroughs Disk, Processing Cabinet and Processing Element with Fairchild Semiconductor Memory (1975).

Set 7: Logic Technology
7.1 Vacuum Tubes and British Valv from the Mark I circa 1950.
7.2 Transistor Circuitry Modules from a PDP-8 circa 1965.
7.3 Integrated Circuit Board from a PDP-11 circa 1972.
7.4 Micro-processor: Computer on a Silicon Chip circa 1976.

Set 8: Memory Technology
8.1 William's Tube: Cathode Ray Tube for Primary Memory circa 1948.
8.2 Core Memory Plane circa 1958.
8.3 Fixed Head Drum from English Electric's DEUCE circa 1957.
8.4 Hard Magnetic Disk from the "Stretch" circa 1961.

Set 9: Integrated Circuits (Full-color slides from the 1984 Computer Era Calendar, chronicling the history of integrated circuits.)
9.1 The first transistor, assembled at Bell Laboratories.
9.2 The first integrated circuits from Texas Instruments.
9.3 A diffusion furnace from National Semiconductor.
9.4 Silicon wafers from Mitel illustrating their fine translucent quality.
9.5 Processed silicon wafers from Inmos after they are packaged.
9.6 The Harris Semiconductor programmable read-only memory, shown during wafer probe test.
9.7 A Ferranti gate array.
9.8 A color raster workstation from CGX used to design very large scale integrated circuits.
9.9 A 16-bit monolithic computing system from Zilog.
9.10 A Photomicrograph illustrating bit-slice technology from Advanced Micro Devices.
9.11 IBM's largest capacity experimental memory chip, a 288K integrated circuit.
9.12 A contemporary data processing chip from Bell Laboratories.



1984 Computer Era Calendar

The Founders Program

Corporate Founders

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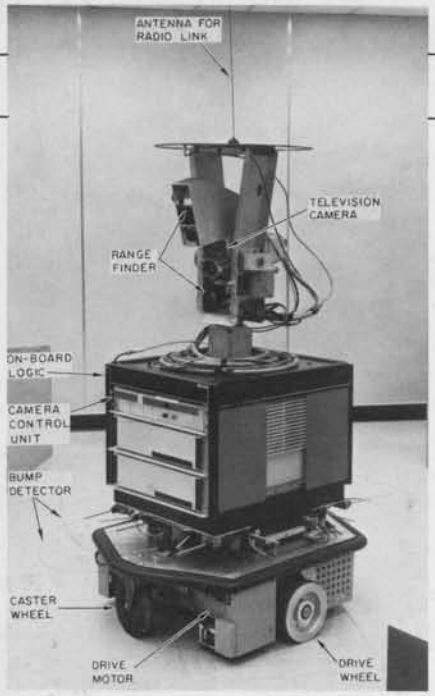

THE END BIT

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A newsbrief of the collection

The Computer Museum has a new found friend named Shakey. Developed in 1969 by the Stanford Research Institute, Shakey was the first fully-mobile robot with artificial intelligence. He was not named until fully operational, and then named himself by his "shakey" actions. Shakey is seven feet tall with his antenna, has a TV camera, and touch and distance sensors. Shakey will be on exhibit in our new home at Museum Wharf.

The Computer Museum

One Iron Way
Marlboro,
Massachusetts
01752

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