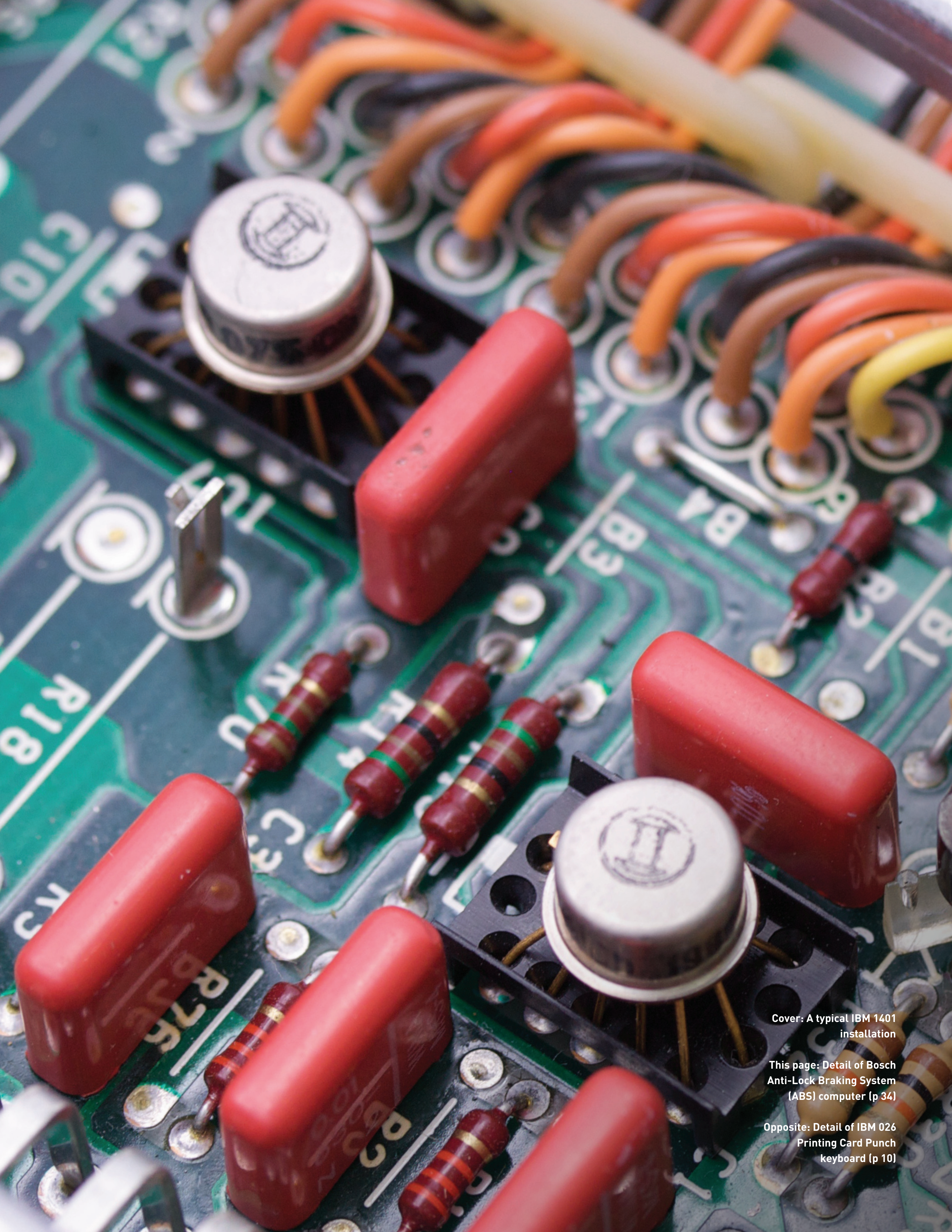
2009

CORE

A Publication of the Computer History Museum

IBM 1401: A Legend Comes Back to Life
The Changing Face of the Mac
The Secret History of Silicon Valley

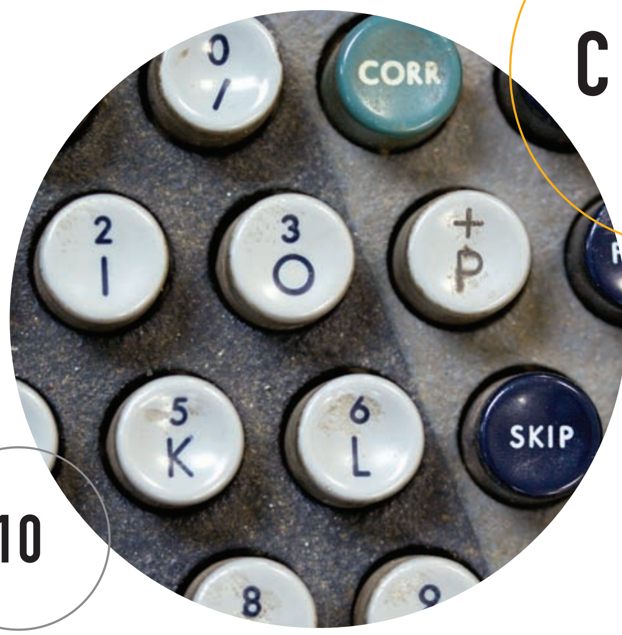


Cover: A typical IBM 1401 installation

This page: Detail of Bosch Anti-Lock Braking System (ABS) computer (p 34)

Opposite: Detail of IBM 026 Printing Card Punch keyboard (p 10)

CORE 2009



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COVER: IBM ARCHIVES

ARCHIVISTS

Archivists:
\ˈär-kə-vist, -ˌkī-\
A person in charge of archives, which is a place in which public records or historical documents are preserved (Merriam-Webster)

ELIZABETH BORCHARDT

DOCUMENTS ARCHIVIST

I enjoy providing access to the Museum's collection. People engaged in researching information from our collection make my work worth it. For example, a hospital was regularly using a 25 year-old IBM 4245 printer that had stopped working. Only the Computer History Museum had the maintenance manuals they needed to repair the printer. Access to our collection provides tremendous value to our community.

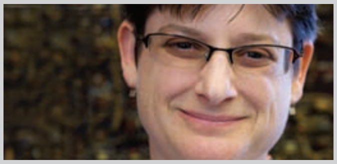
SARA CHABINO LOTT

SOFTWARE ARCHIVIST

Selecting records of historical value from this age of documentary overabundance is quite challenging, but it is also very rewarding. It is the Museum's responsibility to gather artifacts and stories to develop a historical collective memory, and to convey this information from generation to generation—a responsibility I take very seriously.

PAULA JABLONER

DIRECTOR OF COLLECTIONS



One of the joys of being an archivist is the excitement of consistently learning new things, from the historical tidbits gained while cataloging the background stories for new artifacts in our collection. I love passing this new knowledge on to our community as part of the Museum's mission to "preserve and present."

HEATHER YAGER

AUDIOVISUAL ARCHIVIST

My favorite aspect of film and video archival work is preservation. Most of our new video acquisitions are stored in digital formats, so often we are applying traditional archival preservation practices to modern formats. By exploring ways to expand preservation principles to encompass digital videos stored on servers, as well as videos tapes stored on shelves, the Museum can preserve historical content for posterity.

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CEO'S LETTER

A RECIPE FOR

CREATIVE ACCOMPLISHMENT

In his keynote address at the 2009 conference of the American Association of Museums, author Malcolm Gladwell described two essential qualities for what he called "creative accomplishment"—patience and persistence.

Citing his 2008 book, *Outliers: The Story of Success*, Gladwell defined patience in vivid terms: "the 10,000 hour rule." He contends that an individual masters a subject or skill only by patiently spending a minimum of 10,000 hours on it in focused practice. That's an average of 3 hours a day—every day—for 10 years.

Persistence is an equally important ingredient of "creative accomplishment," and it makes sense. Persistence simply means the ability to battle against, and ultimately overcome, the legion of obstacles that stand in the way of creating something worthwhile and enduring.

I am happy to report to you that 2009 has been a year of patience and persistence—and creative accomplishment—for the Museum as an institution. Thanks to your generous support, we patiently maintained our equilibrium in an incredibly turbulent economic storm. For the fiscal year ending June 30, we reported our 14th consecutive year of operating in the black. With our donors' help and commitment, moreover, we were able to do more than simply resist the financial storm. We expanded our public programs to celebrate the 50th anniversary of the integrated circuit, extended the Babbage Engine No. 2 exhibition, opened a new exhibit honoring the history of the semiconductor, and launched the pilot phase of our new education program.

All of this and more is described in our first-ever performance report, which is included with the members' issue of *Core*.

This issue of *Core* is also a tribute to other aspects of computer history that fit Gladwell's recipe. We tell stories celebrating the 25th anniversary of the Macintosh and the 50th anniversary of the IBM 1401, and we survey a small part of "the secret history of Silicon Valley" through a wonderful essay by Steve Blank.

Please accept my sincere thanks for enabling our own brand of creative accomplishment and for making these wonderful results possible this year. Together, we are building on an already great foundation to make the Museum a model for the 21st Century. When you visit, as I hope you will soon, you'll find an institution that is vibrant, growing and optimistic. You can understand why I'm especially excited to be working at the Museum with you in this endeavor.

Warm Regards,

JOHN C. HOLLAR
PRESIDENT & CHIEF EXECUTIVE OFFICER

CONTRIBUTORS

Core 2009 Contributors give us their take on computer history

STEVE BLANK

What is your favorite technology invention?
The Integrated Circuit—Kilby & Noyce

What is your favorite milestone in computer history?
A tie between:
1) William Shockley deciding to start his semiconductor company in Palo Alto.
2) The "Traitorous 8" leaving Shockley Semiconductor to start Fairchild

Why is CHM important?
Each generation assumes it is inventing the future, with no recollection that it's already been done.

Steve Blank is a lecturer at Stanford University's School of Engineering and Berkeley's Haas School of Business. He is a serial entrepreneur, having spent nearly 30 years as a founder and executive of high-tech companies in Silicon Valley.

DAG SPICER

Who is your favorite computer history unsung hero?
Gordon Bell. He had the vision early on that knowing about computers would be important and, with his wife Gwen, took on the arduous task of transforming the early Computer Museum in Boston from a dream into reality.

What is your favorite technology invention?
The 1961 IBM 7030 "Stretch" computer system had features that we still use today and which were absolutely groundbreaking for the time.

Why is CHM important?
We study history not to know dates, times and places but to know ourselves. The computer is now part of all our history and having a place that preserves and explains that history is vitally important to knowing who we are.

Dag Spicer is CHM's Senior Curator.

MARCIN WICHARY

Who is your favorite computer history unsung hero?
Adam Osborne. Just a glimpse of an alternative reality where Osborne Computer survived would make my day.

What is your favorite milestone in computer history?
The coming of micros—many companies jumped in, writing and rewriting the rules as they went along.

Why is CHM important?
Because an artifact doesn't mean much without the slice of history that surrounded its life.

Marcin Wichary is a Senior User Experience Designer at Google and has been a volunteer docent and a photographer at the Computer History Museum since 2007.

FELLOW AWARDS 2009

For more than 20 years, the Computer History Museum Fellow Awards have honored distinguished technology pioneers for their outstanding merits and significant contributions to both the advancement of the computer industry and to the evolution of the Information Age.

The Hall of Fellows is an extension of the Computer History Museum's overarching vision to explore the computing revolution and its worldwide impact on the human experience. The tradition began with our first Fellow, Grace Murray Hopper, inventor of the compiler, and has grown to a distinguished and select group of 47 members. This award represents the highest achievement in computing, honoring the innovators who have forever changed the world with their accomplishments.

In keeping with our mission "to preserve and present for posterity the artifacts and the stories of the Information Age," the Computer History Museum Fellow Awards publicly recognizes and honors these individuals and their accomplishments at an annual Gala Celebration, which was a well attended celebration this year.

We are pleased to honor the Fellow Awards Class of 2009:

Robert R. Everett for his work on the MIT Whirlwind and SAGE computer systems and a lifetime of directing advanced research and development projects.

Don Chamberlin for his fundamental work on Structured Query Language (SQL) and database architectures.

The Team of Federico Faggin, Marcian "Ted" Hoff, Stanley Mazor, Masatoshi Shima for their work on the Intel 4004, the world's first commercial microprocessor.

We thank the nominators of these special pioneers, and also thank Ike Nassi, CHM Trustee, for chairing the Fellows Selection Committee. ○

Nominations for the 2010 Fellows are underway. Visit computerhistory.org/fellowawards..

FELLOW AWARDS

Gordon Moore at the Computer History Museum enjoying a conversation prior to his talk on the Integrated Circuit.

2009 SALUTE TO THE SEMICONDUCTOR

> "Integrated circuits weren't enthusiastically embraced by the customer base in the beginning..."
>
> GORDON MOORE DURING MAY 8TH IC@50 LECTURE EVENT AT CHM

More than 1,000 people attended programs during the week-long CHM IC@50 celebration, which marked the 50th birthday of the integrated circuit (IC).

The IC@50 events were the capstone of the Museum's year-long Salute to the Semiconductor program. This program integrates the Museum's core strengths: a special physical exhibit, "The Silicon Engine;" several CHM Presents evening lectures; a series of CHM Soundbytes lunchtime lectures, a commemorative booklet celebrating the 50th anniversary of the integrated circuit; and several new educational tours.

The IC@50 events included evening lectures by industry pioneers Gordon Moore, Jay Last, Jay Laythrop, Charles Phipps and historian Christophe Lécuyer. Joining the legends were industry executives including Brian Halla, CEO of National Semiconductor, who spoke at the original site of the Fairchild Semiconductor office for the IEEE Commemorative Plaque Unveiling

The IC@50 also provided the first public display of the original Fairchild Semiconductor patent notebooks of Hoerni, Last, Moore, and Noyce. These precious artifacts were on loan from National Semiconductor, the successor to Fairchild Camera and Instrument Corp.

Also on display was a replica of the original Kilby notebook. Texas Instruments created this replica especially for the IC@50 and later donated it to the Museum's collection.

CNET reported: "...As the week wore on at the Computer History Museum, it became clear that with a birthday of this magnitude, it was hard to overstate the impact of the integrated circuit, not just on the technology industry, but on modern society."

Other Salute to the Semiconductor program elements included Harvard Business School Professor Richard S. Tedlow, our first scholar in residence, presenting the Intel 386 business case. Tedlow also spoke to the Museum's student community about how Andy Grove spurred the company's growth during his tenure as Intel CEO. Both events generated stimulating question and answer sessions for our community.

SYNCHRONIZED ELEGANCE IMAGING

550,000

Videos have been viewed on the CHM YouTube channel in just the past year

CHM launched the Silicon Engine exhibit in June with multimedia presentations examining the invention of the integrated circuit, the evolution of the semiconductor industry and the impact of these technologies on our lives. The exhibit draws on the Computer History Museum's collection of 300+ oral histories capturing the first-person stories from the technology giants. It features a multi-screen mini theater showing an 8-minute documentary on the invention of the transistor, the integrated circuit, the rapid growth of the semiconductor and the impact these technologies have made on the human experience.

Missed a Salute event? See the videos on CHM's YouTube channel: youtube.com/computerhistory ○

The IC@50 was co-produced by the Computer History Museum, the Chemical Heritage Foundation and the IEEE Santa Clara Valley Section.

Major funding for the Salute to the Semiconductor was generously provided by the Gordon and Betty Moore Foundation and Intel Corporation. Additional funding for IC@50 events was provided by National Semiconductor.

THE CREATION OF ALDUS

ORAL HISTORIES

INTERVIEWED BY SUZANNE CROCKER
EXCERPTED BY LEN SHUSTEK

The Computer History Museum has an active oral history program to gather videotaped histories from the pioneers of the information age. These interviews are a rich aggregation of personal stories that are preserved in the collection, transcribed, and made available on the web to researchers, students, and anyone curious about how invention and entrepreneurship happens.

Presented here are excerpts from an interview with Paul Brainerd, the founder of Aldus, whose flagship product PageMaker established the PC-based "desktop publishing" industry. The interview was conducted on May 16, 2006.

What was your early publishing experience?
In graduate school, I was the editor of the *University of Minnesota Daily*, a 35,000-circulation daily with a staff of over a hundred students. I learned a lot of valuable lessons there both on the editorial side as well as from a business perspective.

I then went to work for the *Minneapolis Star Tribune* for seven years as assistant to the operations director. We converted from "hot type" composition in the composing room to "cold type" using computer typesetting, and I developed the contracts and the specifications with the various companies. The most important was Atex, who made a text-editing system using computer terminals for reporters to write their stories.

It was an exciting time, getting grounded at a newspaper that had been there for a long time, and being mentored by some excellent people. But it would have been pretty hard to advance there unless I stayed for another 10 or 15 years.

So I joined their supplier, Atex, and moved from newspapers to high-tech. Things moved a lot faster! At the *Star Tribune*, everything required a proposal and two or three months to make a decision. At Atex, things were decided around the water cooler, sometimes in a matter of minutes. I stayed until Atex was purchased by Eastman Kodak in 1983.

Why did you start Aldus?
This whole idea of page layout was near and dear to my heart because I had done it the hard way with exacto knives and razor blades and wax on the back of cold type. Atex was a better but very costly system, mostly used for the larger metropolitan dailies and publications like *Newsweek*. It was fairly arcane, and it could take a month to learn the commands.

So I took the small nest egg from Atex stock plus all my savings—roughly $100,000—and gave myself six months to write a business plan and build a prototype. The engineers worked for half salary, and I worked for no salary. I wrote the business plan, and with the engineers developed the functional specifications for what became PageMaker.

During the summer of 1984, I tried to raise money and was told "no" 49 out of 50 times. The venture capitalists felt that a software company didn't have any long-term market

During the summer of 1984, I tried to raise money and was told "no" 49 out of 50 times. The venture capitalists felt that a software company didn't have any long-term market value.

value. Microsoft hadn't gone public yet! We got to our drop-dead date in September with less than $5,000 left.

Finally, we got a commitment from Vanguard in Palo Alto, who understood why software might have value. We raised $864,000 based on our business plan and a very rough prototype, and we shipped PageMaker 1.0 the following July.

Who was the customer?

When we formed the company in January of '84, it was the professional user. But I made one really smart move, which was we loaded everybody up in my Saab—myself and the three engineers—and took a trip to talk with potential customers about what we had in mind: a page-layout solution for small newspapers. We learned that all these newspapers were owned by chains or other corporate entities, and that their decision-making was typically a one-to-two-year process. That trip convinced us that we would be out of business by the time we sold anything.

That's why it's so important to talk to customers. They loved it, but I realized it wasn't the right market. So I totally revised the marketing section of the business plan to focus on small businesses, churches, schools, and small publishers.

We really underestimated how fundamental the value proposition was—what the "three-legged stool" of PageMaker, the Apple LaserWriter and the Macintosh could do. We were providing an order of magnitude gain compared to the frustrating and costly proofing cycle using a typesetter.

We showed it in January of 1985 when the LaserWriter came out, and people couldn't believe that we could do output of that quality.

> "Technology moves so fast that we often fail to remember the passion, drama and intensity of these moments in computer history. This museum does this for us."
>
> JAY ADELSON
> CEO OF DIGG

Who was the competition?

Our first competition, before we even released the product, was Microsoft, which we were very scared of even then. They had acquired a product from a third party, and put marketing materials together describing pretty much exactly what we were planning on doing. But the product never worked. The code was riddled with bugs and they had to withdraw it from market.

I'd say about half of our competition was like that, and simply dissolved over time. The other half stayed around but made other errors along the way.

> **When PageMaker was first released at a price of $495, that was almost unheard of. But (the gross margin) allowed us to reinvest in customer service, support, and product development.**

What was the association with Apple like?

The alliance was critical to both companies. For Apple, it was critical to the success of the Macintosh, and for Aldus, it was critical to our survival because we did not have the budget to bring PageMaker to the broader market.

We developed a whole desktop publishing marketing plan, which they funded a lot of, including full-page ads in *The Wall Street Journal*. Apple was putting a million dollars plus a month into it, and that gave us incredible momentum. We could never have done that without them.

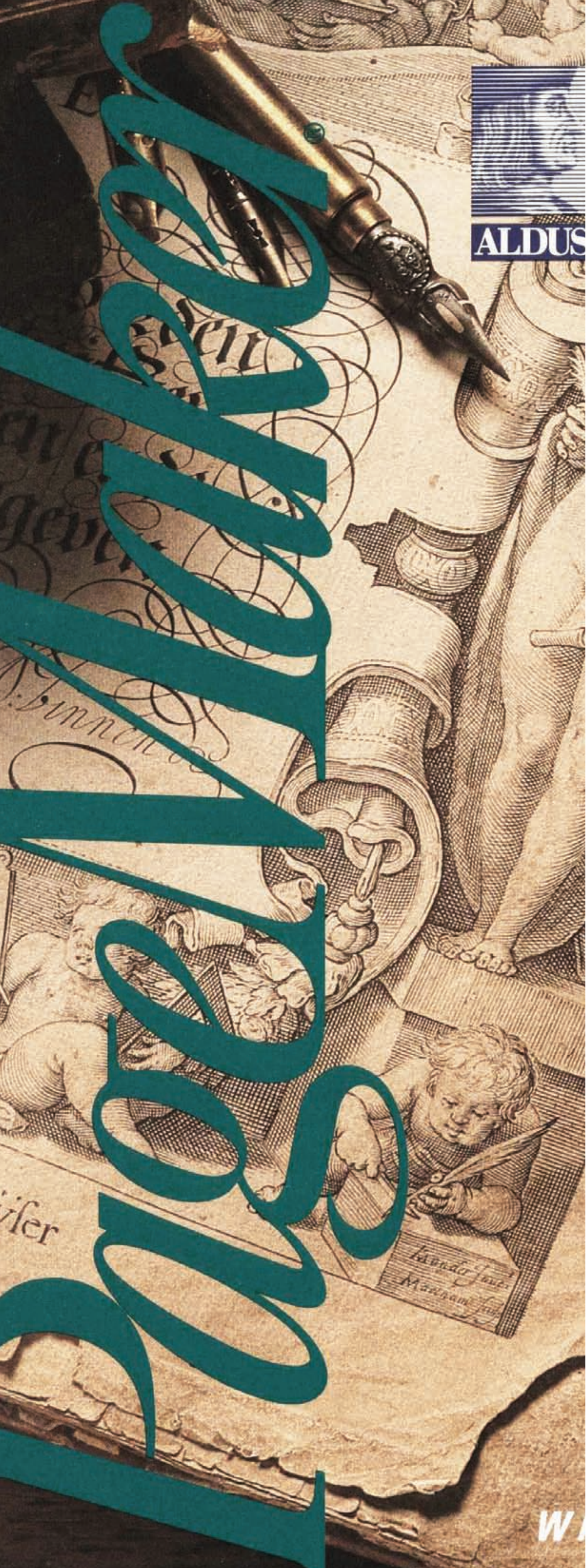
What challenges arose?

When PageMaker was first released at a price of $495, that was almost unheard of on the Macintosh. But it allowed us to have a gross margin of almost 90 percent and gave us all the money we needed to reinvest in customer service, support, and product development.

The problem was that as the industry started to mature in the early '90s, it became more about marketing and distribution. The margins started to go down, and you either had to acquire other companies or be acquired to continue to be successful.

We had become a public company in 1987, which fundamentally changes a company because suddenly you have public shareholders that are no longer interested in long-term product development. I ended up spending way too much of my time dealing with attorneys and shareholders, and less time doing the things I really enjoyed: talking to customers, understanding their needs, and working with the engineers to develop the products.

After seven or eight years, I went to the board and said, "I've really got to work out a transition plan here." The initial concept was to find a replacement, but we tried that two times and it didn't work.



Cover of the box of Pagemaker Version 1.0.

It's very hard, as you know, to replace a founder in this industry.

Instead, I actively solicited Adobe to acquire us. I felt that overall there was good synergy with our product lines, even though there was some overlap with FreeHand and Adobe Illustrator.

What made Aldus and Adobe compatible?

At a 30,000 foot level, we had similar approaches to running a company. But at a working level, there were some very definite philosophical differences.

There was a definite difference in the customer orientation. We spent a lot more time talking to customers. Adobe's philosophy was more of an engineering-based one: if we make a great product, like PostScript, sooner or later people will want it.

But the reason I even considered Adobe was their underlying ethical standard of running a high-quality company that was fair to their customers and their employees. Unfortunately, that couldn't be said of all the companies in the industry.

A lot of thought went into the merger, and I think it was one of the best. We were very honest with employees, and very clear about who would be staying and who would not. We gave a fair severance package, and a bonus to those who needed to stay through the transition. I think 99 percent of the employees felt that they were treated very fairly.

I then made a clean break with the business world and technology, and was off on my new career in the non-profit world. I endowed the Brainerd Foundation, which gives out about $3 million a year in support of environmental and social programs. It is very gratifying work because of the impact it has on people's lives.

And we are grateful for the impact that Aldus had. ○

CHM has conducted more than 300 oral histories since this initiative began in 2002. The online collection provides 150 transcribed interviews available to the public.

For pictures and full transcript of Brainerd's oral history, and the full 25-page transcript of Brainerd's oral history, visit: computerhistory.org/collections/oralhistories.
Title: Brainerd (Paul) Oral History
CHM#: 102657986

Oral history interviews are not scripted, and a transcript of casual speech is very different from what one would write. We have taken the liberty of editing and reordering freely for presentation.

IBM 1401 system.
Opposite: Detail of IBM 026 Printing Card Punch

FEATURE

BA

The story behind CHM's IBM 1401 restoration

BY DAG SPICER

CK TO LIFE

Amid the sound of cards being punched and the smell of hydraulic fluid from its printer, a team of Museum volunteers is restoring a classic computer system from the past in one of CHM's Restoration Laboratories. Known as the IBM 1401, this computer was released in 1959 and became one of the most successful in IBM's history—indeed in the history of computing itself. Never heard of it? That is perhaps not surprising since it's 50 years old. At a time when the world was just beginning to see the potential of computers in education, business and government, the 1401 was already a home run for IBM. With this computer, the company rode the wave of modernization, rapid growth, and optimism about the future that was so characteristic of the early 1960s.

For nearly the entire twentieth century, IBM was well known in the business world. And, thanks to a corporate outlook that was attuned to its own public image, it was known to many ordinary Americans as well. IBM was conservative and staid. It was a company that sold service—not just machines. In a rapidly changing business world, IBM stood for reliability and was known for solving customer problems, not just selling them equipment.

IBM based its business—from its origins at the start of the twentieth century until the start of the electronic computer era—on a piece of stiff paper stock known as a "punched card."

The punched card recorded information in the form of holes punched out of it according to a unique code. This information could be anything: someone's paycheck, a mathematical formula, a list of names, sales figures, or any information that could be contained in the punched card's 80-char-

IBM promotional photo showing typical 1401 system.

acter limit. The idea of a card holding one type of information—a "unit" of information, if you will—led to the card being known as a unit record and the machines that processed these cards were known as unit record (or punched card) equipment.

Such punched card machines performed basic but powerful business functions such as sorting, collating, reproducing (making a copy of the card), and so on. IBM (and its competitors) built machines that could process this information according to a pattern set by the user using wires plugged into a control panel. Panels thus represent a set of instructions or basic form of program.

Unit record equipment was used for nearly the entire twentieth century, albeit in greatly declining numbers after about 1970. IBM made billions of dollars leasing equipment while American (and international) business adopted the unit record approach to their business processes. By one estimate, in 1960 the sale of blank punched cards alone represented nearly 30 percent of IBM's revenue.

IBM Moves to Electronics

IBM began its electronic computer efforts around the end of WWII. Most of these early computers were gigantic, room-filling mainframe machines with a limited market. Typical clients were the military, government departments and well-heeled corporations, insurance companies and banks. By the late 1950s, IBM had produced several successful computers—still large, to be sure—but with increasing performance and relatively decreasing cost, a theme that has come to characterize the industry. There were many incompatible systems and virtually no software tools or languages. (FORTRAN, the popular scientific and engineering programming language, would come out of IBM in 1957; the business-oriented language COBOL was announced in the early 1960s). Users—even competitors—banded together to share information and control panel-wiring patterns.

IBM's unique problem at this time was how to move their lucrative punched card business into the electronic stored program era. The stored program was a feature of mainframes but had not trickled

Known as the IBM 1401, this computer was released in 1959 and became one of the most successful in IBM's history—indeed in the history of computing itself.

down to the level of the small to medium-sized business user. The stored program concept evolved from a need to replace the control panel wiring so typical of unit record equipment to the infinitely more flexible system of storing instructions inside the computer (as we do today), rather than on punched cards or wiring panels.

The computer that allowed IBM to move its customers into the computer era was its Model 1401 Electronic Data Processing System. The 1401 is made up of three parts: a central processing unit (CPU), a card reader and punch (for reading and writing punched cards), and a high-speed printer. It also came with a magnetic tape drive—a feature that would revolutionize business.

IBM was pleasantly surprised (perhaps shocked) to receive 5,200 orders in just the first five weeks—more than predicted for the entire life of the machine!

The 1401 Arrives

The 1401 had a complex birth within IBM. One critical milestone in its creation was the decision to design a system that used magnetic core memory-like the RAM in today's computers—instead of the usual unit record equipment control panel that required laborious wiring. The result was a system that the user interacted with via a small number of special typed words. This was a big improvement in usability. In order to program a control panel, you needed considerable training and patience. While the 1401 did read and write punched cards, its optional magnetic tape system was a real breakthrough. Magnetic tape could store the equivalent of tens of thousands of punched cards on small, portable reels of tape. People began migrating their punched card information onto tape because it was not only more convenient, it saved space, time and, most of all, cost. IBM was pleasantly surprised (perhaps shocked) to receive 5,200 orders in just the first five weeks—more than predicted for the entire life of the machine! The 1401 hit a sweet spot in the market. In fact, it hit two:

1. For users who already had very large systems, the 1401 could be used to offload many minor or "housekeeping" tasks like printing; and
2. For small and medium-size businesses, the 1401 was a replacement—one that worked at electronic speeds—for half a dozen separate pieces of punched card equipment.

As the post-war economic boom continued in the '50s and '60s, business expanded alongside. Many new businesses were formed in industry, commerce, manufacturing, and many other fields. They all needed a way to manage their work. The 1401 was developed to cost about the same as an equivalent separate unit record machines. But, it worked at electronic speeds and had no cumbersome control panel. In all, by the mid-1960s nearly half of all computer systems in the world were 1401-type systems.

Back to the CHM Restoration Lab

The Lab is a white room, about 40 feet by 30 feet simulating a data processing center from years past. An IBM clock hangs on the wall, a totem of IBM's varied manufacturing activities over the years and a tip of the hat to verisimilitude. You enter on a steep ramp built to accommodate a difference in floor height because the entire room is built on a raised floor beneath which snake the dozens of cables for the system. And there are cables! Each is the thickness of a junior-sized baseball bat, is thirty feet long, and weighs 20 lbs. or more. These information pipelines route the signals to and from the CPU to the card reader and punch, printer and tape drives. They have fearsome connectors at their ends that require real effort to plug in or disconnect. This is the *Era of Big Iron* and IBM was a giant in this industry. Its competitors were derisively known as "The Seven Dwarves."

In the Lab are two complete 1401 systems. The first is from Germany; the second—from Connecticut—operated as late as 1995. Each machine has distinctive features but the restoration team settled on the latter system as its restoration target. As a visitor, you'll be invited to sit at a keypunch machine—a typewriter-like device that punches what you type onto a card. (The bits that are punched out are called "chad.") Type your name and the keypunch whirs to life, clacking away as you type. It's an impressive feeling of power as your keystrokes are converted into punched cards.

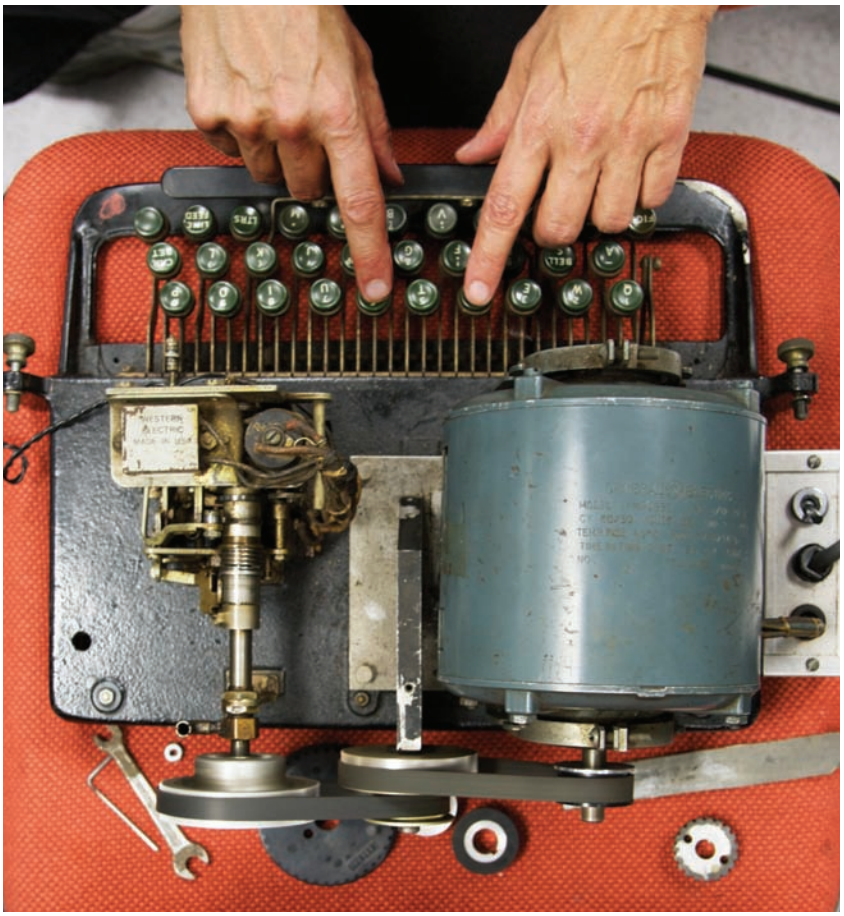
A kindly restoration team member—most likely a former IBM customer engineer as are most of the team—takes your card and adds it to several others. He will feed all these cards into the card reader, then move to the CPU—a cabinet the size of two refrigerators—and push several buttons. Suddenly your cards are pulled into the card reader with a whoosh and flap-flap-flap sound. After a few moments this stops and the printer, a mechanical beast that can move 75 inches of a paper in single second, springs to life, printing your name in giant letters. You have just used a computer, 1960s style!

Getting a printout of your name is cool but don't be misled. The 1401 was a serious business machine. It cranked out the payrolls and did the accounting for tens of thousands of businesses worldwide. The Museum is truly fortunate to have these machines. And getting one running was no small feat. It took a team of more than 30 active volunteers some 20,000 hours over five years and was truly a labor of love. Our 1401's each have over 500,000 separate parts, weigh four tons and—in their day—cost about $6,500 a month to lease (about $50,000 a month in today's dollars).

To Preserve and Present

Having an operating 1401 system is of great historical importance. It makes it possible to study these old applications and the way they were designed. A new generation can learn how people solved problems in the early days of computing and appreciate the creative solutions early computer pioneers found. Perhaps more importantly, in terms of IBM history and the industry as a whole, the 1401 was the product that gave IBM its first realistic glimpse of the size and importance of the market for computers. It caused a paradigm shift in how people worked with computers, whose capabilities (and limitations) would soon become the bedrock of our modern civilization. ○

Dag Spicer is CHM's Senior Curator.



Inside of IBM 026
Printing Card Punch
keyboard and overview

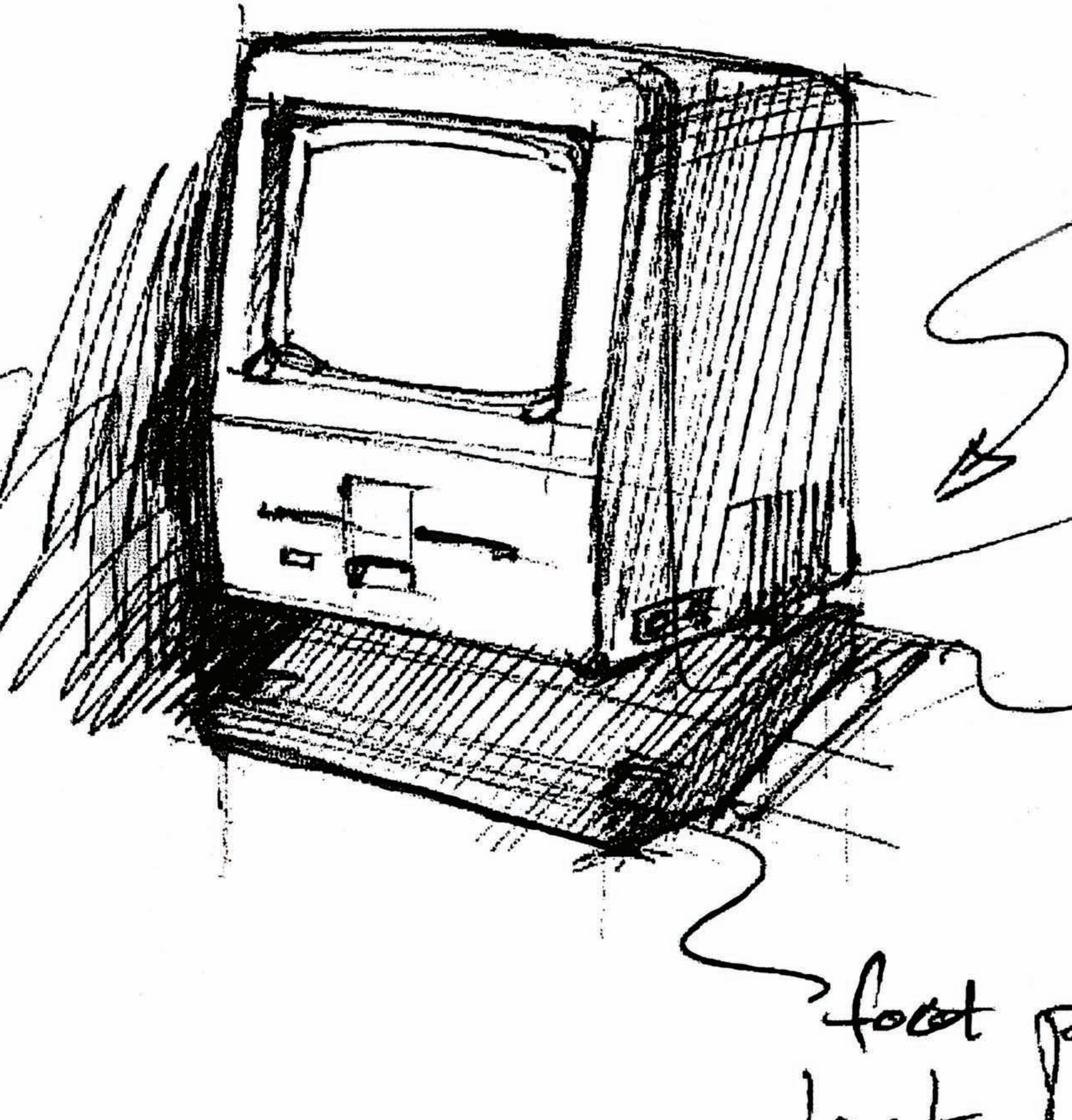
FEATURE

THE CHANGING FACE OF THE MAC

Apple's Macintosh in its early years

BY MARCIN WICHARY

Early sketch of a design for
the Macintosh, by frog design



The original Macintosh has been immortalized by history as nothing less than a silicon update to the myth of Prometheus—bringing enlightenment to a world overtaken by monotone, ugly, hard-to-use and harder-to-love IBM clones. Hailed by Apple and others as the last true computer revolution and a machine perfect in every way, it's easy to imagine it as a single, unified vision, brought to market with ruthless precision and efficiency. In reality, it was anything but.

The first incarnation of the Macintosh, as envisioned in early 1979 by Mike Markkula, Apple's chairman, was a sub-$500 game machine—the smallest sibling of a troika that also included Apple III and Lisa. Jef Raskin, chosen to lead the project, had enough prescience (the game-computer price wars of the early 1980s drove most of the manufacturers to extinction) to counter with something more ambitious: a friendly, general-purpose computer for the masses, available as soon as Christmas 1981. Raskin started by compiling "The Book of Macintosh"—a collection of articulate and influential documents filled with rallying cries such as, "Let's make some affordable computers!" [1] and pondering, "What will millions of people do with them?" [2]

The Mac's cornerstone was to be its friendly user interface. However, the familiar black-and-white reinterpretation of a desk top—developed in parallel between Lisa and Mac and much enhanced from its origins at Xerox PARC—was not the original choice. Raskin later built another computer as an example of the kind of interface he had in mind. Released in 1987, the Canon Cat did away with folders and files (replaced by one infinite document), and favored text and keyboard, over graphics and mouse.

But in Mac's case, the mouse wasn't a given either. Early memos mentioned a light pen, a trackball, and a joystick as the pointing devices of choice. But after being pushed by Steve Jobs toward Doug Engelbart's invention, the design team built and tested over 150 mouse prototypes (the earliest ones using a ball from a roll-on deodorant). Even the decision to remove all buttons but one—often presented as Exhibit A to confirm Apple's autocratic and arbitrary approach to interface design—was the product of many heated discussions.

The initial goal for the Mac's case was to make it highly transportable. Early prototypes resembled Osborne's later, popular portable, and even included provisions for batteries. As the project shifted from Raskin's purview to Jobs', however, this priority changed simply to something "different from everything else." That included the Apple Lisa, whose design was derided by Jobs as having a Cro-Magnon forehead above its screen. [3] But it might still have provided inspiration for the Mac's eventual anthropomorphic cues: The facade resembling a human face, a smirk of a floppy drive, and a chin leaving

The Macintosh as the world knows it, introduced on January 24, 1984, proved its success as a popular personal computer and one of the first to feature a mouse and a graphical user interface.

room to slide in the keyboard. The team endured a couple of distractions—the "Cuisinart Mac" being the most famous of them—but ultimately Jerry Manock's design remained the one chosen for the Mac's premiere.

That covers the three most essential components. But pick any other part—even those that seem to scream "Macintosh"—and you might be in for a surprise too. The processor? The 6809E was the team's first choice. The display? Initial plans called for a 4" or 5" screen, with a measly 256×256 resolution. Storage? The final product is credited with popularizing Sony's 3½" disks, but the Mac is happily seen sporting Lisa's five-inch Twiggy drive in its own user manual.

Even the name, chosen by Raskin as a tribute to his favorite variety of apple fruit, was in peril a couple of times. The advertisements proudly stated, "They didn't call it the QZ190, or the Zipchip 5000." Fortunately, they also didn't call it Annie, Apple V, or Bicycle—though at some point all of these names were attached to the project.

But, as exciting as it is, juggling all these alternatives is, ultimately, pointless. Sure, this might be a favorite pastime for anyone with an interest in computer history: Armed with a sometimes-too-intimate knowledge of business blunders, close encounters, and last-minute plan changes, we enjoy conjuring alternate realities. What if Gary Kildall stayed in his office to talk about the operating system for IBM's upcoming personal computer? What if HP decided to release Wozniak's first machine? What if today's most popular desktop computer was still Altair, and laptop—LisaBook Air? Finally, what if the Macintosh was indeed released as a cheap game console just in time to catch on to the runaway popularity of *Pac-Man*?

But this would be denying the Macintosh its true accomplishment. The first little beige box was finally announced in January 1984, with a $2,495 price tag. ("The design team was horrified," wrote Andy Hertzfeld years later. "[This price] felt like a betrayal of everything that we were trying to accomplish."[4]) The launch was a carefully choreographed marketing event that was as memorable as the product itself. But what turned out to be just as fascinating

APPLE PRODUCT RELEASES

Technology and design evolution that has improved from generation to generation:

Apple I (1976)

Apple II (1977)

Lisa (1983)

Macintosh (1984)

Macintosh Portable (1989)

Macintosh PowerBook 100 (1991)

Newton MessagePad (1993)

iMac (1998)

iPod (2001)

OS X (2001)

iMac G4 (2002)

iMac G5 (2004)

iPhone (2007)

1 Raskin, Jef, "Design Considerations for an Anthropophilic Computer" memorandum, May 28–29, 1979 http://library.stanford.edu/mac/primary/docs/bom/anthrophilic.html

2 "Computers by the Millions," internal Apple memorandum, March 18, 1980 http://library.stanford.edu/mac/primary/docs/cbm.html

3 Sculley, John, Odyssey: *Pepsi to Apple... Journey of adventure, ideas, and the future*, New York: Harper & Row, 1987, p. 160

4 Hertzfeld, Andy, *Revolution in the Valley: The insanely great story of how the Mac was made*, O'Reilly Media, 2004, p. 195 http://www.folklore.org/StoryView.py?project=Macintosh&story=Price_Fight.txt

Hailed by Apple as the last true revolution and a perfect machine, it's easy to imagine it as a single, unified vision brought to market with ruthless precision. In reality, it was anything but.

as the Mac's five-year crusade to establish its own identity was the apparent eagerness, in the decades since, to keep throwing it away.

The Mac's prototypical user, originally simply a "person in the street,"[1] was quickly narrowed down to the "knowledge worker."[5] But the progeny of the first Macintosh found a different purpose in life: the classroom companion; the pioneer of the desktop publishing revolution; the multimedia machine; the hub for your digital lifestyle; the mother ship for your collection of shiny iPods and iPhones.

The exterior evolved as well. Cuddly, humane design gave way to sterile principles of Hartmut Esslinger's corporate Snow White design language and the beige blandness of the Espresso style. The iMac era alone gave us translucent, colorful gumdrop curves and, later, foggy plastics—both admired and copied feverishly by competitors; and both incredibly dated next to today's dark glass and aluminum enclosures.

Throw in both of the architectural transitions—to PowerPC in the mid-1990s, and to Intel a decade later—and the well-publicized drama of finding a replacement for the aging operating system, and it's easy to see that the tumultuous five years it took to bring the Macintosh to market was only a foretaste of the Mac's complicated future and quite possibly the most troubled upbringing of any computer product in history. (Even its near deaths in 1985 and 1997 had a precedent; Apple cancelled the Macintosh project in its early stages on at least three different occasions.)

In some sense, however, all of these metamorphoses were entirely superficial. The principles that defined the Mac's essence reach much deeper. Those principles haven't buckled since Raskin and Markkula met in 1979 to talk about a "crankless computer" (in a nod to Ford's Model T) in one of the rooms of the then tiny Apple headquarters.

The continuing focus on the integrity of the user experience (Raskin in 1984: "You don't build a hardware box just to suit some hardware engineer and then try to cram software into it"[6]) makes the competition lose as much sleep today as ever, prompting nervous responses to the popular "I'm a Mac, I'm a PC" ads. And those ads have never really strayed too far from the first marketing campaign, with all its allusions to George Orwell's *1984*.

The message didn't need to change. Even though it celebrated its twenty-fifth birthday this year, and neither its enclosure nor the technology inside it would be recognizable to the original team, the Mac never sold its soul. It is designed better and easier to use than its competitors and, astonishingly, even with a market share again flirting with double digits, still feels like a "computer for the rest of us."[7]

And, in the end, this might turn out to be the Macintosh's most important legacy. ○

For more information on the Macintosh items mentioned in this article, visit CHM's Catalog Search: computerhistory.org/collections/search.

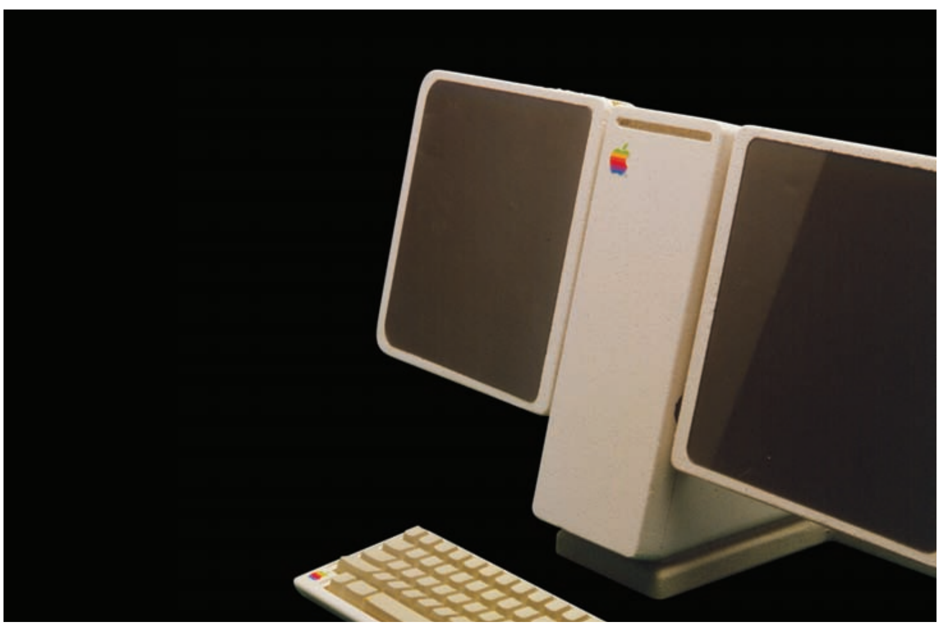
Marcin Wichary is a Senior User Experience Designer at Google and has been a volunteer docent and a photographer at the Computer History Museum since 2007.

5 Macintosh Selling Guide, Apple, 1984 http://archive.computerhistory.org/resources/text/Apple/Apple.Macintosh.1984.102646178.pdf

6 Markoff, John, and Shapiro, Ezra, "Macintosh's Other Designers," Byte, Issue#3 (August 1984, volume 9, number 8). p. 347 http://www.aresluna.org/attached/computerhistory/articles/macintoshsotherdesigners

7 The expression used in the Macintosh introductory brochure and other promotional materials http://www.macmothership.com/gallery/gallery3.html

8 Esslinger, Hartmut, *A fine line: how design strategies are shaping the future of business*, San Francisco: Jossey-Bass, 2009, pp. 7–9



COURTESY FROG DESIGN

EXTRAORDINARY IMAGES

WHEN ANYTHING WAS POSSIBLE

In what has now become the stuff of myth and legend, Apple's collaboration with Hartmut Esslinger and his firm, frog design, almost certainly defined what we now 'know' computers look like. Everyone today is familiar with the ubiquitous mouse and standard form of the desktop computer. But when Esslinger and Steve Jobs met, anything was still possible.

"When I started working for Apple in 1982," says Esslinger[8] "Steve Jobs' ambitious plan to make Apple into the greatest global consumer technology brand on the planet seemed crazy." At that time home computers were the dream of only a few nerds. What these computers would look like, how people would input information into them, even how they would look at the screen was still anyone's guess.

Esslinger and frog created several concepts out of foam and cardboard. They developed these ideas in white with spare lines and a clean look. This look came to be known as the "Snow White" design language and it quickly became part of Apple's Design DNA.

As is evident from the images that follow, generously provided to us by frog, anything was possible in 1982. Most of these images have never been seen anywhere else, and they represent a fascinating moment in history. They illustrate not only the solutions discovered but also the range of exploration it takes to develop an "iconic product with no historic precedent."


apple computer



mac









FEATURE

BY STEVE BLANK

THE SECRET HISTORY OF SILICON VALLEY

The role of World War II in the growth of Silicon Valley

For 20 years, Stanford University students knew Fred Terman as a kindly professor who helped William Hewlett and David Packard start a company, Hewlett-Packard. Fewer people knew Terman as the ultimate Cold War "warrior. He was, in fact, the father of electronic warfare and electronic and signals intelligence and a leader in partnering with the NSA and CIA to transform Stanford into an integral part of the U.S. intelligence community.

He also happened to invent the culture of entrepreneurship at Stanford and Silicon Valley.

It all started in World War II.

The Electronic Shield

The Allied bombing campaign of Occupied Europe was designed to destroy Nazi Germany's ability to wage war. But by 1942, Allied airmen were dying in droves. The German electronic air defense system was taking an increasing toll on bombers and crews. The Allies desperately needed to shut down the German Air Defense system.

So in 1942, the Allies set up the top secret Harvard Radio Research Lab with the goal of defeating the German Air Defense system. Its 800 staffers invented what would become the signals intelligence and electronic warfare industry. Directing this lab was an electrical engineering professor plucked from a school not yet known as an engineering powerhouse: Fred Terman from Stanford.

The Military/University Partnership

World War II forever changed the military's relationships with United States universities. Before World War II, the military did research and development in its own military labs. But Vannevar Bush, the head of the Office of Scientific Research and Development, enlisted universities into the war effort and funded them directly.

During WWII, MIT, Cal Tech, Harvard and Columbia received tens of millions of dollars for military R&D, money that forever changed their trajectory in technology. But Stanford, then considered a second-rate engineering school, got almost nothing. Terman, Vannevar Bush's first PhD student, had written a highly-regarded textbook on radio engineering, and so was recruited to run the Harvard Radio Research Lab.

The"Stanford Dish" radio-telescope in the foothills of the University.

In the mid-1950s, our strategic weapon of choice was the manned bomber. In order for the bombers to penetrate the Soviet air defense system, though, the Strategic Air Command and CIA needed details on Soviet radar so they could build jammers. To this end, Terman dedicated Stanford's engineering resources and made Stanford crucial to the National Security Agency and Central Intelligence Agency for electronics intelligence and signal intelligence. At this moment, the Cold War became an electronic war with the goal of uncovering what was going on inside this closed country.

Fred Terman in his Stanford University office, ca. 1938

COURTESY STANFORD NEWS SERVICE

But Terman returned after the war with the idea of turning Stanford into a center of excellence for microwaves and electronics. He started by recruiting 11 members from his Radio Research Lab. They set up the Electronics Research Lab for basic and unclassified research. In 1946, the Office of Naval Research gave them their first contract to fund Stanford's research into microwaves

By 1950, Terman had turned Stanford's engineering department into the MIT of the West.

Another War and a New Game

In 1949, the Soviet Union exploded its first nuclear weapon. In 1950, the Korean War turned the Cold War hot. And the newly formed National Security Agency asked Terman's team to work on classified intelligence and military programs. Engineering set up the Applied Electronics lab for classified programs. Stanford University was now a full, covert partner in government R&D.

From Cold War to Entrepreneurship

Yet Terman wanted Stanford to focus on advanced research, not the actual production of military systems. So he encouraged his engineering students to start companies that could supply microwave components and intelligence systems to the military. He encouraged professors to consult for those companies. Getting out in the real world is good for your academic career, he told them. And he made licensing Stanford's intellectual property possible. These were heretical concepts in the 1950s and '60s. And they fundamentally changed the Valley into something we recognize today. These ideas caused the Valley to blossom in the mid-1950s into Microwave Valley.

CIA/NSA Innovation

In the mid-1950s, the CIA launched Project Genetrix: They flew high altitude balloons—with 350lb cameras as their payloads—across the Soviet Union. They simply popped the balloons up into the jet stream and hoped the balloons would come out at the other end of the Soviet Union.

But as the CIA was tracking these balloons with radar, it was also picking up an unexpected Soviet radar signal. Eventually the CIA figured out that they were getting this signal because a piece of metal in the balloon was accidentally cut to the frequency of a Soviet height-finding radar and that signal was being picked up in our receiving radar.

This lucky accident spawned Project MELODY. Every time the Soviets launched an intercontinental ballistic missile (ICBM), the CIA sent up radar receivers in Iran. And we used the Soviets' own missile telemetry beacon to steer those radars. So every Soviet radar within a thousand miles bounced off the Soviet ICBM, and the CIA tracked their reflections. This bit of espionage provided intercepts of all Soviet missile tracking radars including all their anti-ballistic missile radars. These receivers were built and designed at Stanford.

In the late 1950s, the Soviets had upgraded their early warning radar to the Tall King. The CIA and Strategic Air Command wanted to know where these radars were and how many there were first.

Someone realized that like all radars, the Tall King radar signals continued traveling out into space. But with the right geometry they bounced off the moon when it was over the Soviet Union. The idea was to point radar dishes at the moon, and then use the moon as a bistatic reflector and listen for the Tall King signals. About once a month everything would line up.

But because this idea required very large dishes, the United States in the late 1950s became very interested in radio astronomy. Under cover of a civilian agency, the CIA funded the Stanford University dish, attached electronic intelligence receivers to it, and borrowed it to search for the Soviet Tall King (and later Hen House) radars.

It was the Cold War crisis and not profit that motivated Terman—and the newly-formed companies of Silicon Valley—in the 1950s and the 1960s. The motivation for entrepreneurship was crisis and it found funding from the military not from industry.

Why It's Called Silicon Valley

If it had been up to Terman, Silicon Valley would be known as Microwave Valley. But serendipity arrived in 1956. William Shockley started Shockley Semiconductor, Silicon Valley's first chip company.

Shockley had a WWII military background as extensive as Terman's. He had been director of operations research for anti-submarine warfare at Columbia, head of radar bombing training for the Air Force, and deputy director of all of weapons R&D in the Cold War. Shockley had a reputation for being a terrific researcher, an awesome talent spotter, and a terrible manager. One testament to his poor skills as a manager was the infamous "traitorous eight." In 1957, eight of his best researchers—including Gordon Moore and Robert Noyce—left Shockley Semiconductor and founded Fairchild Semiconductor.

In the next 20 years, 65 other chip companies start because this one ex-military guy—Shockley—who worked on air to ground radar in World War II, and who happened to manage the team that invented the transistor, started his company in Silicon Valley.

Why We Don't All Work for the Government?

Terman may have been motivated by the Cold War but the Valley, as we know it today, is driven by profit and venture finance. What happened? This started out as Microwave Valley. What changed? The money. Fundamentally, funding for startups in the Valley shifted from the military to venture capital.

Venture capital began simply as a way for rich families to invest. In the early 1940s, J.H. Whitney established a family office to make investments. Lawrence Rockefeller had the same idea and established his family office. So did other rich industrialists.

These family offices were all on the East Coast and tended to focus their investments there, in a wide variety of industries.

But in 1958, after the launch of Sputnik the year earlier, the U.S. government wanted to spur entrepreneurship. The Small Business Administration (SBA) announced it would match every dollar an individual put into a startup. By 1968, 75 percent of venture capital came from the SBA. And, in fact, the idea was so lucrative that corporations set up their own SBAs. And Bank of America, Fireman's Fund, and private companies did so as well.

But everyone was still trying to sort out the right model for investing.

Then in 1978 and 1979, life changed in Silicon Valley when the government made two simple changes: 1) It slashed capital gains tax—from 50 percent to 28 percent. 2) Pension funds were now allowed put up to 10 percent of their holdings into high-risk ventures—venture capital funds being one of them. And to manage that capital, VCs transitioned to limited partnerships. The amount of money directed into VCs jumped by a factor of 10 and Silicon Valley's second engine of entrepreneurship took off by 1979. It was, and still is, fueled by profit.

So in summary: Terman, Stanford, and our intelligence agencies spawned the entrepreneurial culture of Silicon Valley. The military primed the pump as an investor and customer for key technologies (semiconductors used in missile guidance systems, computers at NSA and Livermore, and of course, DARPA's interest in packet switching and the Internet.) But venture capital turned the Valley toward volume corporate and consumer applications. ○

Terman happened to invent the culture of entrepreneurship at Stanford and Silicon Valley. It all started in World War II.

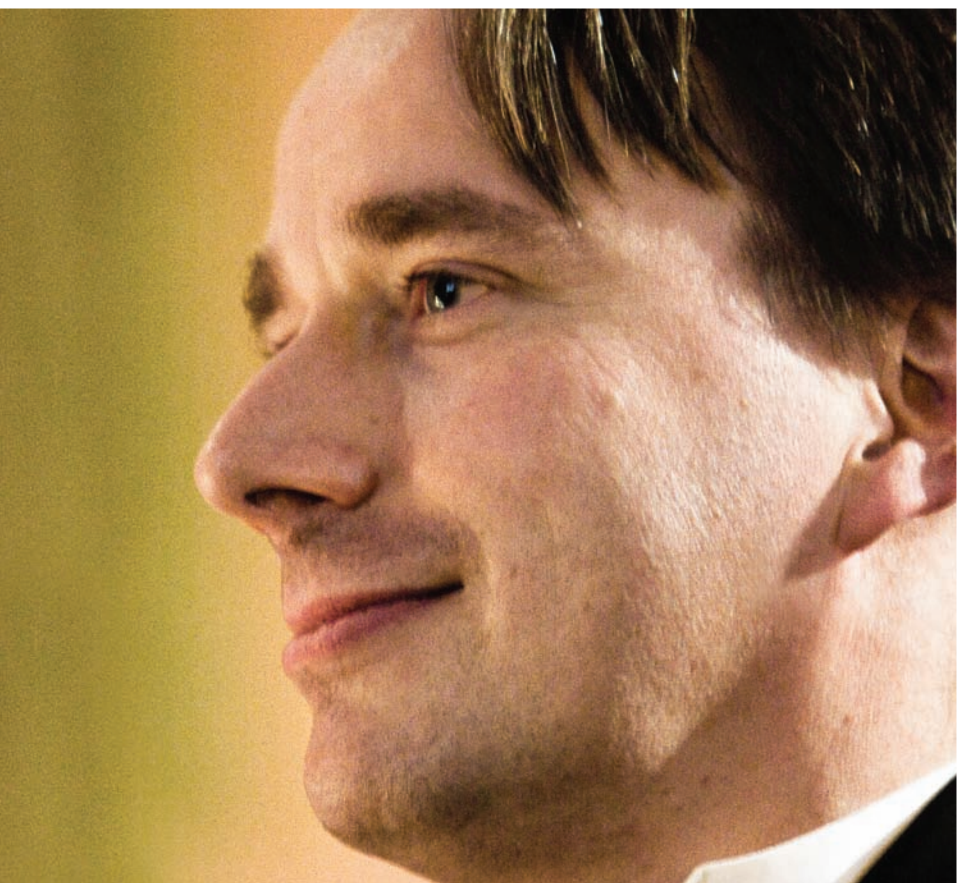
To see Steve Blank's CHM lecture on our YouTube channel visit: youtube.com/computerhistory.

Blank is a lecturer at Stanford University's School of Engineering and Berkeley's Haas School of Business. He is a serial entrepreneur, having spent nearly 30 years as a founder and executive of high-tech companies in Silicon Valley.

REMARKABLE PEOPLE

TECHNOLOGY ROCK STAR

BY FIONA TANG



Though it was created by a single individual named Linus Torvalds, Linux has truly become a world-changing software environment. An estimated 64 million people around the world use Linux, according to the Linux Counter. The Linux Foundation projects the Linux ecosystem will reach $50 billion in the next two years.

A self-professed geek, Torvalds hails from a family of journalists, where he is considered the black sheep. He was named after Linus Pauling, Nobel Prize-winning chemist, and Linus from the Peanuts cartoon. He attributes his "dualistic nature of serious and not-so-serious" to his name.

Torvalds was awarded one of the 2008 CHM Fellow Awards, for creating the Linux kernel and overseeing open source development of the widely used Linux operating system. Linux got its start as an operating system when Torvalds began playing around with MINIX, a UNIX-like operating system—short for Minimal UNIX. Torvalds had simply posted it to a MINIX forum to gather a little feedback. And feedback was what Torvalds got—in spades. Users have quickly become fanatical in their following of Linux.

In spite of the ingenuity of the original creation, Linux, as we now know it, is founded on a quiet spirit of collaboration. To Torvalds, collaboration came hand-in-hand with passion. How did Linux manage to pick up such a huge fan-base of users all working to continually improve on the product? Torvalds said, "They always volunteered. I wouldn't even want to work with people who don't feel passionately about what they do because searching for people to do something doesn't work… It started out slow and on a very small scale. But it was a natural progression." As a result, Linux, with the help of the Internet, has spurred the widespread, successful movement of what is now known as Open Source.

This August, Linux turned 18. It has grown from 10,000 lines of code to roughly 7 million. And even though Torvalds is one of the few scientists in a family of journalists, he's now likely to be the most widely published of his family—and have more fans than most rock stars.

"The impact that Linus has had on the software industry can't be overestimated. He sparked the world's largest technology project in the history of computing. And now, 18 years later, millions of people are contributing to the Linux kernel and the $50 billion ecosystem it supports," said Jim Zemlin, Executive Director at The Linux Foundation. ○

This article was based on Linus Torvalds' contribution to the Computer History Museum's oral history collection. Explore the oral history collection at: computerhistory.org/oralhistory.

Linus Torvalds at the Computer History Museum's 2008 Fellow Awards.

SYNCHRONIZED ELEGANCE IMAGING

CHM COLLECTION BY THE NUMBERS

69,500+
online collection records for search

300+
oral histories recorded since 2002

54
unique countries represented in the collection

5,000
linear feet of archival material

8,521
software titles in the collection

EXPLORE THE COLLECTION

COLLECTION

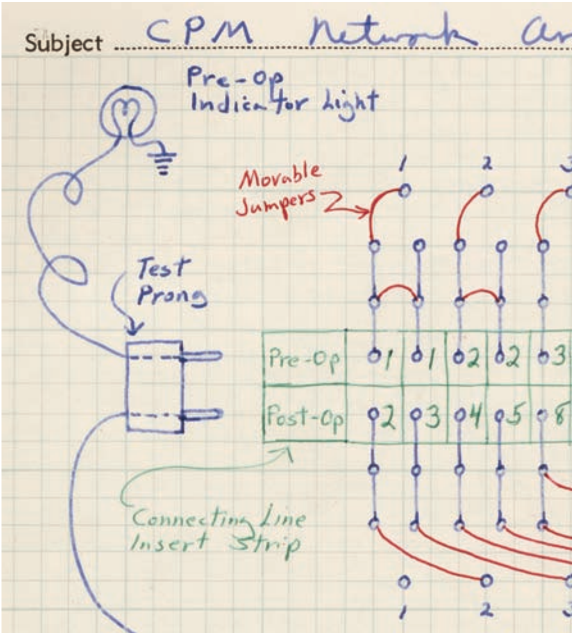
Top and Close-up: Project Network Analyzer (1964): This special purpose device uses a project-specific plugboard inside the unit. The pre-wired switches and lights replaced the external probe of the earlier design.

Bottom: Indicator Circuit (1962): When probing a plugboard set up for a project schedule, these lamps showed how the schedule was affected by changes in task durations.

CPM NETWORK ANALYZER INDICATOR CIRCUIT AND PROJECT NETWORK ANALYZER

BY ALEX BOCHANNEK

CHM#: X5248.2009
DATE: 1962, 1964-1966
DONOR: Doris-Jane Fondahl



Human civilizations have embarked on large-scale projects for thousands of years. But it wasn't until the 1950s that the scientifically founded discipline of project management emerged.

Beginning in 1956, the DuPont chemical company—with Remington Rand Univac—devised the Critical Path Method (CPM) to solve construction scheduling problems. CPM and related methods essentially represent project tasks and their relationships as a network. The extensive calculations necessary for the technique at DuPont were performed by their UNIVAC computer.

In 1958, the U.S. Navy awarded a contract to Stanford University civil engineering professor John Fondahl to investigate the feasibility of performing CPM calculations by hand instead of by expensive electronic computers. He published an influential book on the subject in 1961, which was widely read in the construction industry.

Realizing that some of the manual calculations were quite repetitive, Fondahl constructed a device to aid him in this task in 1962. He wired up an IBM accounting machine plugboard to create the electrical analogy of a project schedule. The Indicator Circuit was used to probe the plugboard, entries were made into a worksheet, and the schedule was then manually recalculated. With the help of Stanford's Electronics Lab, Fondahl constructed the more sophisticated Project Network Analyzer in 1964.

John Fondahl intended to commercialize his inventions but decided against it when smaller, cheaper computers arrived and his interests shifted toward more complex resource-scheduling problems. He continued to use the one-of-a-kind devices in his home and office, though, and preserved both units until his passing in 2008. ○

Left: Detail of Indicator lights on the Project Network Analyzer.
Above: John Fondahl's laboratory notebook describing his CPM Network Analyzer (1962). The Indicator Circuit with its test prong is shown in the drawing.

ELLIS D. KROPOTECHEV AND ZEUS, A MARVELOUS TIME-SHARING DEVICE MOVIE

BY HEATHER YAGER

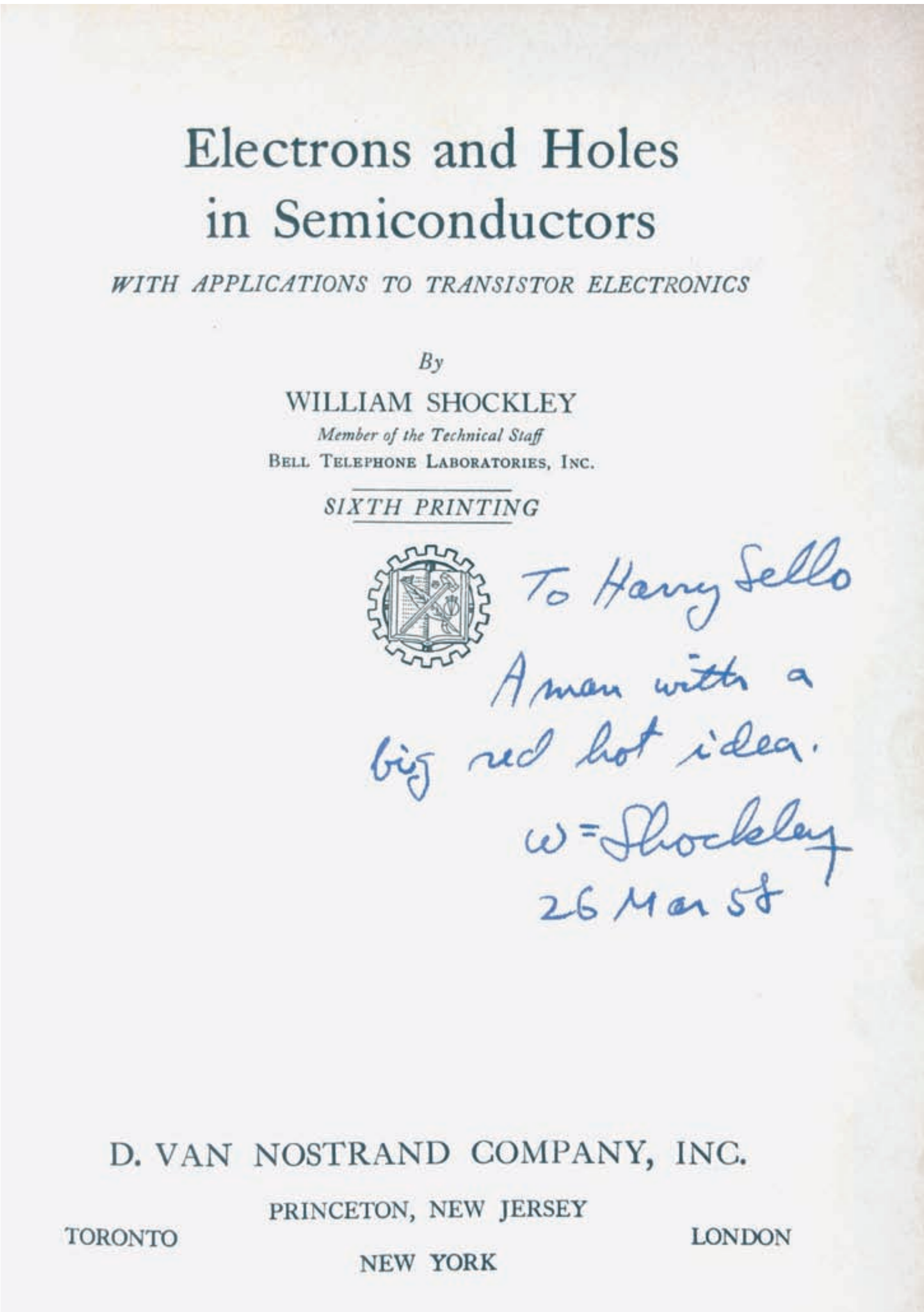
CHM#: 102651555
DATE: ca.1967
PRODUCER: Stanford University, Department of Computer Science

The film *Ellis D. Kropotechev and Zeus* features Zeus, a time-sharing system developed by the Department of Computer Science at Stanford University. Written and acted by programmers and faculty, the film mixes physical comedy with a touch of surrealism and a clever soundtrack featuring the Rolling Stones and Wagner's "Ride of the Valkyries," an engaging look at the culture of computer programming in the 1960s. The story is a race against time: Ellis D. Kropotechev is a computer scientist attempting to run and debug a program before departing to meet his girlfriend. The five hour wait time and error-riddled output of his program cause Kropotechev to lose hope, and he envisions his girlfriend leaving him. As he lights a cigarette and considers giving up, a nearby computer terminal speaks to him and invites him to try a time-sharing device instead. Using Zeus, Kropotechev is able to correct the errors in his program quickly, and the film ends with a shot of Kropotechev and his girlfriend walking arm-in-arm into the sunset.

From the start of the modern computer era in the mid-1950s, programming was a time-consuming process involving punching one's programs onto cards, submitting the cards to a computer operator, then waiting (sometimes a day or more) for results. This film captures the technical importance of the late 1960s transition from this so-called "batch" method to timesharing, an interactive method in which the programmer used a video display terminal to directly interact with the computer himself. Other users also shared part of the computer's time, giving each user the appearance that the computer was responding only to them. ○




Title page of Shockley's book, signed to Harry Sello by the reknowned author.



Electrons and Holes in Semiconductors

WITH APPLICATIONS TO TRANSISTOR ELECTRONICS

By

WILLIAM SHOCKLEY

Member of the Technical Staff

BELL TELEPHONE LABORATORIES, INC.

SIXTH PRINTING

To Harry Sello

A man with a big red hot idea.

W=Shockley

26 Mar 58

D. VAN NOSTRAND COMPANY, INC.

TORONTO — PRINCETON, NEW JERSEY — NEW YORK — LONDON

ELECTRONS AND HOLES IN SEMICONDUCTORS BOOK BY WILLIAM SHOCKLEY

BY DAVID LAWS

CHM#: 102704591
DATE: 1950
DONOR: Harry Sello

Harry Sello generously donated his copy of William Shockley's magnum opus "Electrons and Holes" to the Museum collection for exhibit in the Silicon Engine artifact display. Sello's copy of the book is unique in that when he was working at Shockley Semiconductor Labs in Mountain View he came up with an improved design for a diffusion furnace.

Shockley asked him what he was working on. Impressed with the approach, he asked Harry if he understood all the thermal and mechanical considerations involved. As Harry says, "When the boss asks you a question like that what else can you say but 'Yes.' Several minutes later Shockley returned with a copy of his book signed on the title page with the message, "To Harry Sello. A man with a big red hot idea. W=Shockley, 26 Mar 58." ○

Stills from the movie, *Ellis D. Kropotechev and Zeus.*

RECENT ARTIFACT DONATIONS

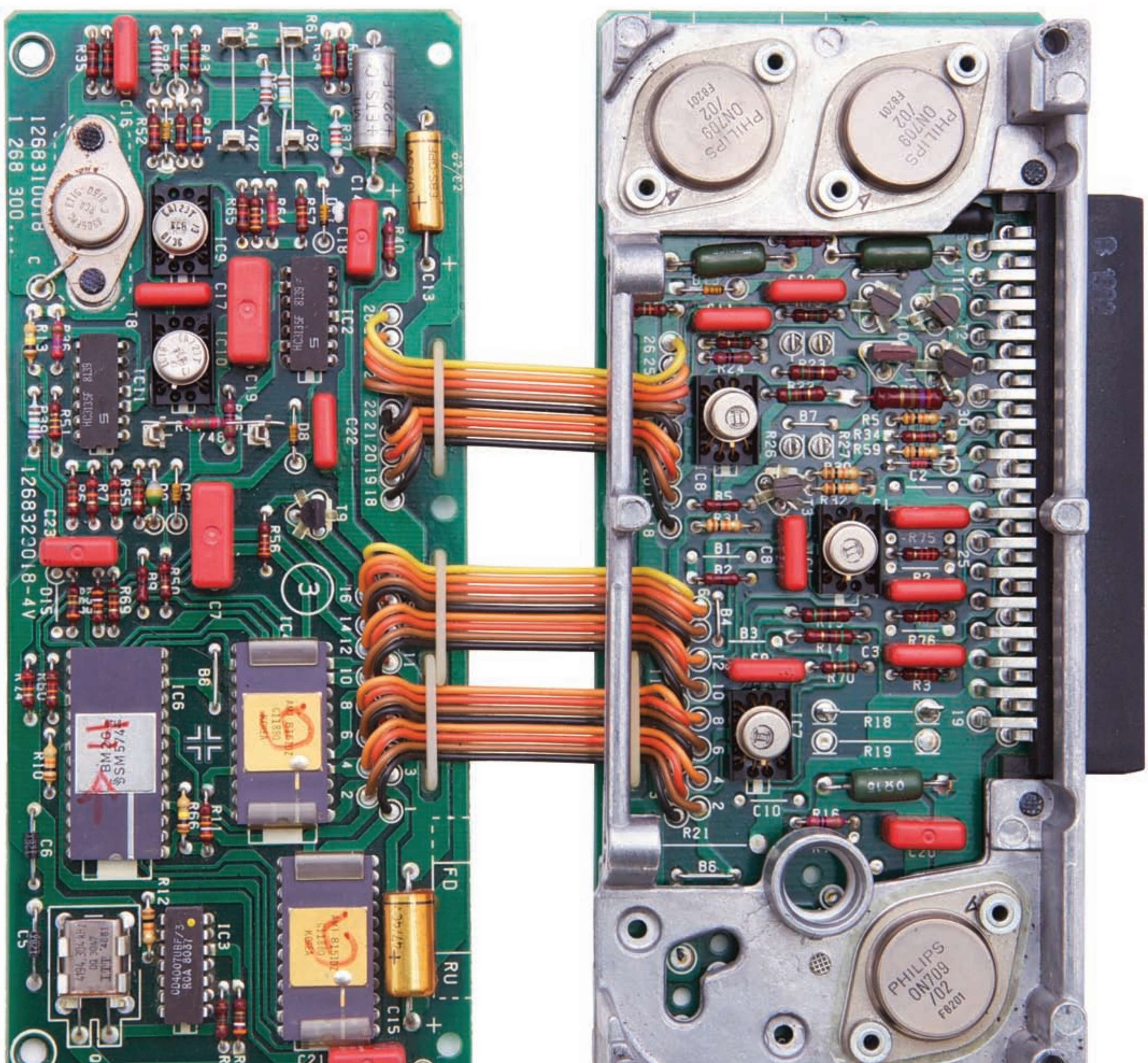
COLLECTION

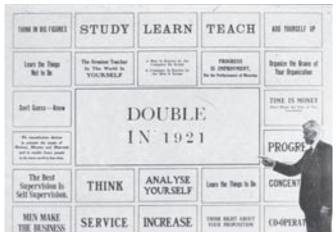
BY DAG SPICER

BOSCH ANTI-LOCK BRAKING SYSTEM (ABS) COMPUTER

CHM#: X5442.2009
DATE: 1978
DONOR: Robert Bosch GmbH

The Bosch ABS-2 system was introduced in 1978 as an option to the Mercedes-Benz S-class luxury car. It marks the beginning of general availability of fully-electronic ABS for passenger cars. By the 1990s, further developments incorporated ABS into more complex traction and stability control systems and ABS is now commonplace in new automobiles This device marks one of the earliest examples of the use of digital control for real-time automotive applications. ○





IBM SYSTEM 360 SLIDE SET

CHM#: X5321.2009
DATE: 1965
DONOR: Dan Leeson

These slides of IBM's very early products, history and key people were used as part of a lecture series given by IBM's Education Department to branch offices around the world. They include images of IBM President and CEO Thomas Watson Sr. ○

TANDEM "NON-STOP" COMPUTER SYSTEMS

CHM# 102711483 – 102711488
DATE: 1983-1997
DONOR: Hewlett-Packard

These five machines represent some of Tandem's "highly-available" computer systems. Such systems were popular with customers who demanded high reliability and quick performance, such as stock markets, telecom companies, banks and ATM networks. While conventional systems of the era, including mainframes, had a mean time between failures in the order of a few days, the Non-Stop system was designed with uptimes measured in years. In 1997, Tandem was acquired by Compaq, which was then acquired by HP in 2002. ○

MYSTERY ITEM

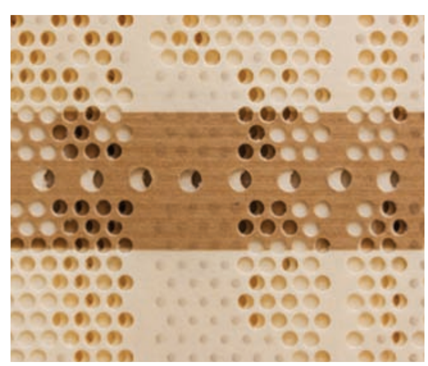
WHAT'S THIS?

Take your best guess!
The first two *Core* readers who submit the correct answers by March 1, 2009, will receive a free copy of *Core Memory: A Visual Survey of Vintage Computers*. Email your guess to: editor@computerhistory.org. Good luck!

Previous *Core* Mystery Item Description
This is a section from a long, interconnected, series of Jacquard loom cards, used to control the patterns made by a weaving machine. Jacquard cards were the inspiration for the punched card accounting systems and computers used during much of the twentieth century.

As these cards were initially used to control computers, it is ironic that the cards shown here were produced using a modern computer-controlled card-making system made by German company Grosse.

The 2008 winners: Gerald Steinback and Jason Walding



ABOUT CHM

The Computer History Museum is dedicated to the preservation and celebration of the computing revolution and its worldwide impact on the human experience. It is home to the largest international collection of computing artifacts in the world, encompassing computer hardware, software, documentation, ephemera, photographs and moving images. CHM brings computer history to life through an acclaimed speaker series, dynamic website, onsite tours, as well as physical and online exhibits.

CURRENT EXHIBITS

2010 will be an exciting year of progress toward completing our major, new exhibition, scheduled to launch in the fall. Please "pardon our dust" as you visit througout the year.

The Silicon Engine
This new exhibit celebrates the 50th anniversary of the integrated circuit (IC) and presents the history and innovations of the IC. The exhibit details the invention of the transistor, its role as a building block of the integrated circuit, the rapid growth of semiconductors and the profound effect these technologies have had on modern life.

Charles Babbage's Difference Engine No. 2
Designed in the 1840s, the Engine is a stunning display of Victorian mechanics and an arresting spectacle of automatic computing. It consists of 8,000 bronze, cast iron and steel parts, weighs 5 tons, and measures 11 ft. long and 7 ft. high. On display until early 2010.

Visible Storage
Closed to pack and move the specific artifacts into the major, new exhibition.

Mastering the Game: A History of Computer Chess
Our History of Chess exhibit examines computing's five-decade-long quest to build a computer to challenge the best chess players.

Innovation in the Valley
Learn about the innovators of computing technology in Silicon Valley who have changed the world, including local giants Apple, Cisco, HP, Intel and Sun.

ONLINE EXHIBITS

Eleven online exhibits at computerhistory.org/exhibits

COLLECTION

Collection:
More than 100,000 items
Catalog Search:
Search 68,000 artifacts online: computerhistory.org/collections/search
Oral Histories:
Search 150 transcribed interviews: computerhistory.org/collections/oralhistories/
YouTube Videos:
View 72 lecture videos: youtube.com/computerhistory

HOURS

WED • THU • FRI • SUN:
12 noon – 4 pm
SATURDAY:
11 am – 5 pm

TOURS

WED • THU • FRI:
1 pm & 2:30 pm
SATURDAY:
12 noon, 1:30 pm & 3:15 pm
SUNDAY:
Times vary, please call ahead

BABBAGE ENGINE DEMONSTRATIONS

WEEKDAYS:
2 pm
SAT • SUN:
1 pm & 2 pm

INFO

EVENTS:
computerhistory.org/events
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computerhistory.org/volunteers

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COMPUTER HISTORY MUSEUM