June 2000

A Publication of The Computer Museum History Center
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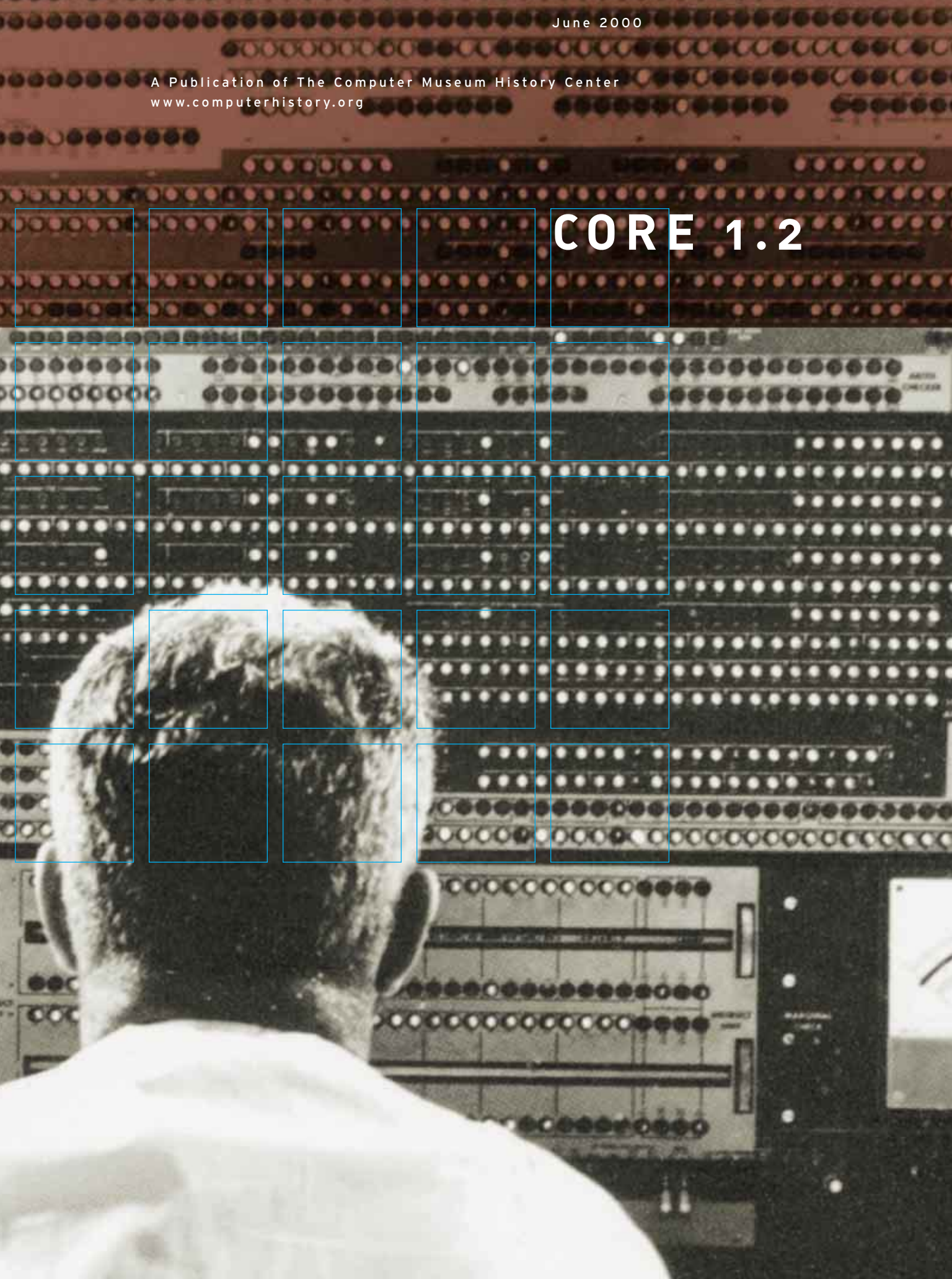
CORE 1.2



A NEW VISION

I'm extremely excited and grateful for this once-in-a-lifetime opportunity to serve as The Computer Museum History Center's new Executive Director and CEO. We have an important dream — to preserve and present the artifacts and stories of the information age — and a rapidly unfolding plan to make it a reality.

Our strategic advantages not only go beyond our growing, world-class collection of artifacts but also include people who make daily commitments of energy, time, and money. We have the best staff, volunteers, Board of Trustees, and donors of any organization I've ever seen!

We have made great strides in the last few months. Over 200 supporters attended our gathering on May 3rd at the Visible Storage Exhibit Area, and I hope you have seen the great press coverage we have been attracting (e.g., ***SF Examiner***, May 12, 2000, "Bits of History"). We are now an independent 501(c)(3) non-profit organization; the Board has added several dynamic new members (list on opposite page), and our staff is growing to meet your needs (page 13). Our Computer History Lecture Series attracts standing-room audiences and world-class speakers; our collection continues to grow exponentially (page 11); we have added some new exhibits to our Visible Storage Exhibit Area — such as the Meiko CS-2 supercomputer, the Pixar Image computer, and a Sun-1 workstation; we are evolving into a leading partner in the NASA Research Park; and we will soon unveil aggressive plans to develop a permanent home in three to five years! And, I must mention the GREAT team of people who have restored an IBM 1620 – it's a sight to behold, and the real lessons that we've learned from this "info-architectural" dig are being documented for the world.

I have developed a set of priorities and tasks all aimed at moving the Museum forward as the authoritative and world-recognized reference for computer history. These priorities include:

PEOPLE – the individuals who make the museum tick: Board, donors, staff, scientists, hobbyists, volunteers, and people interested in computing history.

INNOVATION – the technologies, ideas, and systems to make a revolutionary new class of museum that will capture computing's past, present, and implications for the future.

COMMUNITIES – the organizations, institutions, societies, and groups that will become our partners in building a persistent collaborative network for the longer term.

OPERATIONS – the principles, policies, technology, and people to operate a world-class museum ecosystem that will exceed all your expectations.

There's so much more to be done, but I know you can tell that we are swiftly moving the museum into its next phase! This translates into a call to help in various ways: 1) Take the time to get involved – as a volunteer, innovator, contributor, donor or lecturer – in capturing, preserving, and organizing history; 2) Help us spread the word about our mission, and encourage others to get involved; 3) Give us your ideas, concerns, and suggestions; 4) Carefully consider contributing to the strong financial base we need each year to operate, and to our capital and endowment opportunities that we will be announcing soon.

Again, thanks for your help – we will always need it! You'll hear from me often as we build this living legacy aimed at preserving the invention that has given each of us so much and has truly changed the world.

John C Toole
Executive Director & CEO

June 2000
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CORE 1.2

Mission
To preserve and present for posterity the artifacts and stories of the information age

Vision
To explore the computing revolution and its impact on the human experience

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Executive Director and CEO

Karen Mathews
Executive Vice President

Eleanor Weber Dickman
Vice President of Development & Public Relations

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Digital Persona

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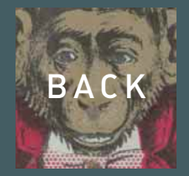

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Mystery Items
from the Collection

Cover Photo
An operator sits at the IBM Stretch's impressive console (see pg 10).

OUR BEGINNINGS

by Eleanor Weber Dickman

Building 126 at Moffett Field, beside the world's largest dirigible hangar

The unloading crew smiled with relief as four 18-wheelers carrying 100,000 pounds of computing history rolled to a stop in front of Building 126 (a warehouse located at NASA's Moffett Field in Mountain View, California). The group was waiting to unload machines, artifacts, documents, photographs, journals and other memorabilia — all bearing witness to the extraordinary history of a most amazing intellectual revolution.

These were not ordinary workmen. In several cases, these very volunteers were developers and users of the mainframes, processors, operating systems, and languages that comprised the collection they were about to move into a Visible Storage Exhibit Area at Moffett Field. This was an important step forward for The Computer Museum History Center that had been established in 1996 in Silicon Valley as the West Coast branch of The Computer Museum in Boston, Massachusetts.

Gordon Bell, Gwen Bell, and Len Shustek stood at the forefront of this effort. Shustek, a staunch advocate for preserving computing history, currently serves as the chairman of the Board of Trustees. Gordon Bell, senior researcher at Microsoft, former VP at Digital Equipment Corporation, and recipient of the National Medal of Technology, and his wife, the visionary Gwen Bell, were the force and drive that had brought The Computer Museum into being over 15 years ago and helped guide it through its amazing development and growth.

IN THE BEGINNING

Gwen Bell remembers how it all began. The concept of a computer museum developed while Gordon Bell, then a professor at Carnegie Mellon University, wrote his classic ***Computer Structures*** with Allen Newell in Pittsburgh in the late 1960s. As Gordon researched diverse information processing systems, he "began bringing back artifacts. Soon, office and home were filled with modules [of early computers], memory devices that predated the core, and calculators that preceded computers."

When the Bells returned to the Boston area so Gordon could run engineering for Digital Equipment Corporation, they needed space for their collection. DEC bought a former RCA building with "a grand lobby and open balcony waiting to be used for exhibits," recalls Gwen. The Digital Computer Museum opened in September 1979.

Its first public event was a lecture on the EDSAC by Maurice Wilkes. At the time, Gwen noted, "the birth of The Museum was coincident with [Digital's] 25th anniversary and... was the Corporation's... present to the public." The Museum was supervised by a distinguished board of directors reflective of the diverse nature of the information industry. Exhibits were augmented with lectures by and about computer pioneers, and included historic and archival collections of machines displayed to show their "intrinsic beauty and functionality."

THE EARLY YEARS: PEOPLE AND PROGRAMS

As the Digital Computer Museum grew, its services expanded. The growth of the archives and library was spurred both by the ongoing collection of artifacts and the development of other programs. Archival documentation, reference materials, and audio-visual transcriptions of lectures extended the Museum's focus to an international scope. In the spring of 1982, the Museum received non-profit charitable foundation status from the Internal Revenue Service. Later that year, the Museum established a store that offered educational material such as books, posters, and slides on the history of computing.

In the fall of 1982, the Museum inaugurated a series of informal talks, known as "Bits and Bites," that included technical presentations as well as reminiscences about the everyday use and development of computers. These talks complemented the formal lectures that focused on significant events in the evolution of information processing, such as Tom West and Tracy Kidder's session on "Inside the Soul of a New Machine."

The Digital Computer Museum celebrates its opening

The Museum relocated to Museum Wharf in the heart of downtown Boston, where it lived for many years

In 1983, a major gallery exhibit devoted to "The Pioneer Computer Timeline" was created, based on a lecture series initiated by Gordon Bell. Speakers included Maurice Wilkes (EDSAC), George Stibitz (Bell Telephone Relay Computers), and John Vincent Atanasoff (breadboard Atanasoff-Berry Computer). A videotaped archive of the series, as well as artifacts such as the Whirlwind, contributed to the integrated exhibit. The Timeline described specifications and gave overview descriptions for each machine in the exhibit. It was Gordon's intent that "the timeline put the pioneer computers in their historic perspective."

A NEW HOME

In the fall of 1983, The Computer Museum finalized plans to relocate to Museum Wharf in the heart of downtown Boston, sharing space with the venerable and popular Children's Museum. The Computer Museum occupied the top two floors of a renovated wool warehouse with a view of the city. It offered greater visibility for the Museum's ambitious educational and preservation goals. An exciting 60,000 square feet of space would be available for exhibition and administration. The Museum, which had dropped "Digital" from its title, set May 1984 as the target date for the opening of its first public exhibition in its new home.

As the year turned, Museum volunteers devoted over 200 person-hours to a series of "packing parties" for the move to 300 Congress Street. And, as they would do 13 years later in California, volunteers helped unpack the collection at its new site.

On November 13, 1984, the Museum officially opened to the public. The initial exhibits included: the Whirlwind vacuum tube computer; the SAGE computer room; Gordon Bell's 20-year timeline of major inventions, software developments, and benchmark applications; and the story of Cray computers. Gwen described the exhibits as "the tip of the iceberg of our collection of artifacts, working machines, software, documentation, photographs and films." Gwen Bell had been at the helm of The Computer Museum since 1982, serving as Founding President, Treasurer, and Executive Director. Oliver Strimpel, the Museum's Associate Director and Curator, aided her from 1983 onward. Joseph F Cashen, a founder of Prime Computer, became the Museum's new executive director in 1987.

PRESTIGIOUS PARTNERSHIPS

In 1988, the Museum signed a collaborative agreement with the Smithsonian Institution's National Museum of American History. The joint arrangement was with the Division of Computers, Information and Society, whose scope encompassed historical research, preservation, and exhibition. The Computer Museum developed a common catalog and a database of both collections, with the goal of preserving all important artifacts.

The Digital Computer Museum's first public event was a lecture on the EDSAC by Maurice Wilkes

Gordon Moore, Len Shustek and Dave House admire the collection after Moore's recent lecture at the Visible Storage Exhibit Area

The museum boasts more than 3,000 computer artifacts, 1,000 films and videos, 5,000 photographs, as well as several thousand linear feet of catalogued documentation and gigabytes of software

The Museum also enjoyed other collaborative relationships with the Scientific Instrument Commission of the Union Internationale d'Histoire et de Philosophie des Sciences, the Science Museum in Kensington (United Kingdom), and the Deutsches Museum in Munich (Germany). According to Gwen, "One of the goals of The Computer Museum [was] to show that computer innovations are not unique to any one country, any one company, or any one institution."

A WORTHY INHERITANCE

Having established a landmark framework for the preservation of the history of computing, the Museum entered a new phase in 1996 with the establishment of The Computer Museum History Center in California. The Boston site continued to emphasize exhibitions while the Silicon Valley organization developed and maintained the archival collections.

A few years later, The Computer Museum in Boston relinquished its exhibition space on Museum Wharf, consolidating its displays under the roof of Boston's premiere Museum of Science. The remaining half of its collections traveled to Moffett Field in February 2000, adding significantly to the archives of the History Center. In 1999, The Computer Museum History Center became an independent entity and is now moving forward with its mission to "preserve and present for posterity the artifacts and stories of the information age."

The Computer Museum History Center currently features a "Visible Storage Exhibit Area," a warehouse space which houses artifacts and other pieces of the History Center's extensive collection. The Museum also conducts a well-respected lecture series and is developing a sophisticated restoration program. One of its first projects involves restoring an early IBM 1620 machine to full operation.

Today, the Museum boasts more than 3,000 computer artifacts, 1,000 films and videos, 5,000 photographs, as well as several thousand linear feet of catalogued documentation and gigabytes of software. All this material now awaits a new home in a multi-million-dollar museum, storage site, and research center that will be built within the next three to five years.

According to John Toole, newly appointed Executive Director and CEO of The Computer Museum History Center, "Our goal is to develop a world-class center where scholars, researchers, and hobbyists can explore, contribute to, and appreciate the important events and discoveries in the timeline of the information age. Our collection of the stories and artifacts of past innovators will become an outstanding showcase for the future."

As Boston Computer Museum's Executive Director Oliver Strimpel once wrote, "The perspective of history casts into sharp relief the astonishing technological changes over the past 50 years of computing. Thus, through preservation, the Museum gains an ability to inspire its visitors..."

In addition to the staff of the Silicon Valley site, the growth of The Computer Museum History Center is aided by a cadre of dedicated volunteers, including Dave Babcock, Lee Courtney, Charlie Pfefferkorn, Elizabeth (Jake) Feinler, and Ed Thelen. Courtney, CEO of Monterey Software Group in Mountain View, stands ready to unpack and set up the new displays. "What the Museum is doing is very important. We really are at the cusp of the information revolution, both with new computers and a history that goes back 50 years. The Museum is capturing this ongoing history and its impact on society."

And, concludes Trustee Chairman Len Shustek, "...we want to build the world's most comprehensive center for the study and research of computing history — creating the industry's center for the technical history of computers, and becoming a specialized and significant center for technical visitors from around the world." He further believes that we are "responsible to provide universal access, freedom from censorship, efficient searches, clever organization, fair intellectual and commercial property rights, and unlimited archival storage — all in a way that makes economic sense."

Fortunately, with its professional, lay, and volunteer leadership, The Computer Museum History Center stands poised to meet this challenge in an exciting and successful way. All who are interested are invited to join us as we implement our vision for the future. ■

Eleanor Weber Dickman is the Vice President of Development & Public Relations at The Computer Museum History Center

NOW

REPORT ON MUSEUM ACTIVITIES

Karen Mathews is the Executive Vice President of The Computer Museum History Center

by Karen Mathews

The year 2000 has been action-packed so far and I certainly believe that there is no stopping us now. Engaging the creative, competent, principled leadership of John Toole is a real coup, and the Museum is already benefiting from his presence. If the Museum offered stock I'd be buying it up, because this organization is a definite winner. Board, staff and volunteers continue to pull together here to create wonders — the drive, stamina and collective abilities are phenomenal. Numerous developments of late have furthered the Museum's mission to preserve and present the artifacts and stories of the information age. Here are just a few:

Gordon Bell with Ned Chapin at a private reception for Core Supporters

Gray-Bell Archive

A central part of the Museum's mission is to present personal stories and perspectives behind important computing developments. In pursuit of this goal, the Museum recently instituted the Gray-Bell Archive, supported by computing industry pioneers Jim Gray and Gordon Bell. "What we have in mind with this archive is to capture views of the pioneers and various aspects of computing," says Bell, a Museum trustee.

As part of the Gray Bell Archive, the Museum was able to acquire the extensive University Video Communications (UVC) collection, containing nearly 200 video presentations by computing legends such as Seymour Cray, Gordon Moore, Bjarne Stroustrup, Alan Kay, Donald Knuth, John Backus, Carver Mead, and many others. Many contain information not recorded elsewhere.

With the addition of the UVC collection, the Museum's video and film archive now includes 1,000 titles. Some of these are both viewable online and available on videotape at a nominal charge for classroom, professional or personal use. Visit our website for details, or call Karyn Wolfe at +1 650 604 2570.

Donor Notes

Last December, Trustee John Shoch challenged donors to join him in becoming a Core Supporter. He asked donors and friends to show their continued commitment to the Museum by making gifts between 1K ($1,024) and 64K ($65,536). During the challenge period, more than 60 supporters made contributions totaling $510,000. On February 10, Gordon and Gwen Bell opened their home in a private reception for these Core Supporters, including Gordon & Betty Moore, Gene & Marian Amdahl, and Arthur & Toni Rock (page 12). We thank everyone who contributed to this appeal.

The Museum is now completing its drive for the fiscal year ending June 30, 2000. Please join us and support our mission to preserve the artifacts and stories of the information age by becoming a Core Supporter today!

Since many supporters pay their annual memberships and make donations through gifts of appreciated stock, we have made it even easier to give. Morgan Stanley Dean Witter is now handling the Museum's stock transfer plan. Here is the account information:

FBO: The Computer History Museum Center, DWR Account # 112-014033-072, 245 Lytton Avenue, Suite 200, Palo Alto, CA 94301-1963, DTC #015. Simply contact Matthew Ives at Morgan Stanley Dean Witter, +1 650 853 4072 or Eleanor Dickman at the Museum, +1 650 604 2575.

A crowded Visible Storage Exhibit Area and an air of excitement as Shustek introduces Toole

Chairman of the Board Len Shustek (left) and new Executive Director and CEO John C Toole engage the crowd on May 3

Special Event

A special announcement reception, **REFLECTIONS OF THE PAST, NEW VISION FOR THE FUTURE**, was held May 3rd in the Visible Storage Exhibit Area. Over 200 supporters and friends attended to celebrate the arrival of the Museum's new Executive Director & CEO, John C Toole. Museum Board Chairman Len Shustek, John Toole, and NASA's Nancy Bingham entertained and informed attendees with information about our new leadership, vision, and plans.

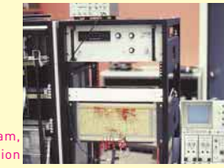
Many thanks for the stellar volunteer services of Mary Artibee, Dave Babcock, Peggy Burke and the creative team at 1185 Design, Lee Courtney, Eleanor Dickman, John Francis, Barbara French, Eli Goldberg, Milt Mallory, John Mashey, Charlie Pfefferkorn, Bill Pitts, Aimee Quemuel, LaFarr Stuart, Ed Thelen, Betsy Toole, Mike Zahares, and other giving and talented people who helped with this event.

Old friends Dave Patterson (left), Bernard Peuto (Museum Trustee), and Forest Baskett

Computing pioneer Donald Knuth admires the Jonniac on May 3 at the New Vision event

Beowulf innovator Thomas Sterling with a Beowulf cluster: off-the-shelf commodity PCs that provide low-cost, high-performance computing

Cliff Stoll fascinates attendees at the reception following the Early Computer Crime lecture



The original SuperPaint hardware, the first paint program, forms part of the Museum's permanent collection

Computer History Lectures

Over 100 people came to hear **BEOWULF-CLASS PC CLUSTERS: AN HISTORICAL PERSPECTIVE** featuring Thomas Sterling of NASA JPL and the California Institute of Technology on April 13. Prof. Sterling revealed the motivation and importance of Beowulf-class computing, its hardware and software elements, and its history - from inception of 16-processor systems, to present day systems of up to 1,000 processors and more.

EARLY COMPUTER CRIME on March 23rd attracted over 300 people who experienced the rare opportunity to hear inside stories from those who have been at the heart of identifying, reporting on and protecting against computer crime. Presented in the wake of the "denial of service" attacks this past spring, panelists — including Whitfield Diffie, distinguished engineer at Sun Microsystems; John Markoff, technology writer for ***The New York Times***; Peter Neumann, principal scientist at SRI International; and Cliff Stoll, astronomer and story-teller — reminisced and discussed the nature of computer crime with an energetic audience. SRI alumnus Donn Parker of Adario provided the introduction. A reception gave attendees a chance to interact with the speakers and explore the Museum's artifacts.

RECOLLECTIONS OF EARLY PAINT SYSTEMS, presented on January 13, featured Dick Shoup and Alvy Ray Smith relating stories of their early adventures in pixel graphics and the development and use of SuperPaint, the world's first paint program. Over 100 people attended the lecture and were entertained by stories and re-creations of some of the earliest computer graphics.

Dedicated volunteer Ed Thelen and Museum Curator (and forklift operator) Dag Spicer unload one of many artifacts from a recent shipment

IBM 1620 Restoration Project

Now in its second year, this volunteer project with team leader Dave Babcock is making great progress. The team is reading and cataloging the 1620 software collection (over 300,000 punch cards) acquired last year, thanks to a hardware loan from Melbourne Technical Services. The project's significant milestones include:

- Completing a semiconductor replacement for the machine's defective core memory unit
- Successfully executing the main IBM CPU diagnostic
- Building, debugging, and running both the console and paper tape emulators
- Sorting and cataloguing 10 boxes of 1620, IBM System/360, and unit record equipment documentation

Through the team's hard work, the Museum now has a running 1620! As the project continues, we will post updates to our website.

Volunteer Notes

The Computer Museum History Center relies on a unique set of dedicated volunteers — and we have some of the best. From college students to CEOs, our volunteers donate their time and talents to preserve computing history. Recently, Museum volunteers have:

- Prepared our newly added 13,000 sq. ft. auxiliary warehouse to safely store more artifacts
- Unloaded four tractor-trailer loads of artifacts from the DEC historical collection donated by Compaq and two loads of artifacts from The Computer Museum at the Museum of Science in Boston
- Prepared 5,000 sq. ft. of additional exhibit space
- Created exhibit displays
- Catalogued hundreds of artifacts
- Donated countless hours and expertise

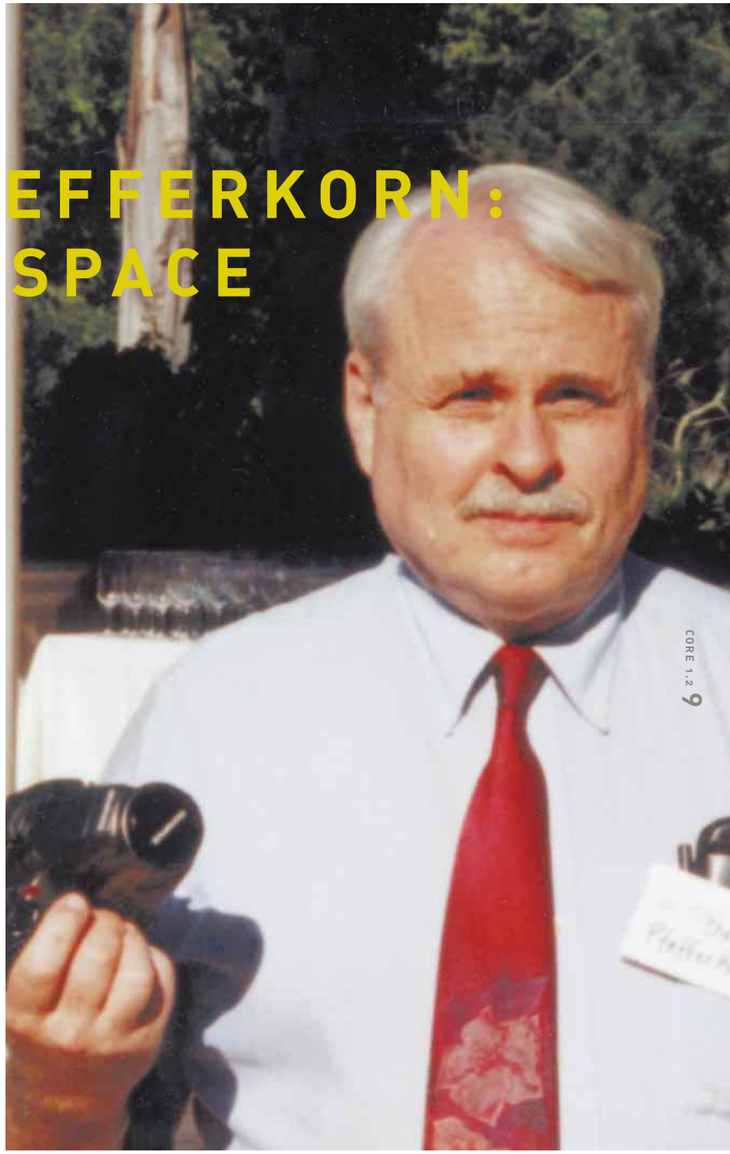
There are a number of volunteer opportunities and countless ways to get involved:

- Helping arrange, catalogue, clean, and photograph artifacts
- Preparing for and staffing lectures and other events
- Assisting with projects in our administrative offices
- Engaging in specific projects geared to individual expertise and talent, including a current need for sheet metal fabrication for the IBM 1620 Restoration Project

We are defining a number of exciting new volunteer projects that require help. If you would like to volunteer to make a difference, contact our volunteer coordinator Lee Courtney (courtney@computerhistory.org). He is a volunteer himself and can help you get involved. ■

VOLUNTEER CHARLIE PFEFFERKORN: MASTER OF SPACE AND TIME

by Lee Courtney



As with most non-profit organizations, a group of dedicated volunteers helps leverage the work of the staff. The contributions of our volunteers include physical plant improvement, curatorial assistance, exhibit construction, restoration, and research. One of these great volunteers is **CHARLIE PFEFFERKORN.**

Working with Dag Spicer, the Museum's Curator, Charlie is responsible for planning and organizing the Museum's complicated storage needs. He analyzes the requirements, creates detailed diagrams, and then helps supervise the placement of the artifacts. He volunteers on a weekly basis.

Charlie helped to mastermind the effort to absorb the recent tidal wave of donated artifacts at the Museum. He planned and helped execute critically important projects, such as relocating a large part of the collection and receiving the Digital Historic Collection, a massive donation by Compaq of 1000+ artifacts transported in four tractor trailers. We're very lucky to have someone as talented and dedicated as Charlie Pfefferkorn, who has rightly earned the title, **MASTER OF SPACE AND TIME** at the Museum!

As a volunteer, Charlie appreciates the chance "to see and work with the various artifacts that define the history of computing." He meets people who have participated in the development of computing and gets to know volunteers with "interesting backgrounds and lots of neat stories" who are making a "significant contribution" to bringing "computer history alive."

Charlie earned a PhD in computer science from Carnegie-Mellon University and was a faculty member at Purdue University. Interestingly, his PhD thesis was in artificial intelligence, focusing on using the computer to design room layouts containing equipment or furniture. His interest in space and storage has thus persevered over the years and now benefits the Museum.

Since arriving in the Silicon Valley over 25 years ago, Charlie has worked for several companies in various technical, managerial, and consulting roles, including working with the ILLIAC IV and other computing projects at NASA Ames. He is also actively involved in the Software Development Forum in San Jose, where he serves as a member of the Executive Council and as co-chair/founder of the International Software SIG. He is also a Visiting Fellow and "Pubmeister" for the Silicon Valley World Internet Center. ■

Lee Courtney is also a volunteer and the volunteer coordinator at The Computer Museum History Center

THE IBM STRETCH SYSTEM

by Dag Spicer

In the early to mid 1950s, IBM and UNIVAC, the only two large companies building computers, were considering the use of transistors in their products. Though the transistor effect had been discovered in 1947 at Bell Labs, vacuum tubes remained commonplace in computer hardware, while American manufacturers struggled to make a reliable, mass-producible transistor.

Today it may seem surprising that IBM was undergoing tremendous turmoil about its role in the new field of computers. However, the public had begun to associate the UNIVAC name (not IBM) with computers. CBS's 1952 election coverage included a UNIVAC machine that correctly predicted Eisenhower's victory. And, when former IBM customers started assigning key contracts to UNIVAC, IBM executives took notice.

Steve "Red" Dunwell and Werner Buchholz, two senior IBM engineers, proposed a new machine, code-named "Datatron." Based on transistors, the machine would enable IBM to leap ahead of UNIVAC and would embody many new architectural concepts.

100 TIMES FASTER

In a famous memo dated October 25, 1954, Dunwell wrote: "The Datatron program is intended to assure IBM a preeminent position in the field..." and will "take a giant step and make substantial advances on all fronts." A team of senior IBM technical and management staff met to consider building what John von Neumann had earlier exhorted them to create: "the most advanced machine... possible in the present state of the art." Besides allowing IBM to leapfrog its main competitor, Dunwell argued that the machine would allow IBM to unify its various computer products — roughly divided along scientific and business lines — thus greatly reducing manufacturing costs and simplifying IBM's engineering and production processes.

After great internal debate and a contract from Los Alamos Scientific Laboratory, the project went ahead. Now code-named "Stretch," the machine was to be "100 times faster than the most advanced computer working today," and President Tom Watson proudly noted that the new machine could complete "100 billion computations in a day."

THE NEWS SPREADS

The first machine (officially named the IBM 7030) was delivered to Los Alamos on April 16, 1961. Although far short of being 100 times faster than competing machines, it was accepted and ran for the next 10 years, with the then-astonishing average reliability of 17 hours before failure.

While customers were generally happy with the machine's performance, internally, Stretch was considered a failure for not meeting its speed benchmark. IBM reduced the price from $13.5 million to $7.78 million, thus guaranteeing that every machine was built at a loss. Dunwell's star within IBM fell dramatically, and he was given fewer responsibilities.

As time went on, however, attitudes within IBM changed. From a lagging position in industry, IBM had moved into the forefront through the manufacturing, packaging, and architectural innovations Stretch had fostered. Dunwell's exile ended in 1966, when the contributions Stretch had made to the development of other IBM machines — including the monumentally successful System/360 product line — became evident. Dunwell was made an IBM Fellow that year, the company's highest honor.

A SUCCESSFUL FAILURE

The Stretch story is only one of many in the history of computing that shows how triumphs are built upon the ashes of "failures." Stretch is one of the hallmark machines — despite its near invisibility to history — that defined the limits of the possible for later generations of computer designers and users. You may recognize many Stretch innovations in present-day products:

- Multiprogramming
- Memory protection
- Generalized interrupt system
- Pipelining
- Memory interleaving
- Speculative execution
- Lookahead (overlap of memory and arithmetic ops)
- Concept of a memory bus
- Coupling two computers to a single memory
- Large core memory (1MB)
- The eight-bit character (the "byte")
- Variable word length
- Standard I/O interface

"THE FASTEST WAY TO SUCCEED IS TO DOUBLE YOUR FAILURE RATE."
Thomas J Watson Sr, founder of IBM

Ironically, microprocessor companies 20 or 30 years later "re-invented" most of these innovations. The Computer Museum History Center has parts of the original Stretch machine (serial number 1) from Los Alamos and a complete Stretch (minus core memory unit) from the Lawrence Livermore National Laboratory.

STRETCH SPECS

The Stretch covered 2,500 square feet, the size of the average American home, and weighed approximately 40,000 lbs. The CPU alone was 900 square feet (30' x 6' x 5'). Nine machines were ultimately produced and sold for $7.78 million each (1961 dollars). The processing units alone used 21kW.

Stretch employed aggressive uniprocessor parallelism; had an instruction set of 735 instructions (including modes) of variable field length; used magnetic core memory (6 x 16KW, 2.1us cycle time); and had 169,200 transistors. The basic machine cycle was 300ns (3.3 MHz), and it performed at approximately 500 KIPS (code dependent). Stretch accommodated word lengths of 64 + 8 check bits (SECDED), had a disk of 2MW and 8Mbps, and used magnetic tape in its 12 x IBM 729 IV tape drives. The machine had a 1,000 cpm (card per minute) card reader; a 600 lpm printer; and a 250 cpm card punch.

FURTHER READING

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Dag Spicer is Curator & Manager of Historical Collections at The Computer Museum History Center

A version of this article first appeared in ***Dr. Dobbs Journal*** online.

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to The Computer Museum History Center

MECHANICAL CALCULATORS

Friden SRQ 10 Calculator (1964), X1781.2000, Gift of Andrew Egendorf

Friden STW 10 Calculator (1950), X1782.2000, Gift of Andrew Egendorf

Friden ST 10 Calculator (1945), X1783.2000, Gift of Andrew Egendorf

Monroe LA7-160 Adding Machine (1945), X1805.2000, Gift of Andrew Egendorf

NCR 31A Accounting Machine (1940s), X1821.2000, Gift of Dale Takeda

UNIT RECORD EQUIPMENT

IBM Type 3741 Dual Data Station (1984), X1806.2000, Gift of Bill Richardson

IBM Type 3742 Dual Data Station (1984), X1803.2000, Gift of Bill Richardson

IBM Type 5225 Printer (1984), X1804.2000, Gift of Bill Richardson

IBM Type 557 Alphabetic Interpreter (1948), X1802.2000, Gift of Bill Richardson

MICROCOMPUTERS

IBM 5110 Personal Portable Computer System (1978), X1780.2000, Gift of Carol Tomlinson

MITS Altair 8800 (1975), X1827.2000, Gift of Craig Payne

Morrow Designs MD-2 (1983), X1800.2000 A, Gift of Joe Pryluck

Commodore 128 System (1984), X1775.2000, Gift of Robert and Mary Ward

Mac Portable (1989), X1894.2000, Gift of Randy Katz

MINICOMPUTERS

HP 3000/52 (1980), X1880.2000, Gift of Advant Corporation

HP 3000/I (1974), X1881.2000, Gift of Advant Corporation

HP 3000/III (1978), X1882.2000, Gift of Advant Corporation

HP Micro 3000 (1986), X1883.2000, Gift of Advant Corporation

SUPERCOMPUTERS

Meiko CS-2 Supercomputer (1994), X1860.2000, Gift of UCSB and Alpha Processor

MIT J-Machine Supercomputer Prototype (1988), X1858.2000, Gift of MIT

IBM MRCS - Multi-RIOS Computer Server Prototype (1991), X1776.2000, Gift of IBM Research

WORKSTATIONS

PIXAR Image Computer (1985), X1823.2000, Gift of Loren Carpenter

Sun 4/260 System (1988), X1801.2000, Gift of William King

Sun-1 Workstation (1982), X1825.2000, Gift of Caltech

Sun-1 Workstation (1982), X1826.2000, Gift of Caltech

OTHER/SPECIAL PURPOSE

Heath EC-1 Electronic Analog Computer (1960), X1827.2000, Gift of Paul Kostka

Sony SOBAX Electronic Calculator (1978), X1887.2000, Gift of Eric Barbour

Lynn Conway's personal papers on IBM ACS Project (1965+), Gift of Lynn Conway

Ford/Visteon Engine Computer Collection (1978-1999), X1835.2000 - X1840.2000, Gift of Ford/Visteon

IBM Floppy Disk Drive (Project Minnow) Prototype (1970), X1841.2000, Gift of David Noble

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We look forward to getting to know you!

A future lecture will feature Dave Ditzel talking about his experiences with the Fairchild Symbol, a one-of-a-kind machine he was delighted to re-discover at a recent visit to the Museum

UPCOMING EVENTS

JUNE 22
COMPUTER BOWL KICK-OFF EVENT
www.computerbowl.org

THE FAIRCHILD SYMBOL MACHINE
David Ditzel, Transmeta
Computer History Lecture

EARLY TRANSISTORIZED COMPUTERS
Richard L Grimsdale,
University of Sussex
Computer History Lecture

NOVEMBER 9
Annual Fellow Awards

Check our website regularly for updates and details: www.computerhistory.org.

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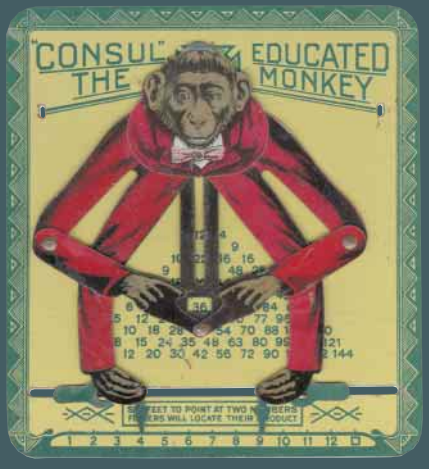
The Computer Museum History Center is housed at NASA Ames Research Center, Moffett Field, California. To attend an event or to tour the collection, please call Wendy-Ann Francis +1 650 604 2579 a minimum of 24 hours in advance. The collection is open to the general public by appointment on Wednesdays at 1:00 pm. Members may also request private tours.

Design + Layout = Skout

MYSTERY ITEMS

from the Collection of
The Computer Museum History Center

"CONSUL," THE EDUCATED MONKEY is a simple mechanical calculator made of movable sheet metal parts and a multiplication table insert. When pointing the monkey's feet at a pair of numbers, Consul points to the result in the pyramid of numbers between his hands. By sliding in an "addition table," Consul can also be made to add by the same principle. The calculator was patented on June 27, 1916, by William Robertson, of Belmont, Ohio, and the invention assigned to the Educational Novelty Company of Dayton, Ohio. Consul's packaging states: "It makes no difference to the monkey whether children are bright or stupid. He never loses patience at having to answer their questions."



From the permanent collection of
The Computer Museum History Center.
"Consul," The Educated Monkey (1916), XB302.84,
Gift of Gwen and Gordon Bell

WHAT IS THIS?

This item will be explained in the next issue of CORE.

Please send your best guess to mystery@computerhistory.org before 7/15/00 along with your name and shipping address. The first three correct entries will receive a free poster:
25 YEARS OF MICROPROCESSOR EVOLUTION

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