MARCH 2001

CORE 2.1

A PUBLICATION OF THE COMPUTER MUSEUM HISTORY CENTER
WWW.COMPUTERHISTORY.ORG

FROM IDEAS TO REALITY

Thank you for your incredible support last year in so many ways. Due to everyone's efforts, we are growing rapidly, and our programs, people, and leadership are enjoying many new successes and facing many new challenges. Our annual fundraising campaign, which is critical to our success, is in progress. Please help by getting everyone possible involved in the Museum – it's your organization!

The transition to a new year is a great opportunity to look at how we are transforming ideas into reality. This issue of *CORE* highlights several steps forward, including exciting plans to break ground for our new building in 2003, and many significant new additions to our collection (page 6).

It's often easy to let the excitement of a new building, the camaraderie of events, and day-to-day tasks overwhelm our awareness of the fundamental ways we are preserving computing history. I want to tell you about some of the upcoming advances you will see, saving plans for others, such as our Cybermuseum, for a future issue:

Lecture Series – We have extraordinary lectures this year, and I hope to see everyone there. Watch as we continue to target a variety of major audiences with the richest possible content. We are also seeking corporate partnerships for these lectures to preserve "behind the scenes" stories for generations to come.

Collections – You often hear about the great new items we have added to our collection, but you might not know about our approach to systematic growth. We take stewardship very seriously, and, thanks to many of you, our collection is expanding. We are building a growing nucleus of people and techniques to support more robust endeavors in accession, storage, retrieval, and availability. This includes major warehouse efforts and database changes, all intended to make our incredible collection more easily available to everyone.

Oral Histories – We want to expand and streamline our ability to make, edit, and rapidly distribute oral histories in many formats. Our lectures are recorded for posterity, and we have incredible audio and video resources in our archives. We are exploring new methods to capture information and catalog it quickly. Other historians and experts will help in this important effort.

Volunteer Programs – Our volunteers are absolutely the best; I've seen everyone from Trustee to student get engaged in such positive ways. Our Volunteer Steering Committee now meets monthly, and we are always looking for people willing to make new projects and ideas happen. This year you will see a diversity of volunteer projects targeted to our needs and the unique skills of our people. We are also putting ideas together for a docent program, which is so critical to our future institution.

Exhibits – Our Exhibits Committee is working hard on strategies for the new building. We will be exploring exhibit design concepts, so look for some unique displays and experimental techniques in the years to come. There will be an enormous amount of energy needed very soon to assemble and display our collection creatively for the first showcase in our permanent home. We are also taking advantage of increasing opportunities to show our collection in other museums and in temporary exhibits such as Intel's International Science and Engineering Fair (ISEF).

Research – We are continually looking for ways to make our artifacts, stories, and "info objects" more accessible. People already use our resources for historical research of their own, and this trend will continue to grow. We want to develop new mechanisms for data storage and retrieval, in order to make it more effective for computer historians, press, corporations, scientists, and the broader public to work with us.

Outreach – You will also see a series of programs designed to reach out to a variety of audiences and community. We are fortunate to be able to collaborate with our partners in the NASA Research Park as well as many seasoned organizations throughout Silicon Valley and the world.

Facilities – Until our new building opens, we will retain use of our current warehouse space, including the Visible Storage Exhibit Area (Building 126), the site of many receptions and tours. You will soon see a few changes, including new ceiling tiles, better climate control, and new exhibits – a facelift for us – so you can enjoy more of the depth and breadth of the collection.

As you can see, there's a lot to do, and each aspect presents exciting challenges. But it's the combination of them all that will make the Museum a lasting institution. Please help us in every way you can to turn these visions into reality… your help really makes a difference.

Finally, I hope everyone takes the time to ENJOY the diverse, stimulating, and important programs that are now available. We're positioned in such an exciting and unique time. Become part of the celebration of computing history, even as it continues to unfold. Together we are building a truly outstanding institution dedicated to preserving the stories and artifacts of the information age!

JOHN C TOOLE
EXECUTIVE DIRECTOR & CEO

CORE 2.1

March 2001
A publication of The Computer Museum History Center

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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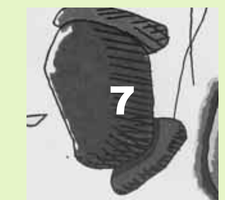
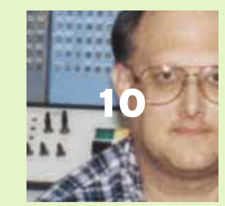
The Museum seeks technical articles from our readers. Article submission guidelines can be located at www.computerhistory.org/core, or contact Editor Karyn Wolfe at the address above.

Cover: The Data General NOVA Serial Number One
See story on page 2 *Photo by David Pace, Museum Photo ID #102621784*

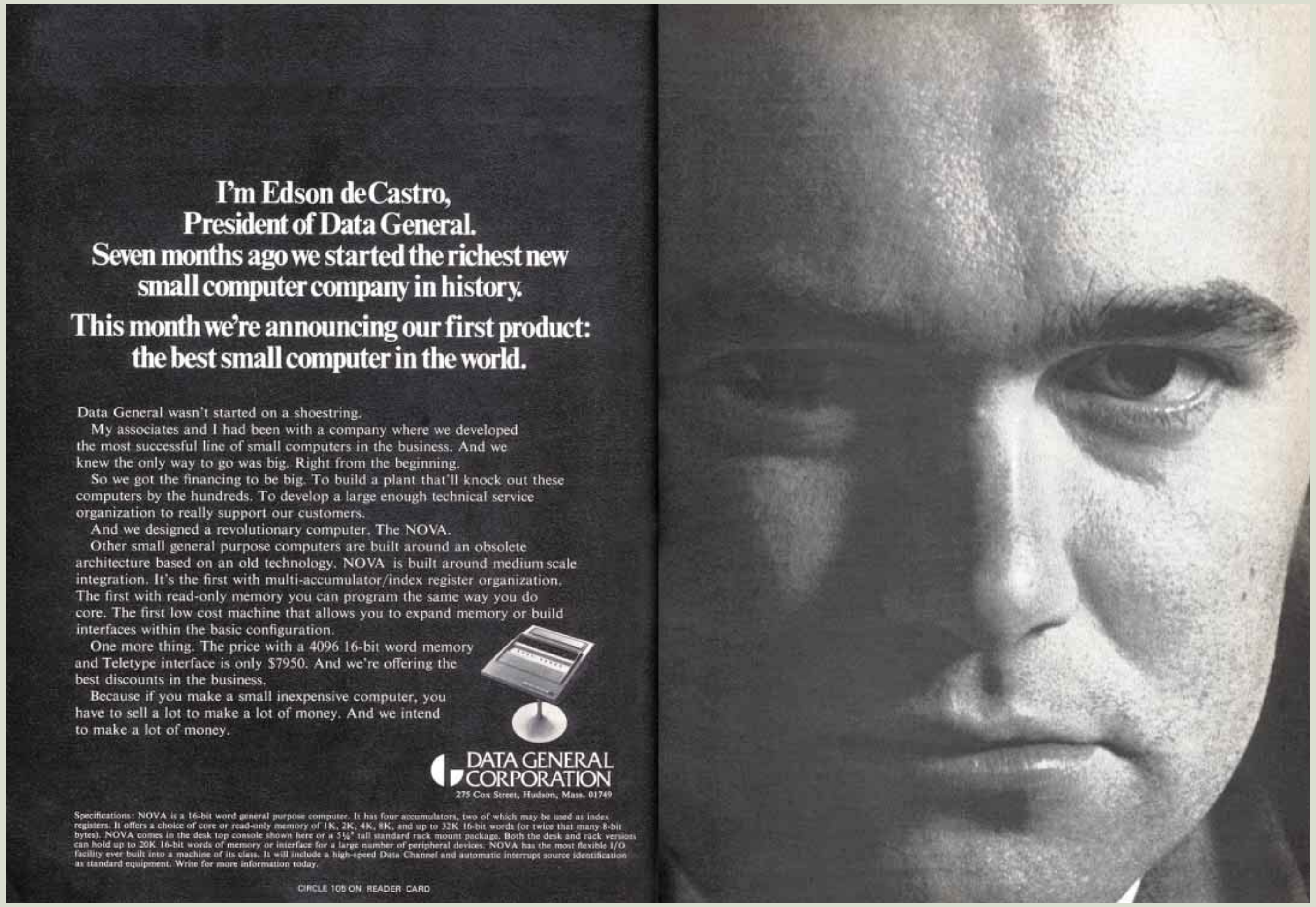




IN THIS ISSUE

THE DATA GENERAL NOVA

DAG SPICER



Two-page ad in December 1968 *Datamation*

TCMHC Photo #102621786

EMC/Data General donated the Data General NOVA Serial Number One and the NOVA 1200 to the Museum on January 10, 2001. Trustee Sam Fuller (left) accepted the gift on behalf of the Museum from NOVA designer Ed deCastro (center) and Joel Schwartz, president of the Data General Division of EMC

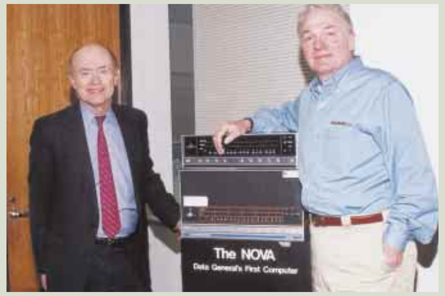


Photo by Oak Hill Studio, Fitchburg, MA
TCMHC Photo #102621785

NOVA designers Ed deCastro and Ron Gruner (NOVA 1200)

At an official ceremony in Westboro, Massachusetts on January 10th of this year, Serial Number One of the Data General NOVA minicomputer became part of The Computer Museum History Center's permanent collection. The machine was donated by EMC, which acquired Data General in 1999, and currently maintains a Data General division.

Announced in late 1968 at the Fall Joint Computer Conference in San Francisco, this popular minicomputer was widely adopted by industry and academia as a simple-to-program, yet powerful machine with an elegant architecture based on a 16-bit word length. At a time when Honeywell and Digital Equipment Corporation (DEC) dominated the minicomputer industry, the NOVA was the first machine to seriously challenge their strong positions in education, government, and process-control markets.

Data General (DG) former president and founder Edson deCastro, the hero of Tracy Kidder's book *The Soul of a New Machine*, which describes the later DG Eclipse project, now notes that the NOVA "was a revolutionary machine for its time." In a bold two-page advertisement (see fig 1) in the December 1968 issue of *Datamation*, deCastro pulled no punches about the machine's features, low price, and superior value.

Looking back on the project, deCastro notes that, "either this machine was going to work, or we'd be out of business.... There was no 'Plan B.'" With only 28 employees, deCastro designed the NOVA's logic, while Henry Burkhart wrote the software and Dick Sogge implemented circuit and memory design—all from a small building in Hudson, Mass., that is now a beauty parlor.

The original *Datamation* ad made clear that volume and low price were key elements in the NOVA strategy. At half the price of competitive machines (including machines from deCastro's old employer, DEC), DG sold over 300 machines in the first year alone at about $8,000 each. Museum Trustee Sam Fuller, who accepted the donation of the NOVA on behalf of the Museum, also sang its praises. "The NOVA was a landmark," explains Fuller, "by being such a high performer at such a low price." Another element, deCastro notes, was "what we would call today a "RISCy instruction set [RISC = Reduced Instruction Set Computer]. Other manufacturers were convinced that performance was only attainable via complex instruction sets." There was thus an "architectural bonus" to the NOVA's simplified programming model that resulted in higher speeds. Gordon Bell, then vice-president of engineering at competitor DEC, explains that, as often happens with new start-up companies, frustration over unappreciated innovations led team members to create the Data General spin-off. "The NOVA 1," reflects Bell, "had special meaning for Digital since the DG founders had been the designers of DEC's 12-bit PDP-8, and 18-bit PDP-9 minis. Furthermore, the founders had proposed an impressive and scalable architecture (PDP-X) that the company [Digital] had rejected."

Like many new products, the first NOVA was not without some early problems. Harvey Newquist, one of five founders and head of manufacturing for the tiny company, says that the very first NOVA was actually lost before it ever reached its first customer, the University of Texas. In February of 1969, Newquist placed the new machine in the passenger seat of his 1964 Mustang, drove to Logan Field, and checked it into the cargo department of a major airline. Newquist and the group then celebrated the milestone of shipping their first product. Unfortunately, due to a strike, the airline lost the package. After a week of fruitless searching by expediters and the airline, DG shipped a replacement. At a time when production was only two units per month, this setback was painful for the new company. Three months later, the airline reported that the machine had been located in a cargo shed at Chicago's O'Hare Airport where it had been consolidated into a shipment of shoes. In spite of the initial loss and panic the loss had inspired, NOVA team members were delighted to find that the machine, when returned to headquarters, worked as soon as it was plugged in.

Architecturally, the NOVA sported a 16-bit word length (rare in machines of this size and price), allowing for a relatively large amount of memory and for a long product lifespan as improved device technology extended the NOVA "family" for another 15 years. Shortly after its initial introduction, DG offered an impressive array of peripherals and options (see specifications on page 6). Like its mainframe siblings, the NOVA was organized with a central processing unit surrounded by multiple (in this case, four) general-purpose registers, two of which could be used for indexing. This simplified the programmer interface from that of single-accumulator

Photo by David Pace
TCMHC Photo #102621788

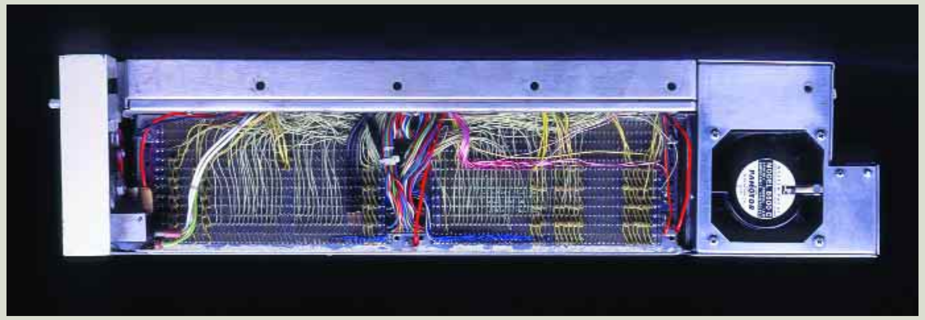


Photo by David Pace
TCMHC Photo #102621787

Data General NOVA One

The NOVA mounted in a telescope control system and in use, circa 1981, at the University of Texas (the operator rests his hand on NOVA control panel)

machines in which more frequent accesses to memory are required. It also allowed mathematical operations, like (fixed- and floating-point) multiplication and division, to be executed without constant memory references, again resulting in improved speed.

Not only innovative architecturally, the NOVA was also acclaimed for its hardware economy and efficiency. The designers had eliminated transformers and other costly components in the machine's memory system. A wireless backplane improved reliability, although on the first NOVA itself, now in our collection, a fair number of jumpers are seen to be in place—not unusual for the first iteration of a new machine. The chassis could accommodate seven printed circuit boards and be populated with either memory or I/O device controllers, allowing DG to pursue many different markets. The large circuit boards contrasted with DEC's "Flip Chip" board designs, though the jury is probably out as to which was more reliable: a small number of large boards or a large number of small boards. The NOVA's entire central processor was contained on one of these 15-inch boards, and the device technology was Medium Scale Integration (MSI) TTL from Fairchild.

Both Newquist and deCastro note that the NOVA originated from the realization of two things:

1. *…that their main competitors, DEC and the Computer Control Division of Honeywell, got into minicomputers as an extension of their existing markets of selling circuit modules to technically sophisticated customers like universities and laboratories. DG was not hampered by this legacy and realized that large circuit boards, designed expressly for one purpose, could result in large cost savings.*

2. *…that the advent of Medium Scale Integration (MSI) integrated circuits (ICs) allowed for fewer components and interconnections overall, greatly increasing reliability.*

Applying these principles required working very closely with a local Printed Circuit Board (PCB) manufacturer, since boards of this size had rarely been made. The NOVA boards were double-sided and 15-inches wide, and initially did not fare well with the wave soldering process used by volume manufacturers. This was one of the toughest challenges that Newquist and the vendor had to overcome in order to produce working hardware.

But large circuit boards had the additional benefit of increasing maintainability. Previously, customer engineers at DEC had had to troubleshoot machines to the gate level. The NOVA had only seven boards, compared to more than 10 times that number in DEC's Flip-Chip-based PDP-8. DG engineers simply swapped out these large boards with new ones while the defective units were brought back to the factory for service. As deCastro notes today, the large boards allowed DG to eliminate DEC's "unnecessary level of interconnect."

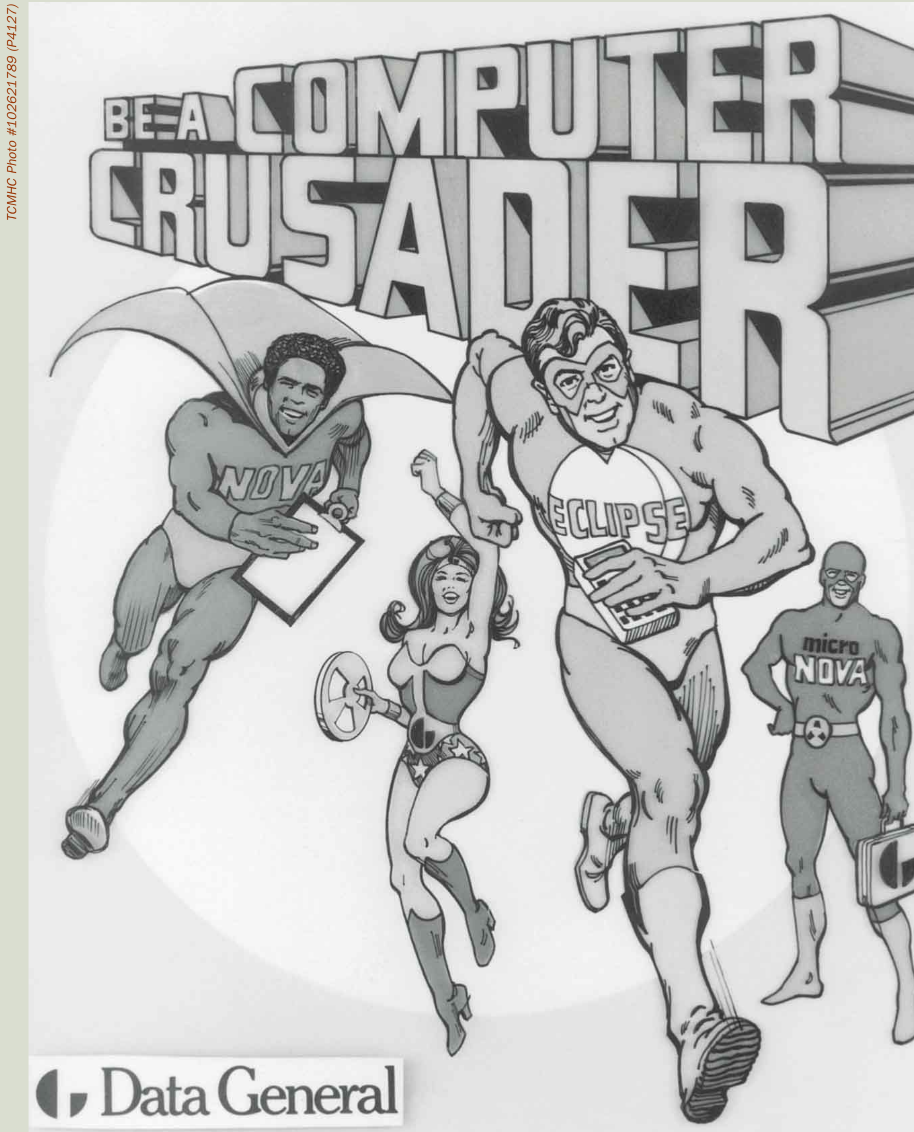
What about software? Newquist indicates that DG's model was "here's the car, the tires will come later." A rudimentary assembler and other about five other utilities on paper tape came with the original NOVA. Yet within a year, the NOVA shipping list had over 2,400 items available: 1,800 hardware options; 600 software options. DG also employed what today we would term "Just in Time" (JIT) assembly, or "mass customization": keeping low inventory (turnover was 10 x inventory per annum) and using modular assembly in which pre-made sub-assemblies were kept on hand and put together into a complete machine only when a customer order was placed.

As noted earlier, the Museum's "new" NOVA was originally shipped to the University of Texas to guide that university's radio telescope, which it did for 14 years until it was exchanged for an Eclipse and returned to the halls of DG. Thanks to the DG alumni association, known as the "Grey Eagles," the machine was rescued from a storage closet in the company's executive suite and marked for preservation. Ed McManus, a Grey Eagle member, led the charge to save the NOVA by asking The Computer Museum History Center Trustee Gardner Hendrie whether the Museum was interested. It was a simple decision!

Also part of the donation was a NOVA 1200, the successor to the original machine. NOVA 1200 designer Ronald Gruner indicated that the original NOVA was special because it was a "breakthrough in size and cost, and it just changed the way people thought about computing." Gruner's observation about the NOVA is one frequently seen in the history of computing: with each new advance in computational paradigm (from mainframes to minis to micros, and now ubiquitous computing), qualitative differences in the ecological niches such machines inhabit surpass their mere quantitative improvements in performance. The NOVA defined a new "price point" for a widely-useful amount of computer power. It thus broadened the community of people generally using computers and redefined how such power could be used in what were formerly manual or analog applications (such as process control and scientific research), as well as in traditional digital areas (data communications and processing). There was also a brisk market for the NOVA in the OEM product space, in which computers are embedded into larger, higher-value products. In turn, this expanded user base supported the adoption of the NOVA architecture, and Data General extended and refined the diversity of software applications, peripherals, and models. The NOVA grew into a "line" of computers, differentiated by specific improvements in memory speed or size, expandability, and cost.

As the NOVA family grew—including a single-chip implementation, the

TCMHC Photo #102621789 (P4127)



Data General publicity featuring the NOVA, micro NOVA, and later Eclipse

MicroNOVA, designed by Museum Trustee Gardner Hendrie—its influence spread beyond its immediate customer base, extending to a new generation of computer designers. Instead of Farrah Fawcett posters, for example, a certain high-school student in Los Gatos, California was said to be so delighted with the machine that he had pictures of it taped to his bedroom wall. That student, for whom the NOVA was more interesting than the latest Hollywood starlet, was Steve Wozniak. Even accounting for the somewhat rarefied tastes of computer designers, this is an impressive testament to the machine's influence, as was the total production of all NOVAs and NOVA-variants, some 50,000 machines.

Does deCastro have any heroes? "If I had to pick someone I really admired, it would be Bob Noyce. He worked hard with us to develop Intel's first semiconductor RAM chip, which was used on the faster successor to the NOVA, the SuperNOVA." A new generation of computer designers now admire deCastro and his NOVA team, whose first machine now resides in the permanent historical collection of The Computer Museum History Center. ■

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

NOVA specifications and references >>

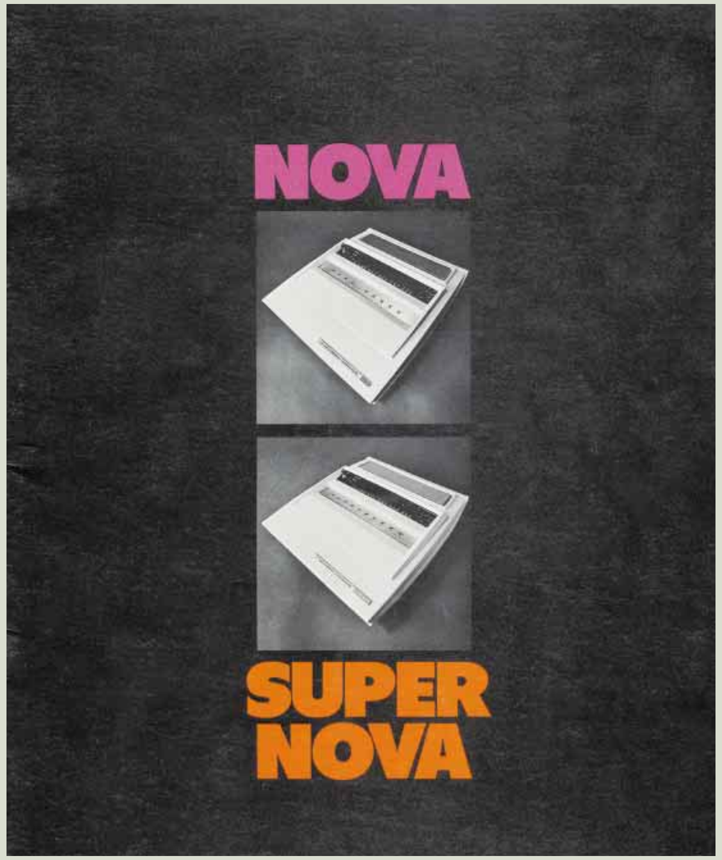


Image taken from a NOVA/SUPER NOVA brochure

Data General NOVA 1200 (1973), X2067.2001, Gift of EMC Corporation/Data General Division

Data General NOVA Serial Number One (1968), X2066.2001, Gift of EMC Corporation/ Data General Division

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Technical specifications

Architecture: Four accumulators (registers); two of which can be assigned as index registers

Software at time of introduction: BASIC, assembler, math routines, floating-point interpreter, text editor

Technology: Medium-scale integration (MSI) TTL

Word Length: 16-bit

Memory: 4,096 16-bit words; 20KB (max) within cabinet; 32K (max), with external cabinet. Both core and ROM are available and can be mixed (ROM typically used in industrial control applications once software has been developed in core or for user-defined routines)

I/O: Teletype, paper tape reader, paper tape punch, plotter, printer, disk, general purpose wiring board (for customer-designed interfaces); 16-level interrupt scheme, DMA supported

Memory Access Time: 1.6uS (625kHz)

Clock speed: approx. 1.5MHz

Size: Rack-mount: 5 1/4” x 19” x 23” (HWD); Desktop 7” x 23” x 25” (HWD)

Weight: approx. 50 lbs
Package style: Desktop or rack-mount

MTBF: approx. 5,500 hours

Price: $3,950 basic unit (1968); $7,950 w/ 4K core and Teletype interface

Power requirements: 400W

References/for further reading

www.dg.com/about/html/data_general_nova.html

Fundamentals of Mini-Computer Programming, 1973, Data General # 093-000090-00, TCMHC document #102622936

NOVA/SUPERNOVA Brochure, n.d., Data General, TCMHC document #102622937

NOVA Price List, Effective: Dec 1, 1968, 1968, Data General, TCMHC document #102622938

NOVA 1220 Computer, Product Data Sheet, TCMHC document #102624096

NOVA 800 Computer, Product Data Sheet, TCMHC document #102624095

NOVA 1200 Computer, Product Data Sheet, TCMHC document #102624093

NOVA 820 Computer, Product Data Sheet, TCMHC document #102624094

RECENT DONATIONS

TO THE COMPUTER MUSEUM HISTORY CENTER COLLECTION

Amdahl 470 Nameplate (1975), X2052.2001, Gift of Bill Spangler

Atari 800 System (1984), X2054.2001, Gift of Rhoda and Larry Yelowitz

Burroughs L-9000 (1975), X1742.2001, Gift of Redwood Lease

Computer Control Company DDP-24 (1963), X2060.2001, Gift of Ron Rowe

Cray 2 Board (1984), X2042.2001, Gift of Geri Harrand

Cray 3 Module (1992), X2043.2001, Gift of Geri Harrand

Cray 4 Board (1995), X2045.2001, Gift of Geri Harrand

Cray 4 Module (1995), X2044.2001, Gift of Geri Harrand

Cray Y-MP EL (1992), X2095.2001, Loan of NASA Ames Research Center

Data General NOVA 1200 (1973), X2067.2001, Gift of EMC Corporation/Data General Division

Data General NOVA Serial Number One (1968), X2066.2001, Gift of EMC Corporation/ Data General Division

DEC MicroVAX II (1979), X2069.2001, Loan of NASA Ames Research Center

DECstation 5000/133 (1993), X2070.2001, Loan of NASA Ames Research Center

IBM 3480 Tape Drive (1983), X2092.2001, Gift of MontaVista Software

IBM PC Jr system (1983), X2053.2001, Gift of Fred Waters

Jackson Dynamic Output Tube Tester (1943), X2065.2001, Gift of Scott Anderson

SGI Personal Iris (1988), X2094.2001, Loan of NASA Ames Research Center

The Computer Museum History Center seeks and accepts various types of computing-related artifacts from hardware and software to memorabilia, video footage, and documentation. If you would like to make a donation to the Museum, please visit our website for details at: http://www.computerhistory.org/donor or call (650) 604-2579. All donations must be approved in advance by our collections committee. Thank you.

FROM THE COLLECTION

CHRIS GARCIA

PALM PILOT PROTOTYPE

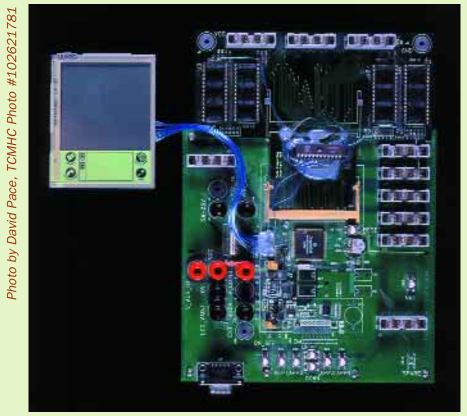


Photo by David Pace, TCMHC Photo #102621781

Since the days of the mechanical calculator, people have been trying to devise a computer small enough to change the definition of "computer" itself by packaging the functionality of a desktop into handheld form.

In the early 1990s, companies like Go and Apple released machines that were by far the most portable of their time. These early PDAs (Personal Digital Assistants) were slow and expensive, promised more than they could deliver, and suffered in the marketplace as a result. While the machines were very advanced, making full use of technologies including wireless e-mail and handwriting recognition, they failed to live up to sales predictions (one of which called for one billion dollars in sales in 1993). After the failure of those first machines, the future of the handheld computing market was uncertain until Palm Computing Inc., a division of U.S. Robotics, came out with its Palm Pilot "Connected Organizer" in 1996.

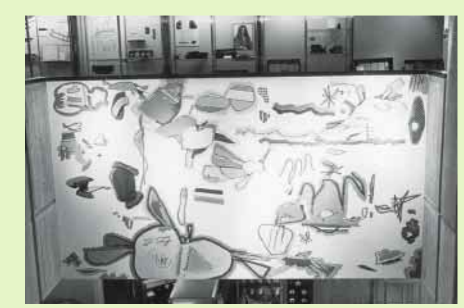
The board shown here is the very first hardware prototype of the Pilot handheld organizer, and was made in the spring of 1995. The actual working hardware on the board is nearly identical with production version units in the Pilot 1000 and 5000 series, which shipped in the spring of 1996. The design of the Pilot was based around the Motorola 68328 Dragonball Processor. This is an embedded 32-bit CPU based on a 68000 CPU core with integrated LCD controller, real-time clock, timers, serial I/O, power management, and sound generation. The Palm Pilot, accompanied by its operating system, Palm O/S, has created a vibrant community of hackers and developers who seek to add still more functionality to the basic unit. Palm Pilots face competition from cellular telephone makers (Nokia, for example) who seek to build Palm functionality into their telephones. Concurrently, Palm is itself adding cellular functionality to its devices, as well as licensing its operatin system to many companies to keep the market growing. This wide adoption highlights the convergence of computing and communications—one sure to redefine human relationships, whether personal or professional. ■

Palm Pilot Prototype (1995), X1980.2000, Gift of Ron Marianetti

Chris Garcia is Historical Collections Coordinator at The Computer Museum History Center

AARON CREATES

TCMHC Photo #102627459



TCMHC Photo #102627460

These images from our photo archive document a painting called *Primavera in the Spring*, and Harold Cohen coloring the image (1980). Cohen’s robotic and artificial intelligence-based painting system, AARON, generated the design, a “turtle robot” (see back cover) drew the lines with imperfections and subtleties emulating human art, and the image was colored in by hand. While the original wall-sized mural was not moved from Boston, the painting event itself was recorded for posterity in these images and Museum records. Several surviving smaller paintings of AARON exist in the Museum’s permanent collection. ■

FROM THE COLLECTION CONTINUED

THE BEHEMOTH

BEHEMOTH, Big Electronic Human-Energized Machine...Only Too Heavy (1983-1991), L2003.2001, Loaned by Steve Roberts

After speaking at a Museum lecture on Sept 7, 2000, Steve Roberts presented BEHEMOTH to The Computer Museum History Center as a long-term loan

Photo by David Pace, TCMHC Photo #102621783

Photo by David Pace, TCMHC Photo #102621746

(far left) BEHEMOTH, the "Technomadic Adventure Platform" built by Steve Roberts, traveled more than 17,000 miles before it found a new home at The Computer Museum History Center.

The helmet features a Private Eye display, ultrasonic head-mouse sensor, fluid heat exchanger and headset with boom microphone.

In the early 1980s, feeling trapped in his suburban lifestyle, Steve Roberts began to reevaluate his life. Roberts, a freelance technical writer who had published articles in magazines such as *Byte*, decided to tour the country on a recumbent bicycle of his own design, the Winnebiko. During his trip, Roberts made his living publishing stories and writing a book as he went along, using his on-board Radio Shack TRS-80 Model 100 and a CompuServe account to e-mail his stories to publishers.

After redesigning the bike (as Winnebiko II), Roberts went off in an entirely different direction, devising BEHEMOTH (Big Electronic Human-Energized Machine...Only Too Heavy): a 580-pound, 105-speed recumbent bicycle with a four-foot yellow trailer solar panel array that allowed the incorporation of many more technologies than on previous bikes. Roberts envisioned a project where a "computer and communication tools rendered physical location irrelevant." BEHEMOTH sported antennas for communication over various amateur and public radio networks, several networked computers (including an Apple Macintosh and an Intel 386-based laptop), a special keypad on each bicycle handle to allow typing, and a security system that would alert police if the vehicle were disturbed. The helmet is perhaps the most futuristic-looking part of BEHEMOTH, with its heads-up display, motion sensors for cursor control, lights, fluid heat exchanger to keep the head cool, and audio system. A complete feature list is shown below.

Roberts logged over 17,000 miles on BEHEMOTH and gave hundreds of radio, television, and print interviews over the several years he was on the road. This wide exposure points to BEHEMOTH as an important milestone in the integration of technologies for recreational use, as well as a highly visible artifact of early wireless mobile networking. Roberts retired BEHEMOTH to begin a new project called the Microship. ■

INTEGRATED EQUIPMENT

Console (forward enclosure under fiberglass hood)

- Macintosh 68K (control GUI and primary workspace)
- Bicycle Control Processor (FORTH 68HC11)
- Ampro 286 DOS platform for CAD system
- Toshiba 1000 repackaged laptop for scrolling FAQ
- 80 MB hard disk space
- Audapter speech synthesizer
- Speech recognition board
- Trimble GPS satellite navigation receiver
- Audio and serial crosspoint switch networks (homebrew)
- PacComm packet TNC (VHF datacomm)
- MFJ 1278 for AMTOR (HF datacomm)
- Diagnostic tools (LED matrix, DPM, etc)
- Handlebar keyboard processor
- Ultrasonic head mouse controller
- Icom 2-meter transceiver
- Radiation monitor
- Cordless phone and answering machine on RJ-11 bus
- Folding 6-segment aluminum console
- Fiberglass fairing

RUMP — Rear Unit of Many Purposes
(white enclosure behind seat)

- Stereo System (Blaupunkt speakers, Yamaha 18W amp)
- 10 GHz Microwave motion sensor (security)
- UNGO physical motion sensor (security)
- Rump Control Processor (FORTH 68HC11)
- Audio crosspoint network, bussed to console
- Ampro DOS core module for heads-up display
- LED taillight controller
- Motorola 9600-baud packet modem for backpack link
- 7-liter helmet-cooling tank and pump
- Personal accessory storage
- Air compressor for pneumatic system
- 15 amp-hour sealed lead-acid battery (1 of 3)

Helmet

- Reflection Technology Private Eye display
- Ultrasonic head-mouse sensors
- Helmet lights (2)
- Life Support Systems heat exchanger for head cooling
- Setcom headset with boom microphone

SPARCPACK
(aluminum case atop RUMP)

- Sun SPARCstation IPC with 12MB RAM and 424 MB disk
- Sharp color active-matrix display
- Motorola 9600-baud packet modem
- 10-watt solar panel

Trailer (WASU — Wheeled Auxiliary Storage Unit)

- 72-watt Solarex photovoltaic array (4.8 Amps at 12V)
- Qualcomm OmniTRACS satellite terminal
- Ham Radio station:
  - Icom 725 for HF
  - Yaesu 290/790 for VHF and UHF
  - AEA Television transceiver
  - Audio filtration and Magic Notch
  - Antenna management and SWR/power meters
  - Automatic CW keyer
  - Outbacker folding dipole antenna on yellow mast
- Dual-band VHF/UHF antenna
- Telebit CellBlazer high-speed modem
- Oki cellular phone, repackaged and integrated
- Telular Celjack RJ-11 interface
- Credit card verifier for on-the-road sales
- Trailer Control Processor (FORTH 68HC11)
- Audio crosspoint network, bussed to console
- Bike power management hardware
- Two 15 amp-hour sealed lead-acid batteries
- Security system pager
- Canon bubble jet printer
- Fluke digital multimeter
- Mobile R&D lab, tools, parts, etc.
- Makita battery charger (for drill and flashlight)
- Microfiche documentation and CD library
- Camping, video, camera, personal gear
- Fiberglass-over-cardboard composite structure
- High-brightness LED taillight clusters

Bike and Frame-Mounted Components

- Custom recumbent bicycle
- 105-speed transmission (7.9 - 122 gear inches)
- Pneumatically-deployed landing gear
- Pneumatic controls, pressure tank, air horn
- Hydraulic disk brake
- Under-seat steering
- Handlebar chord keyboard
- CD player

More thorough details, along with information about Roberts' Microship project, may be found on the Nomadic Research Labs website: http://www.microship.com

FOCUS ON PEOPLE

DAVE BABCOCK

RESTORING A HISTORICAL PERSPECTIVE

ELEANOR DICKMAN

Dave Babcock in front of the IBM 1620 he helped restore

The computing history bug first bit Dave Babcock at a dinner with Grace Hopper in July 1970. She handed him a "nanosecond" (an 11.8" stretch of wire symbolizing the distance electricity travels in a billionth of a second), and he was hooked! But his fascination with computers – and later their restoration and preservation – began with his first access to an IBM 1620 as a 14-year-old honors math student. "It electrified me," Dave recalls, "and I knew this was the field I wanted to be in."

His first book about computers was on 1620 computing, and was written by Fred Gruenberger, a professor at San Fernando Valley State College (later Cal State Northridge). Dave later enrolled in Fred's senior-level computing class. "I could have gotten into hot water because I was a freshman," he admits, "but I did well in the class, so [my professor] didn't complain." Dave's relationship with Fred grew: first assisting with writing one book, co-authoring another, and then collaborating on publishing a magazine on popular computing. It was Fred who introduced Dave to the legendary Hopper, and a new kind of history was about to begin.

Dave most often expresses his commitment to computing history in terms of "collecting the stories, the lessons learned, and why [pioneers] did what they did." In some cases, he believes "this can be more important than just saving physical artifacts, because the world is run by people." Dave enjoys being a docent for The Computer Museum History Center because he "gets to learn the stories. It is even more special because pieces of their story are also my story."

The software development engineer (now with Hewlett Packard after 10 years at Silicon Graphics) says he is "always on the computer. My wife can never tell if I'm doing work or enjoying my hobby." His commitment to preserve history gives him perspective in his work. "You work in the industry, develop a revolutionary thing. Five years later, it's old technology, and five years after that it is thrown away." He stresses the need to be aware of the lifespan of innovations and ways in which they evolve. This gives him "the ability to see trends, the big picture…"

On the other hand, his professional career has helped him serve The Computer Museum History Center because he has "a lot of contacts, and [he] enjoys promoting the Museum at work or at conferences." Dave brings 30 years of project management experience to his volunteer role at the Museum, with skills in long-range strategic planning and "people organization" as well as technical expertise.

LEADING THE IBM 1620 RESTORATION

Dave's lifelong fascination with the IBM 1620 (his first "hands-on" computer) led him to write an instruction simulator for it on his Palm Pilot. His feat was mentioned by Board Chairman Len Shustek in a 1998 newspaper article, which was read by an original 1620 engineer, who suggested that the Museum restore its 1620. The idea appealed to Dave, as long as the project would maintain "the historical authenticity of the machine." Dave wrote a formal proposal to The Computer Museum History Center, volunteering to spearhead the project.

Dave saw the project as a valuable way to develop important protocols about restoration management and documentation of the process. About 24 people throughout the United States said they would be willing to help. Work began in earnest in January 1999. A core team of about eight engineers actually did the hands-on work, while others scanned manuals, collected needed parts and documentation, and worked on the web page. The group committed to spending a full Saturday every other week "for as long as it took."

As the project has progressed, the collection of items related to the 1620 has grown: four file cabinets with a "pretty complete set" of software from a retired Purdue professor, a console typewriter, books on 1620 architecture from England, and many personal accounts. Components that are replaced are marked in red within the machine, so that it is absolutely clear what has been changed. Lacking original peripherals, the team built emulators, pioneering a new technology in support of restoration. And through it all, the team has kept a detailed log that Dave describes as "what we did and what we learned — adding not only to the understanding of the machine, but also to our knowledge of the restoration process." Lee Courtney, the Museum's "volunteer volunteer coordinator," credits Dave's leadership for the success of the restoration. "Dave Babcock is like pennies from heaven for an organization like The Computer Museum History Center," says Lee. "He has unlimited energy and really inspires other people through his infectious enthusiasm." Lee most appreciates the fact that Dave is "so knowledgeable about issues, why the technology is important, and how we should preserve it."

In spite of a demanding new job, Dave is overseeing the final aspects of the 1620 restoration and still remains active in volunteer activities. He describes his involvement with The Computer Museum History Center as "what I do for me!" Like most volunteers, he believes he gets "more out of it than I put into it. I feel privileged to be part of preserving computing history." He considers The Computer Museum History Center to be "the only organization with the breadth and depth of contacts to really preserve computing history," and says, "I really think we are in the best position to be a major force" in this arena. Concludes Lee, "Dave is a pillar of the Museum, in terms of making us a world-class institution that knows how to preserve the history of computing."

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

CURRENT STAFF AND VOLUNTEER OPENINGS

The Computer Museum History Center offers a unique chance to help build a world-class Museum that will preserve and present information age artifacts and stories for generations to come. We are actively seeking qualified, motivated, and talented people for the following positions:

STAFF

- Curator
- Curator of Collections
- Events Coordinator
- Fund-Raising Assistant
- Office Assistant
- Vice President of Facilities and Logistics
- Director of Cybermuseum Exhibits

For detailed information about these job opportunities and how to apply, please visit our website at www.computerhistory.org/jobs

VOLUNTEER

- Technical Research & Reference Team member
- Office organization and systems support
- Visible Storage Exhibit Area renovation team member

For detailed information about these and other volunteer opportunities, please visit our website at www.computerhistory.org/volunteers or call Karyn Wolfe.

REPORT ON MUSEUM ACTIVITIES

KAREN MATHEWS

Karen Mathews is Executive Vice President at The Computer Museum History Center

FELLOW AWARDS 2000 – AN EVENING TO REMEMBER

Over 300 entrepreneurs, computer scientists, business leaders, academics, and other supporters of computer history attended the prestigious Fellow Awards on November 9, 2000 at the Hotel Sofitel San Francisco Bay, to celebrate the achievements of Fran Allen, Vint Cerf, and Tom Kilburn. Internet impresario Peter Hirshberg was the master of ceremonies and entertained the crowd with his visions of "Digiland," a memorable – yet fictional – plan to complement the Museum's new building. Also on stage were futurist Paul Saffo, Board Chairman Len Shustek, CEO & Executive Director John C. Toole, introducers Gerald Estrin and Anita Borg, and 2000 Fellows Fran Allen and Vint Cerf. Fellow Tom Kilburn was unable to attend the event in person and delivered a moving speech via video from the Museum of Science and Industry in Manchester, U.K., where he powered up the historic Manchester Baby – over 50 years after its first successful run in June 1948. The event was sponsored by 1185 Design, Citigate Cunningham, CRN, and Mid-Peninsula Bank.

2000 FELLOW AWARD RECIPIENTS

Fran Allen, for her contributions to program optimization and compiling for parallel computers

Vinton Cerf, for his contributions to the creation and growth of the Internet

Tom Kilburn for his contributions to early computer design including random access digital storage, virtual memory, and multiprogramming

From left to right: Trustee Peter Hirshberg, Award presenter Gerald Estrin, 2000 Fellow Vint Cerf, Executive Director and CEO John Toole, Trustee Chairman Len Shustek

Emcee and Trustee Peter Hirshberg's Digiland Resort concept with Bugland, Ventureland, Obsolete Square, Memory Lane, the Carousel of CEOs, Etherland and Marketingland

VOLUNTEERS AT WORK AND PLAY

It is largely through the generous help of our volunteers that the Museum is able to operate and sustain its growing activities. A number of volunteers have expressed how much they enjoy getting together to work with artifacts, at events, etc.

Volunteer coordinator (and volunteer extraordinaire) Lee Courtney arranged a different kind of volunteer get-together in December: an exclusive tour of the enigmatic Blue Cube. The Blue Cube – a turquoise structure located on Onizuka Air Station's 23 acres between Sunnyvale and Mountain View – is a Silicon Valley landmark, yet few people know what happens there, and an aura of mystery surrounds it. It is one of two satellite-command and control centers for US military satellite and shuttle missions. About 25 Museum volunteers in two separate groups got a mission briefing from commanding officers, and a tour of the facilities. Several people who attended announced that it was "very cool."

The Volunteer Steering committee (VSC) is identifying and coordinating activities to increase participation and promote challenging and productive projects for volunteers working with staff. The VSC and staff are also working on a volunteer handbook. A schedule of workdays for the year 2001 is published on the Museum's website, and watch for more social activities in the upcoming year as well.

Fran Allen signs poster for Peter Nurkse, with Museum staff John Toole and Karen Mathews in background

LECTURES PRESENT STORIES OF THE INFORMATION AGE

The Museum's lecture program is an important way to present and preserve the personal stories behind information age developments. Since CORE 1.3, the Museum has held four lectures:

On November 8, 2000, the eve of our Fellow Awards, new Fellow **Frances E. "Fran" Allen**, Senior Technical Consultant, IBM Research's Solutions and Services – and the first woman to be named an IBM Fellow – spoke on the 1956 "Stretch-HARVEST Compiler," at the George Pake Auditorium, Xerox Palo Alto Research Center. The lecture was co-hosted by the Institute for Women and Technology (www.iwt.org).

Sun Microsystems Fellow and VP **James Gosling** spoke to an audience of over 200 on January 9, 2001, with personal stories on the origin and development of Java, a programming revolution that, among other things, converted static web pages into interactive, dynamic, animated documents bolstered by distributed, platform-independent applications.

On January 23, 2001, Cray Inc. chief scientist and former Tera Computer co-founder and Chief Scientist **Burton Smith** described the evolution, innovations, and disasters that accompanied the development of hardware and software for the 1980s groundbreaking Denelcor HEP. The HEP was the first commercial system designed to apply multiple processors

Fran Allen on the Stretch-HARVEST: "No project happens in isolation — even one labeled 'top secret' as this one was at the time. The people and institutions involved, the political climate, and the shared knowledge, views, and value systems all contributed to making this an interesting project at an interesting time in the history of computing."

Java creator James Gosling

Photo by David Pace, TCMHC Photo #102621748

This Star7 (*7) early Java artifact is in The Computer Museum History Center collection

REPORT ON MUSEUM ACTIVITIES

CONTINUED

Cray Inc. chief scientist Burton Smith

The Denelcor HEP was a uniform shared memory multiprocessor that used fine-grain multithreading to tolerate memory latency, synchronization latency, and even functional unit latency. Six systems were delivered to customers during the years 1981-1985.

to a single computation, and the first to have multithreaded CPUs. Smith, primary HEP architect and Denelcor's Vice President of Research and Development from 1981 to 1985, also designed part of the HEP's hardware, including the interconnection network, and funded the development of automatic parallelizing compilers for the system.

David Stork, chief scientist at Ricoh Silicon Valley's California Research Center and consulting associate professor of electrical engineering at Stanford University, delivered an absorbing presentation on February 6, 2001 on "The HAL 9000 Computer and the Vision of 2001: A Space Odyssey." He illustrated the talk with clips from Arthur C. Clarke's 1968 epic film, "2001: A Space Odyssey," and its central character, the HAL 9000 computer, which could speak, reason, see, play chess, plan, and express emotions. Stork examined the areas where "reality" either exceeded or fell short of the HAL vision. Stork is the creator of "2001: HAL's Legacy," a forthcoming television documentary for PBS television.

To add your name to the e-mail lecture announcement list, please send a request to: info@computerhistory.org

OPERATIONS ITEMS NEEDED

People occasionally ask for a list of items we need for use in Museum operations. Here are some choice items from our list. As always, we will appreciate your help.

Panel van—for moving artifacts

Digital camera and lighting equipment —to photograph artifacts and people

DVD recording equipment that interfaces to other devices

Video and sound equipment for informal, high-quality recording

Portable, high-lumen LCD projector for communicating ideas

Color laser printer (HP4050 or 4500)

BETA/SP to VHS video duplicating machine

EVERY GIFT MAKES A DIFFERENCE

An encouraging stream of donations flowed into the Museum in December and January, as supporters across the country responded generously to our year-end Annual Fund appeal. Personal donations are already 20% above the total gifts received from individuals last year, and we are three quarters of the way through the fiscal year ending June 30. December's results are an exciting indication of extraordinary support, and we are devoted to achieving our ambitious goals for the rest of the year. Please call Eleanor Dickman if you would like to make a donation or upgrade your gift by June 30.

The Annual Fund keeps the Museum vibrant and enables us to fulfill our important mission as we steadfastly work toward the construction of an exciting, new world-class facility – YOUR new Museum. John Toole has spoken of all the programs, activities, and new directions we are pursuing in the coming years. And, we're planning to break ground for our new landmark museum in 2003! Trustees and some generous individuals have already made significant leadership gifts to both our new building and the Annual Fund, but they, and we, need your support as well. Special thanks to all of the donors who donate to the Museum each year at the "Core Supporter" level of $1,024 (1K) or above. Thank you for your commitment, and for all your help to get friends and colleagues involved. You are our partners in this pace-setting venture. It's going to be an exciting journey.

NEW BUILDING PLANS

KIRSTEN TASHEV

Illustrations by Ian Espinoza

NASA commissioned these concept drawings of the NASA Research Park. The Computer Museum History Center's future site is located just to the right (or south) of the large dirigible hangar.

The Museum's efforts are well underway to create a new and worthy home in which to fulfill its mission—to preserve and present for posterity the artifacts and stories of the information age. This fall, after many years of planning, the Museum embarked on a formal process to develop and design a new 112,000 square foot world-class exhibition and research facility. The new building will not only house our extensive collection but serve as a forum to communicate and collect computer history through permanent and temporary exhibitions, lectures, special educational programs, and a multi-media research library.

In three to five years, the Museum's permanent facility will be located in the new NASA Research Park near historic Hangar One, as part of its partnership with the NASA Ames Research Center. NASA is working to establish a high-caliber, shared-use, research and development campus in conjunction with local communities, involving partnerships with government, academia, private industry, and non-profit organizations. NASA Ames Research Center Director Henry McDonald says that he is "pleased to welcome [the] important collaboration" of NASA and the Museum to the NASA Research Park. He indicates that the Museum is a good fit for the campus because "NASA's roots in information technology are linked to some of the most significant accomplishments we have seen in the history of computing." The Museum will contribute to the quality of the Research Park "through its historical artifacts and cyberspace access and provide an important research tool for scientists, in addition to building world-class exhibits in its outreach to Silicon Valley and throughout the world."

Last October, when the Museum began soliciting qualifications for the new building from top architectural firms, the response was very enthusiastic, resulting in proposals from 10 firms, many with extensive experience developing other new museum institutions. Upon reviewing the submitted materials according to specific selection criteria, the Museum's Building Committee invited six firms to interview in early January 2001. After careful consideration, the Museum has asked EHDD Architecture, San Francisco, CA; Michael Maltzan Architecture, Los Angeles, CA; and William McDonough + Partners, Charlottesville, VA, to participate in an architectural competition from which we will select a winner in April 2001 and promptly thereafter begin schematic design.

The Museum is also beginning a search for an appropriately dynamic and innovative exhibition design team. We are conducting an interview and proposal process during February and March 2001, so that an exhibit design firm can begin concurrently with the architectural team in April 2001. Our approach is to have the architectural and exhibit design teams work closely together so that the exterior and interior building designs will inform each other and create a seamless and fully-integrated environment for our visitors.

In thinking about how the architecture of our new building could manifest or reflect the history of computing, many wild and wonderful thoughts have come to mind. We ask ourselves, "How could a building say something about computing: past, present, and future?" Can the building's architecture communicate our story abstractly by drawing inspiration from binary code, circuit boards, punched cards, or perhaps more literally by taking on the physical shape of say a disc platter, supercomputer, or vacuum tube?

Kirsten Tashev is Building & Exhibits Project Manager at The Computer Museum History Center

THANKS TO OUR ANNUAL FUND DONORS

We acknowledge with deep appreciation the individuals and organizations that have given generously to the Annual Fund.

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This information is current as of February 25, 2001. Please notify us of any changes to your listing (wolfe@computerhistory.org). Thank you.

YOUR ANNUAL DONATION to The Computer Museum History Center will help preserve the artifacts and stories of the Information Age for future generations. Please help us fulfill this important mission.

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___ other $ ____________

___ 16K ($16,384)

MAJOR CORE SUPPORTER

___ 8K ($8,192)

CORE SUPPORTER

___ 4K ($4,096)

___ 2K ($2,048)

___ 1K ($1,024)

GENERAL SUPPORTER

___ $500

___ $250

___ $100

___ $35 (student)

___ other $ ____________

YES, I want to help save computing history. Please process my donation at the level indicated. I look forward to learning more about the programs and activities of The Computer Museum History Center, especially its plans for growth in the coming years.

___ Enclosed is my check payable to: The Computer Museum History Center

___ I prefer to donate stock and will notify you when the transfer is made

___ Charge my Visa ____ Mastercard ____

Visa/Mastercard number ________________________

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Please return this form (or facsimile) with your remittance to:

The Computer Museum History Center
P.O. Box 367 Moffett Field, CA 94035
+1 650 604 2575 (tel)
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www.computerhistory.org

WELCOME to our network of supporters. We look forward to getting to know you!

ANNUAL FUND APPEAL

Is your name on our list of Annual Fund donors? If so, you are one of a select group of people who appreciates the impact of the computing revolution on our lives today. You also take pride in your own role in ensuring that this history of innovation is preserved for posterity. We are grateful for your generosity and support. And if your name is not on this list, we welcome your contribution and will be delighted to add your name to our roster. You may use the form on this page to join our family of donors. Thank you!

STOCK DONATIONS

We gratefully accept direct transfers of securities to our account. Appreciated securities forwarded to our broker should be designated as follows:

FBO: The Computer Museum History Center; DWR Account # 112-014033-072; DTC #015; and sent to Matthew Ives at Morgan Stanley Dean Witter, 245 Lytton Avenue, Suite 200, Palo Alto, CA 94301-1963.

In order to be properly credited for your gift, you must notify us directly when you make the transfer. If you have any questions regarding a transfer of securities, please contact Eleanor Dickman.

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or

THE COMPUTER MUSEUM HISTORY CENTER
PO Box 367, Moffett Field, CA 94035

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UPCOMING EVENTS

PLEASE RSVP FOR ALL EVENTS AND ACTIVITIES

THU, MARCH 8, 6 PM
THE DARTMOUTH WORKSHOP AND ITS IMMEDIATE CONSEQUENCES: THE ORIGINS OF ARTIFICIAL INTELLIGENCE
Museum Fellow John McCarthy, Stanford University
NASA Ames Main Auditorium
Moffett Field, CA

SAT, APRIL 14, 9AM – 5 PM
VOLUNTEER WORK PARTY
Bldg 126, Moffett Field, CA

WED, APRIL 18, 6 PM
THE INTERNET: 21ST CENTURY TIDAL WAVE
Museum Fellow Vinton Cerf, MCI WorldCom
NASA Ames Main Auditorium
Moffett Field, CA

SAT, MAY 12, 9AM – 5 PM
VOLUNTEER WORK PARTY
Bldg 126, Moffett Field, CA

MON, JUNE 4, 6 PM
XEROX ALTO RETROSPECTIVE
Chuck Thacker & Butler Lampson, Microsoft
NASA Ames Main Auditorium
Moffett Field, CA

FRI, JUNE 15 – SAT, JUNE 16
DEC RETROSPECTIVE
A symposium featuring panel discussions, exhibits, and opportunities to network and reminisce featuring Gordon Bell, Alan Kotok, Ed Kramer, Bernie Lacroute, Grant Saviers, Ed Schein, Bob Supnik and others.
Location TBD

TCMHC Photo #102618937 (P924)

DEC's beginnings lay in producing small logic modules like this engineer is adjusting here.

THURS, OCTOBER 11, 6 PM
FROM SMALLTALK TO SQUEAK
Dan Ingalls, Walt Disney Imagineering
NASA Ames Main Auditorium
Moffett Field, CA

TUES, OCTOBER 23
FELLOW AWARDS BANQUET
Fairmont Hotel, San Jose, CA

THURS, NOVEMBER 8, 6PM
QUESTIONS ANSWERED
Donald Knuth, Professor Emeritus, Stanford University
NASA Ames Main Auditorium
Moffett Field, CA

ATTENDING EVENTS AND TOURING THE COLLECTION

The Museum is housed at NASA Ames Research Center in Moffett Field, California. The collection is open to the general public by appointment on Wednesdays and Fridays at 1:00 pm. Donors and groups may also request private tours.

To attend an event or to tour the collection, please call Wendy-Ann Francis at least 24 hours in advance.

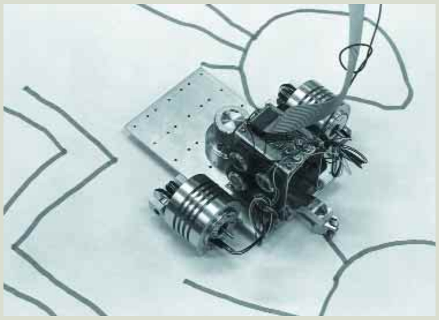
VOLUNTEER OPPORTUNITIES

The Museum tries to match its needs with the skills and interests of its volunteers. Monthly work parties are listed in the calendar and generally occur on the 2nd Saturday of each month. For more information, please visit our volunteer web page at www.computerhistory.org/volunteers.

MYSTERY ITEMS

FROM THE COLLECTION OF THE COMPUTER MUSEUM HISTORY CENTER

THE ROBOTIC TURTLE



Turtle Robot for the AARON AI Paint System (1976), X50.82, Gift of Harold Cohen

Explained from CORE 1.4

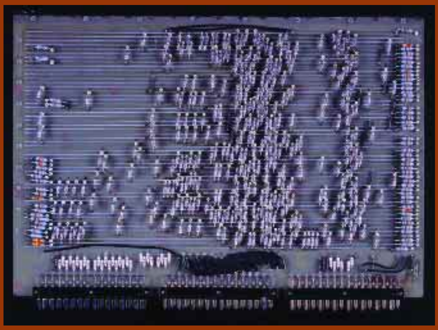
Harold Cohen developed this “drawing turtle” in 1976 as part of his robotic and artificial intelligence-based painting system, AARON. A leading British abstract artist of the 1960s, Cohen discovered computers in 1968, while a visiting professor at the University of California, San Diego. He began working on proposals for research in the area of computer-generated art, one of which reached Professor Ed Feigenbaum at Stanford University. Feigenbaum brought Cohen to the Stanford artificial intelligence labs in the early 1970s, where Cohen did much of the development on the software and the turtle. The works created by AARON and the turtle represent one of the earliest interactions between the arts and computer science.

The 5" x 7½" by 7" wheeled device used a pen to draw on large sheets of paper with sonar devices at each corner to help track location. Cohen intended the lines the turtle drew to be imperfect, with subtleties that would normally be associated with human-drawn lines. Cohen presented the AARON system at an art exhibition at the Museum of Modern Art in San Francisco in 1979. In later years, the Tate Gallery in London and The Computer Museum in Boston showed the turtle in action and displayed several of Cohen’s pieces. In the early 1990s, Cohen created instructions that allowed AARON to paint in color, and retired the turtle in favor of a small robot arm. ■

WHAT IS THIS?

THIS ITEM WILL BE EXPLAINED IN THE NEXT ISSUE OF CORE.

Photo by David Pace, TCMHC Photo #102621782



Please send your best guess to mystery@computerhistory.org before 04/15/01 along with your name and shipping address. The first three correct entries will each receive a free poster: **COMPUTER CHRONOLOGY - THE EMERGENCE OF THE INFORMATION AGE**

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