January-March 1994 Volume 1.3

The Analytical Engine

NEWSLETTER OF THE COMPUTER HISTORY ASSOCIATION OF CALIFORNIA

Editorial: CAMPAIGN 1994

The Association begins a new year, and everything we had dreamed of doing, we're doing. The ENGINE gets thicker, the e-mail deeper. New computers – well, new old computers – are lugged to our doorstep. Delivery vans bring boxes of books and files. Collaborations are proposed, exhibits planned, names written excitedly on scraps of paper and then logged. And under it all the certainty, slightly awed still: *This thing is working.*

We promised to build, from the outset, an organization with room to grow – an organization that could start with a few like-minded individuals, and smoothly become a major voice for the preservation of computers and their history, without spending scarce energy to rethink and rebuild. The blossom is implicit in the seed, the song foresung by the note and the many awaited by the few.

Well, it does seem that in these few months (where'd they go?) the CHAC and the ENGINE have earned the interest and respect of an illustrious community. The chorus of welcome has convinced us that CHAC can bloom into a great, broadly representative, and truly grass-roots organization – even though right now, so to speak, it's still folded tight.

All signs suggest that growth is crucial for us – and soon. CHAC is legally established as an organization; it has an eagerly awaited newsletter; it's beginning to attract media attention (see SPOTTER;) and, as for collecting hardware, software and docs, just read the ACQUISITIONS column on page 25. Really, it's been almost more than we can keep up with.

Now we need size. Size means weight; presence; recognition; visibility. Size convinces donors that charitable organizations are worthy and credible. Size helps us reach out to potential members. Size brings down costs through economies of scale. Size will make the ENGINE a more attractive, more comprehensive newsletter.

And size alone won't build a museum – but it's a key ingredient in the dealing we'll need to do, between now and 1999.

So we're calling our own bluff. By the end of 1994, a year from this publication, we want 1,994 new members and ENGINE subscribers for the CHAC. Promotions, perks, collaborations, colloquia, prizes, press releases, or (even) a party – whatever it takes, we'll do.

In coming months, look for mentions of the CHAC in the computer and general press, at trade shows, on bulletin boards – electronic or otherwise – and on the net. The more you see, the more it means we're accomplishing.

Meanwhile, join, if you haven't. That *is* what this is all about. That *will* make the biggest difference. One person, one subscription, one check *does* matter. *You* are the spirit, the meaning, the bootstrap load, the inspiration of the Computer History Association of California – because the history we try to save is *yours.*

You've done the work! Now take the credit! Join the CHAC today!

PROCLAIM THE DAY

Looking at our science — that ungainly, anarchic, thrilling thing that even today plows so much of its own energy back into growth — it seems so unlikely that anyone could reasonably use the words "electronic computer" and "fiftieth anniversary" in the same sentence. But the day is almost upon us; because February 16, 1996 will be the fiftieth anniversary of the dedication of ENIAC, the first complete and functional electronic digital computer in the United States.

Our good friend and great resource, Douglas Jones of the University of Iowa's Computer Science Department, has suggested that that day should be one of remembrance and celebration, to remind ourselves — and others — of how far computing has progressed in so short a time, how much the world has gained from computing and computers, and (not incidentally) how much work it all was and by how many. Another phrase rarely found in conjunction with "electronic computer" is "pat on the back," but if this revolution is fifty years old and still going strong, it's time for one.

Given two years at our disposal, the CHAC means to run with this. We hereby propose, and will propose to appropriate agencies of the Federal Government, that February 16, 1996 should be proclaimed National Computing Science Day throughout the United States. A recognition long sought in itself, this can also be an occasion for forums and promotions about computing science and its contributions to economic production, education, research and entertainment.

On page 78 of the electronic ENGINE, or on the mailing cover of the paper edition, you'll find a Ballot. Please use it to jot down and submit *your* ideas of what a National Computing Science Day could and should be.

IN MEMORIAM: TOM WATSON

Thomas J. Watson jr., whose foresight and dedication transformed IBM from a manufacturer of accounting machinery into the world's most formidable computer company, died at Greenwich Hospital in Greenwich, CT, on December 31, 1993. His death followed a short illness.

Few captains of industry have faced a more difficult mission than Tom Watson did, or carried it out with such strategic foresight and attitude. He was the son of Thomas J. Watson sr., first president of IBM, one of the world's most meticulous visionaries and autocratic managers; as Tom Watson recounted in his 1990 autobiography, *Father, Son and Co.*, relations between the two were often strained and perennially difficult. The younger executive would make decisions with full awareness of their far-ranging consequences, only to be overruled by the older one, who could point to his own record of success. In the thirty years between 1922 and 1952, Watson sr. had built IBM from a modest producer of general business hardware into an international corporation that dominated the market for electromechanical accounting machinery. His achievement was prodigious.

Yet after World War II, when American business began to be intrigued by the possibilities of electronic computing, Watson sr.'s confidence in his own methods prevented him from offering the necessary leadership. IBM's first commercially available stored-program computer, the Selective Sequence Automatic Calculator (SSEC), was an electromechanical machine that owed much to prewar concepts. IBM was then in danger of falling behind other companies, such as Remington Rand, which realized that the potential benefits of digital computing justified a clean break with past practice.

In January 1951, at the age of thirty-seven, Tom Watson bet his own reputation — and then the whole company, as IBM did time and again — on comprehensive adoption of digital technology. The Defense Calculator or Model 701, meant for scientific use and discussed at length on page 4 of this issue, was quickly followed by the Model 702 for business applications and the smaller Model 650. The 650 stunned the market by selling in the hundreds, rather than dozens; it was IBM's most popular computer model for many years, and 1,800 were eventually sold.

Lifted on a wave of renewed confidence, IBM was then ready for a second great expansion. The company proved to the world that its electronic computers shared the legendary reliability of its accounting machinery. Furthermore, because IBM computers used IBM tabulators and printers for input and output, sales of the older equipment were helped rather than hurt when computers were sold. Tom Watson had masterminded a strategy that let his company reap the benefits of both approaches — the prestige derived from headlong entry into a new age, and the sales volume that accrued from extending the useful life of existing design.

Watson then spent the revenues of this success on research and development that would fortify IBM's seemingly unassailable position. IBM's labs developed ferrite memory for the Model 704, transistor logic and circuit printing for the 7030 and 7090, the RAMAC disk memory....the list is nearly endless. Yet computing technology matured so quickly that by 1960, in the context of design, IBM was no more than first among equals. Its preeminence in the market was endangered.

In December 1961, the internal SPREAD committee recommended that IBM should commit unprecedented resources to development of a completely new, internally consistent line of computers. The products of this commitment might sweep the market, or sink the company. Watson — a seasoned combat pilot, Alpine skier and powerboat racer — trusted his often daring judgment and concurred with the report. The development of System/360 cost five billion dollars; it was the single most expensive American industrial project in history. But its impact was in proportion. In his definitive *Historical Dictionary of Data Processing,* James Cortada calls System/360 "perhaps the most dramatic success story in the history of American products, even surpassing....the Ford Model T car." At the end of 1965, the first full year that System/360 shipped, IBM had captured almost two-thirds of the domestic market for computing machinery. Under Watson's guidance, this success was repeated, notably with the System/370 introduced in 1970.

The dividends of success were stunning. In 1952, when Tom Watson assumed the presidency of IBM, the company's annual revenues were about $300 million; in 1971, when his health compelled him to resign from the chair of the board, they exceeded $8 billion. By 1979, when he stepped down from the chair of IBM's executive committee, annual sales were almost $23 billion. Watson had won his bet, again and again.

He returned to "private life" and spent his retirement, so-called, in public service. His belief that sound diplomacy depended on honesty and trade, and his affection for the Russian people that arose from wartime experience in the Soviet Union, led President Carter to nominate him U. S. ambassador to that country in 1979; he continued in that capacity under President Reagan. In this occupation and numerous others, Watson demonstrated that the drive of a renowned businessman could be tempered and refined by the humanity of a statesman.

This text was originally intended as commemoration of Mr. Watson's 80th birthday, which he would have celebrated on January 8th, while this issue was still on press. We profoundly regret making a more definitive use of it. The Association offers condolence to Mr. Watson's wife, Olive Cawley Watson; to his children, Thomas J. Watson 3rd, Jeannette W. Sanger, Olive F. Watson, Lucinda W. Mehran, Susan W. Whitman, and Helen W. Blodgett; to his many grandchildren, and to his colleagues and friends around the world.

THE IBM 701 in CALIFORNIA

Introduction:

In every issue of the ANALYTICAL ENGINE, we proclaim and celebrate "computing in California." Why, then, is this issue's big-iron article about the pride of Poughkeepsie — the trailblazing IBM 701?

Because, at the very outset of the digital computing era, the 701 conclusively demonstrated that the Golden State was wild for all the computer power it could get! Bearing in mind that only nineteen machines were ever built, look at these serial numbers, sites and delivery dates:

2 University of California, Los Alamos, NM March 23, 1953

3 Lockheed Aircraft Company, Glendale, CA April 24, 1953

5 Douglas Aircraft Company, Santa Monica, CA May 20, 1953

8 U. S. Navy, Inyokern, CA (China Lake) August 27, 1953

10 North American Aviation, Santa Monica, CA October 9, 1953

11 Rand Corporation, Santa Monica, CA October 30, 1953

13 University of California, Los Alamos, NM December 19, 1953

14 Douglas Aircraft Company, El Segundo, CA January 8, 1954

16 University of California, Livermore, CA April 9, 1954

18 Lockheed Aircraft Company, Glendale, CA June 30, 1954

In other words, including Lawrence Radiation Lab's acquisitions for Los Alamos, over half the total production went to California purchasers. (Of those, half went to aircraft companies, fulfilling Konrad Zuse's prediction that digital computing would become a necessity for aircraft design.)

It's an impressive list, especially since leasing a 701 was a major commitment for even the largest institution. Anyone who wants to construct the timeline of California's love affair with computing can anchor the origin right here. — Editors]

ORIGINS AND LEGACY OF THE IBM 701

Douglas W. Jones
Department of Computer Science,
University of Iowa
Internet: jones@cs.uiowa.edu

THE HISTORICAL SETTING

In January, 1951, Thomas J Watson jr., Executive Vice President of IBM, convened a meeting in his office to discuss a proposal by his assistant, J. W. Birkenstock, for a new computing machine using CRT memory with about 20,000 digits of memory per tube, and with a clock cycle allowing it to multiply two numbers in one millisecond. The proposal suggested that up to 30 machines might be made, beginning with a single prototype, the Defense Calculator, under government contract and nominally a response to computing demands posed by the war in Korea.

At this time there were about twenty electronic stored-program digital computer projects in the world, all but three using binary number representations. Most were patterned after Von Neumann's machine at the Princeton Institute for Advanced Study, with

40 bits per word. The Defense Calculator was planned with a slightly shorter word, 36 bits, and far better input/output facilities than the IAS machine. The difference in word length was corollary to the selection of a 6-bit byte when recording data on magnetic tape, a new storage medium IBM was currently developing.

The Defense Calculator was designed fairly quickly, based on the experience with the IAS machine and with early experimental systems at IBM. Newly developed component packaging methods resulted in a machine remarkably compact for its time. The logic was packaged in 64-pin modules with a row of 8 vacuum tubes on the front of each module; logical operations were performed by germanium diodes in the base of each module. Modules were plugged into a backplane, and the design permitted modules to be swapped while the system was powered up. The resulting CPU occupied a cabinet about the same size as was used 25 years later for the VAX 11/780; a second similar-sized cabinet held 72 cathode ray tubes storing 512 memory bits per tube, for total memory of 1K words.

By April 1952 the prototype Defense Calculator was fully assembled; within two months, the complete system was in use and undergoing debugging. The first production model was shipped in December 1952, to IBM's corporate headquarters at 590 Madison Avenue in New York, and became an instant favorite with sidewalk gawkers. The second machine was delivered to Los Alamos on April 1, 1953, and was working at the site within three days. (In the context of this amazing feat it is worth noting that Los Alamos was operated by the University of California, and that relations between the university and the laboratory were far closer then than in later years.)

Thomas J. Watson sr., preoccupied with his company's almost sacred commitment to electromechanical punched-card technology, still had doubts about the new machine; but they were probably alleviated by the monthly rental of a fully equipped 701, which, at $17,600, was about ten times the price of a typical family car. His son, on the other hand, noted that customers continued to honor their contracts even while the announced rental fee more than doubled from its original $8,000. "That was when I felt a real *Eureka!,*" he noted decades later in his autobiography. "Clearly we'd tapped a new and powerful source of demand."

On April 7, 1953, the Defense Calculator was publicly unveiled at an event attended by over 150 guests, including John von Neumann, William Shockley, J. Robert Oppenheimer, and a roster of highly placed scientists and executives. At this event, the machine was newly described as the "IBM Electronic Data Processing Machines, known as the 701." A doctored photograph of the prototype Defense Calculator was used in a two page advertisement in National Geographic in 1953, referring to it simply as "The New IBM Electronic Data Processing Machines."

In early 1953, the 701 memory units were upgraded from 512 bits to 1024 bits per CRT, [was this the first implementation of double-density? — Ed.] and a reference manual was produced.

The entire planned series of eighteen IBM 701's was produced and shipped in only nineteen months — from December 1952 to June 1954 — proving that assembly and testing of massive, complex DP machinery held few terrors for this uniquely experienced company. IBM's first venture into commercial electronics at this scale was accomplished with the thoroughness that had become their best-known trademark. After the eighteenth 701 was shipped to Lockheed Aircraft in Burbank, CA, enough spare parts remained on hand to assemble a nineteenth machine, which was delivered to the U. S. Weather Bureau on the last day of February, 1955.

THE IBM 701 INSTRUCTION SET

The IBM 701 had a 36 bit word packed with two 18 bit instructions. Each instruction had a 6 bit opcode, leaving 12 bits for the memory address. Memory was addressed to the half-word, so the architecture allowed up to 2K words, the entire capacity of the upgraded CRT memory subsystem developed in 1953.

The sign bit of each instruction determined whether the instruction was being used to address words or half-words. Negative instructions were word addressed, while positive instructions were half-word addressed. Half words were packed into words in big-endian order, with odd addresses being used to reference the least significant halves.

Numbers were stored in signed magnitude form, and all of the documentation assumed that the values being stored were signed magnitude fractions, with the point immediately to the right of the sign bit and left of all of the magnitude bits.

The machine had an accumulator and a multiplier-quotient register, and new complexity was introduced by two extra magnitude bits at the most significant end of the accumulator. These extra bits allowed sequences such as "load, add, add, add" to be performed before a check for overflow was needed, and allowed such sequences to arrive at correct results even when intermediate values were out of bounds.

The instruction set included 21 programming instructions and 8 input/output instructions. The programming instructions included the expected load, store, add to accumulator, and subtract from accumulator instructions, but also load negated and add or subtract absolute value. As expected, the machine had multiply and divide instructions, but it also had round and multiply and round instructions that incremented the accumulator if the most significant bit of the multiplier-quotient register was one. Finally, there were left and right arithmetic shifts in single and double precision form and a logical and instruction that operated from accumulator to memory.

Control structures were constructed by branch and conditional-branch instructions, but programmers who wanted to code using procedures were forced to write self-modifying code. Conditional branches could branch on zero, branch on positive, or branch on overflow. A special instruction was included to write the address field of a half-word in memory, allowing straightforward self-modification, and there was a halt instruction.

The input/output instructions included instructions for starting unit record read or write operations, for copying one data word to or from a unit record, and for sensing or setting device status or control bits. Special instructions were included to handle backwards reads from tape, to write end-of-file marks on tape, to rewind tape units, and to set the drum address of the next drum transfer, but the central I/O instructions were, to a remarkable extent, equally applicable to all devices.

As noted previously, the sign bit of each instruction was used to determine whether the memory address was a half-word or full-word address, and with a 6 bit opcode field, this would seem to leave room for only 32 instructions. In fact, the 5 control-flow instructions were always used to address half-words, and the 4 shift instructions and I/O instructions did not use the sign bit. As a result, there was plenty of space in the instruction set to extend the machine as later models were introduced.

INPUT/OUTPUT DEVICES

The 701 was developed soon after IBM had constructed an experimental Tape Processing Machine, and the success of that experiment encouraged extensive support for 7-track magnetic tape on the 701. The decision to support 7-track tape, with 6 data tracks and one parity track, led to the selection of a multiple of 6 for the word-length; this tape format, originating with the 701, quickly became an industry standard that was almost universal for the next 15 years.

The 701's tape drives could be supplemented with a fixed-head drum that allowed random access to individual words. Each drum unit had a capacity of 2048 words, and was clearly thought of as swap-space and not as a device for storing files. Other peripherals offered on the IBM 701 were modifications of standard IBM unit-record data processing machines, a card reader, a card punch, and a line printer. These were all "programmable" peripherals, with patch-panels controlling operations on the data encountered. All three devices were limited to 72 characters per line of data printed, punched, or read, with the patch panel controlling the mapping between the 72 columns seen by the computer and the presentation of that data on punch card or listing.

Input/output was complicated particularly by the utterly bizarre data formats of cards and print records. For example, cards were read row by row, so that two 36 bit words of input contained one row of data from the punched card, while the character code used on the card used each column to hold one 12 bit character. This comes very close to the philosophy espoused in Jackson W. Granholm's "How to Design a Kludge" (Datamation, Feb. 1962, page 30), and many programmers were forced to spend hours writing code to translate between character data formats.

Another problem with input-output was that all data transfers were done under program control, which — assuming moderately high performance of tapes and drums — placed stringent timing constraints on I/O code. On later systems, the life of programmers was greatly simplified by the introduction of direct memory access I/O devices.

THE DESCENDANTS OF THE 701

The IBM 701 and 702, introduced within weeks of each other, defined two parallel lines of development for electronic computing, with the 701 intended for scientific and military customers, while the 702 was aimed at the business market. (The 702 was a decimal digit serial computer descended from the experimental Tape Processing Machine; it was developed in parallel with the 701, using similar technology, but it was not related to the 701 at the instruction set level.) Watson jr. understood that the 701 was, to use today's term, a "power user's machine," and provided energetic support for the quick development of a more capable successor.

At the end of 1953, while the earliest 701s were still being delivered, Gene Amdahl — later well known as the co-designer of the IBM System/360 and the founder of Amdahl Corporation — was put in charge of developing a follow-on to the 701. On May 7, 1954, this was unveiled as the IBM Type 704 Electronic Data Processing Machine. The 704, almost three times as fast as the 701, was the first commercially available computer to incorporate floating-point arithmetic, and the first IBM computer to have index registers. The 704 systems control program (SCP), which monitored the progress of calculation and offered program control for input/output, can be considered IBM's first operating system.

Perhaps the primary innovation of the new model was ferrite core fast memory, which was announced in October 1954, even before the first 704 was delivered. The first core memory unit for the 704 was installable in sizes up to 4,096 words; within two years, 32K words of core could be installed. This technology contributed much of the 704's speed and offered greatly improved reliability. However, the expansion of 704 main memory to over 2K words posed a problem that programmers have faced with annoying frequency on later machines, that of addressing a large main memory with a small direct address field.

SHARE

In August 1955, IBM gave a seminar in Los Angeles, as a briefing for potential 704 customers. Several executives who attended that seminar met again almost immediately, on August 22, to establish a group for mutual support and pooling of information on the 704, called SHARE. The rapid growth of SHARE — possibly the first, certainly a very early, computer users' group — was particularly important to the success of the IBM 704. By the end of 1980, SHARE had grown to represent over 1,500 computer installations, of which the majority did scientific work.

LANGUAGES

The speed and power of the 704, its register architecture, and the SCP's ability to perform low-level grunt work, encouraged the development of larger applications which incorporated subroutine programming. Code reusability became an issue, and conformity to agreed coding guidelines became crucial to this. Even at the inaugural meeting, members of SHARE agreed on the need for a uniform assembly language format for the 704; eventually, an assembler written by Roy Nutt of United Aircraft emerged as the standard.

Higher-level languages also received attention. As early as late 1953, John Backus began to argue for the development of a compiler for the 704 specifically, and in 1956 a group under his direction completed this project, by then known as FORTRAN. Optimized for numeric calculation, this language offered unprecedented computational power and guaranteed the future of the 704 for years to come. The 72 column limit originally imposed by the 701/704 card-reader continues to puzzle FORTRAN programmers to this day.

BEYOND THE 704

IBM eventually sold 123 Model 704's, a gratifying improvement over sales of the 701 and a total that absolutely mandated aggressive development. The 704 was followed by the Model 709, the last vacuum tube machine in this series, and by the experimental transistorized machine known internally as the 709TX. Borrowing heavily from the advances of Project STRETCH while remaining fully compatible with the 709, the impressive TX was re-designated 7090 when the first example was sold to Sylvania in October 1958. The 7094 and 7094 II, announced in the early 1960s, were faster still.

WHAT WAS ACCOMPLISHED?

The 70x family accomplished more for IBM than could, probably, ever have been foreseen when the original specification was laid down. It defined a computer architecture that endured for thirteen years, and might have lasted much longer. It gave notice that IBM, long the dominant vendor in tab card equipment, intended to be as formidable a competitor in the lucrative new world of computer-driven data processing. It proved that IBM's polished sales force could sell computers as effectively as they had sold less sophisticated products — a transition managed less well by many of IBM's competitors. Finally and conclusively, it dethroned Remington Rand as the primary American builder of computers.

The 7094 II marked the end of the line for the 701 architecture. Lack of market was not an issue; demand for these computers and for compatibles could have continued for many years. Rather, the SPREAD report of December 1961 changed the underlying direction of IBM's marketing policy for computers.

Until 1964, IBM built two parallel lines of computers for users in different categories. Construction for science, higher education and the military was exemplified by the 701, 704, 709, 7090/94, and 1620, while machines meant for business and industry included the 702, 705, 7070, and the 1401 and its successors. Naturally, potential customers didn't line up into the two long neat rows that IBM would have preferred, and many users ran "business" applications on "scientific" computers or *vice versa.*

IBM never argued with success unless it envisioned greater success. The SPREAD report warned that, although this two-pronged approach had resulted in tremendous market share for IBM, it entailed wasteful division and duplication of effort internally. The company's array of niche machines should be replaced by a line founded on a single basic architecture, with enough gradation in power, capacity, and peripheral capability to fill the needs of any prospective customer for an IBM computer. This idea, and five billion dollars, resulted in the innovative and immensely superior System/360.

Without a doubt, the 360 series justified its titanic investment — the largest in any single American industrial project to that time — and went on to become the "greater success" that Tom Watson and Vin Learson had predicted. But for many computer users and historians, a 701, 704 or 709x remains the machine that quintessentially defines "big iron."

REFERENCES

Most of this material comes from *IBM's Early Computers,* Bashe, Johnson, Palmer and Pugh, MIT Press, 1986. This book gives an excellent overview of IBM's role in the early part of the computer era, and it gives moderate technical detail. Incidental reference has also been made to Cortada's *Historical Dictionary of Data Processing,* Greenwood Press, 1987, and to Tom Watson's autobiography, *Father, Son & Co.,* Bantam, 1990; the quotation above is from page 243 of that edition. [The introductory table is abridged from "Customer Experiences" by Cuthbert Hurd, *Annals of the History of Computing,* Volume 5, Number 2, page 175, (c) April 1983 IEEE, and republished by permission. — Eds.]

I have also used my 1953 copy of IBM's "Principles of Operation" document for the IBM 701. This agrees in most places with the technical appendix in Bashe, Johnson et al, but gives far more detail on instruction timing and I/O data formats. It begins with an introduction to programming that is remarkably timeless; the machine may be obsolete, but the fundamental material a programmer must know in order to program in machine language has not changed!

DAWN OF THE MICRO: Intel's Intellecs

by Kip Crosby

Even sitting on a plain formica table, not powered up, it looks incredibly gutsy and serious. Thanks to the cheerful cooperation of CHAC member Hal Layer, I'm looking at one of California's — and the world's — first micros, the Intel Intellec 8.

This sky-blue beauty first appeared sometime in 1972 or 1973, two years or more before the Altair 8800 often credited as the "first microcomputer" by standard histories. Yet there's nothing tentative or prototypical about the Intellec 8, whose design and construction puts many later (and cheaper) "hobbyist" computers to shame. The story of its origins is scarcely known, even within Intel itself.

BACKGROUND

Founded in 1968 by former Fairchild employees Robert Noyce, Gordon Moore and Andrew Grove, the Intel Corporation immediately set to work designing and fabricating IC memory and microprocessors. The first Intel micro chipset, the 4004, was a four-bit, three-chip combination developed by Marcian "Ted" Hoff at the request of ETI/Busicom, a Japanese calculator manufacturer.

The 4004 design was a success, and Hoff lobbied Noyce to renegotiate the contract with ETI, securing the right to sell this chipset on the open market. Paradoxically, Intel's marketing department raised objections. The company's primary volume was in memory chips, which were easily produced and found an established market; if Intel began to sell microprocessors in significant quantities, profits might be overwhelmed by increased support costs.

But Intel had taken a step from which there was no retreat. CTC (Computer Terminal Corporation, later called Datapoint) commissioned an 8-bit version of the 4004 chipset — capable of handling an extended-ASCII character as a single word — for its line of video terminals. Hoff and Intel's chief of semiconductor design, Federico Faggin, were excited by the sales potential of these microprocessors and foresaw opportunities for further development; but the 8008 project dragged on, and CTC cancelled its development contract with Intel, eventually awarding it to Texas Instruments instead. When the 8008 appeared in 1971, it had cost a fortune, faced an uncertain market, and already had to prove itself against competition.

To find a way forward, the company took stock of its assets. Intel's highly qualified staff of electronic designers were experienced at both chip and board levels, having produced a wide variety of plug-compatible processor and memory boards for OEM's. Their product line included a complete array of support logic chips. Finally, the company could fabricate or outsource other components — chassis, cases, power supplies, and input-output devices — at competitive cost while maintaining high quality. The formidable imperative of the microprocessor, bolstered by Intel's broad and deep abilities in production, set the stage for the Intellec series of "development systems" — which would be revealed in retrospect as the first American microcomputers.

INTELLEC SERIES HARDWARE

The Intellec series of development computers comprised four models of CPU:

4 Mod 4	4004 chipset
4 Mod 40	4040 chipset (a later superset of the 4-bit 4004)
8 Mod 8	8008 chipset
8 Mod 80	8080 chipset
MDS-800	8080 chipset

Intel maintains that the 8 Mod 8 was first produced in 1973 and discontinued in 1975. Tony Duell has an 8 Mod 80 CPU board dated 1972, and the 8 Mod 8 and 4 Mod 40 are both listed in the Intel Data Catalog published in February 1976, so the actual period of production may have been somewhat longer. (Pertinent Intel docs must be read carefully because the names MCS4, MCS40, MCS8 and MCS80 were used almost indiscriminately to refer to chipsets, computers or full systems.) The number of 8 Mod 8's built is an open question since the company has no contemporary figures on file, but given that this author found only five in the course of six months' research, they aren't common.

The line of modules and peripherals, known collectively as the Microcomputer Development System, was comprehensive and included a fast paper tape reader for each CPU model; single or dual diskette drives with the available Intellec MDS-DOS operating system; a universal PROM programmer; two in-circuit emulator boards and three ROM simulator boards. The Intellec chassis was available as a rack-mountable barebone, supplied with a CPU board, RAM board, PROM board, I/O board and twelve empty slots.

Adroit combination of these components could bolster microcomputer development from initial hardware stages to product prototyping; whatever was completed of the developer's system could be cabled to the MDS, which would simulate, emulate, or provide the pieces still on the drawing board. Product literature emphasized speed and ease of use. The Intellec paper tape readers, "20 times faster than [a] standard ASR-33 teletype," would "load 8K...program memory in less than 90 seconds." Really impatient customers were advised to order the MDS-DOS 8" diskette subsystem and MDS-DRV second drive, each of which would hold up to 200 files per 256K soft-sectored diskette. (This format, compatible with the IBM 3540 diskette reader for mainframes, was later adopted for the drives of several early CP/M micros.)

INTELLEC SERIES SOFTWARE

The 1976 Intel Data Catalog lists the following software available for the Intellec series, all written in FORTRAN IV:

Cross assemblers: MAC40 for 4040/4004, MAC8 for 8008, MAC80 for 8080

Simulator/debuggers: INTERP/40 for 4040/4004, INTERP/8 for 8008, INTERP/80 for 8080

Language/compilers: PL/M HLL, a micro port of IBM's PL/I by Gary Kildall, with cross compilers for the 8008 and 8080

All software included a source editor and docs; it was supplied on 9-track tape at 800 BPI. Compiled or assembled code could be tested against the appropriate simulator, then run on an Intellec computer or the developer's own system, or encoded in BNPF ("Begin-Negative-Positive-Finish") format to burn ROM's.

THE REAL ARTICLE

Clearly, Intel's conception of appropriate hardware and software for the MDS was far broader and more profound than the ideas governing contemporary development of so-called "hobbyist computers." At $2,395, the Intellec 8 was substantially more expensive than a later Altair 8800 or other 8080-based kit computer, but delivered solid value for money. Twenty years after it was built, Layer's 8 Mod 8 looks as if it could still boot and run for another century.

Its dimensions of 7"x17"x14" (18x44x36 cm) make it slightly smaller and taller than a modern AT-class desktop box, and at 30 lb (13.6 kg) it might be a bit heavier. It has a *very* real front panel, tastefully silkscreened in white on navy blue, with three banks of sixteen red LED's:

[Text in *uppercase* is the actual panel text.]

Bank 1:

STATUS: cpu RUNning, cpu WAITing, cpu HALTed, console access HOLDing, cpu address SEARCH COMPLete, console ACCESS REQuested, console INTerrupt REQuested, INT DISABLE [not used on the Mod 8].

CYCLE: FETCH instruction, cpu MEMory read/write, cpu I/O read/write, DmA, READ/INPUT, WRITE/OUTPUT, INTerrupt cycle, STACK [not used on the Mod 8].

Bank 2:

ADDRESS access: [15 and 14 not used on the Mod 8,] 13-0 display memory during access.

Bank 3:

INSTRUCTION / DATA: 7-0 display instruction or data between cpu and memory or input/output.

REGISTER/FLAG DATA: 7-0 display contents of cpu data bus or register on execution.

above two rows of white rocker switches:

Row 1:

ADDRESS / DATA: MEMory ADDRESS HIGHer bits for dma, I/O ADDRESS for manual access, SENSE DATA input.

ADDRESS / INSTRUCTION / DATA: MEMory ADDRESS LOWer bits for dma, INTerrupt INSTruction for fetch, DATA deposit to memory or input/output, data for load to PASS COUNT register.

Row 2:

ADDRESS CONTROL: LOAD PASS count to register, DECRement loaded address by one, INCRement loaded address by one, LOAD high and low address to register for dma.

MODE: cpu input SENSE data, I/O ACCESS for edit at cpu wait mode, MEMory ACCESS for edit at cpu wait mode, execute to SEARCH point and WAIT, enter manual WAIT state. (Tony Duell's comment on SEARCH/WAIT: "Very nice feature....You could set a trap on a particular location, and also set a counter. Then, the CPU would be forced into a wait state on the nth access to that location. Great for single-stepping the exit condition of large loops.")

CONTROL: single STEP through program or CONTinue from search complete, DEPosit 8-bit word during access, DEPosit 8-bit word AT programmed HaLT, cpu fetch/execute manual INTerrupt, RESET program counter to zero.

[Switches listed as "not used on the Mod 8" were enabled on the Mod 80 only.]

To the right of these controls and indicators is a combination keylock/power switch, and a PROM socket! with a power switch of its own....no need to pull the case and card when blowing or reading a fresh EPROM on an Intellec. Oh, and it's a ZIF socket, nothing new under the sun.

But let's pull the case anyway....woops....it doesn't pull, it's a flip-up case with a piano hinge at the back — something that all too many micro owners might prefer even today. Underneath the case, the sides of the card cage are hinged too, then securely fastened to the frame. Access to components is excellent by any standard, certainly by comparison to modern nanotower cases and postcard motherboards.

An early clue to component quality is the startling size of the power-supply capacitor, as big as a small fist. The power supply is so conservatively rated that, when Layer bought the computer, the seller advised him to salvage the supply and junk the rest! Other low-stress components include a giant muffin fan in the backplate, and the cage itself, made out of aluminum bar stock.

The passive mainboard's sixteen slots run front-to-back and the slot guides are yet more satin-finish aluminum. Each modular card plugs into a full-length hundred-pin connector (identical to S-100, although the connections aren't,) and is supported by nylon card guides at both ends; the card guides are riveted to the crossbars of the cage. Fliplocks at the top corners of each card protect against creep and vibration, although I suspect that only a trip through a paint shaker would loosen a card accidentally.

Seven standard card modules were supplied with the 8 Mod 8:

imm8-82 Central processor module with 8008 CPU, memory and I/O interface, interrupt logic and crystal clock

imm6-28 (x2) 4K RAM module: 32x1Kbit 2102 static RAM chips

imm6-26 2K PROM module: 8x2Kbit 1702A static EPROM chips, eight empty sockets

imm8-60 I/O module: four 8-bit inputs, four 8-bit outputs, a UART, and serial TTY connectors

imm6-76 PROM Programmer module cabled to the 24-pin EPROM socket on the front panel

and the control module for the front panel. Nine slots were left empty. The stock machine was delivered with 8K static RAM and the Mod 8 system monitor (with paper tape support) burned into the 2K PROM; by combining and swapping other cards and chips, any combination of RAMs, ROMs or PROMs could be installed, up to the 16K addressable by the 8008. Unusually, RAM and ROM boards could be installed globally set to the same addresses, and their individual chips then enabled or disabled with jumpers.

[Available accessory cards included an Output module with eight 8-bit ports (8-62,) a breadboard for wire-wrap sockets (6-70,) and the 6-72 "pop-up" card with extended connectors to raise any module clear of the card cage.]

The backplate carries out the theme of sturdy construction. On each side of the fan mount, a subordinate cage provides five sockets for DB37 connectors. Hefty 3-wire power and a current loop interface through a Jones plug cater to the anticipated Teletype connection.

BUT IS IT A MICRO?

The Intellec 8 has been denied the reputation that it deserves — as California's and, possibly, America's first microcomputer — for two reasons that I find cogent.

Primarily, any 8008-based device is relegated to the archaic age of micros. Like Nat Wadsworth's SCELBI-8H and Jonathan Titus' Mark 8, the Intellec saw only limited production and never entered the "popular" legend and culture of computing. The 8008 went on to become an embedded processor in Datapoint Beehive terminals and DEC PDP-11/34 front-panel boards; its successor the 8080 seized its day to power cheap, commercially available kit-built computers that helped ignite the micro revolution....leaving the 8008 to be part of history in a more limited sense, as the preoccupation of historians.

Secondarily, the Mod 8 had an especially narrow declared purpose, as a system to build systems. It was diffidently marketed by Intel, which was still wary of selling microprocessors in volume to the general public. Certainly the company's strategy, to create broad-based demand incrementally through the good opinion of influential hardware and software developers, was defensible....especially in light of the results. But it did mean that awareness of the Mod 8 was limited to a small population of technical specialists — to those specialists, furthermore, who thought that the potential of micro development and programming justified a sizable investment in an MDS system. In a way, this asked MDS customers to have more faith in the future of microprocessing than Intel itself had. But in 1994 it's hard — almost literally "unthinkable" — to recreate the mindset of respected computer professionals who thought the micro was a dark horse, a sucker bet, a testbed, or a toy. Only a handful knew what the micro even aspired to, not to mention what it would achieve.

But a computer's importance to history has never been a function of its CPU type, nor should it be. And special purpose is no deterrent to general fame — certainly ENIAC, which "only" computed artillery tables, and COLOSSUS, which "only" screamed through brute-force solutions to Germany's encoded military traffic, are two of the historian's all-time favorites. The Mod 8 was a deeply considered, robustly built, versatile, well-documented Real Computer™ with an architecture heavily biased toward systems development. A similarly meritorious Mod 8, or better yet MDS-800, optimized for general computation or business programming might have become the first widely sold commercial microcomputer. One good look at the Mod 8 will confirm that Intel could have built such a machine, if their corporate strategy had called for one.

Still, there's no need to play "might have been" with an Intellec, which is a fairly formidable box as it sits. Like a long-fendered prewar roadster or a Schneider Trophy seaplane, it embodies a vanished past so pure that it becomes evocative. Sit for two hours, if you ever get the chance, with a Mod 8 and its manuals; when you stand up, you'll know a *lot* more about computers.

[Thanks to Tony Duell, Jodelle French, Doug Jones, Benjamin Ketcham, Klemens Krause, Hal Layer, Jay Maynard and "Milan" for source material, answers and encouragement. — KC]

RSN: DSP ON A Z-80

We had announced Doug Mandell's article on early digital signal processing for this issue; unfortunately, in the interim, Doug went mission-critical and got swept away by a code tsunami. We sympathize (no doubt along with many of our readers) and look forward to publishing this article when it's ready. — Editors

LAND OF THE SILENT GIANTS: A Day at Livermore

On October 27, 1993, we — Tom Ellis, Tim Swan and KC — met at CHAC's garage and rolled up our sleeves for the drive. In El Cerrito it was a bright, warm fall morning; the heat in Livermore, thirty miles further from the coast and bordering the Valley's stony desert, might be punishing by comparison. National *and* local security had dictated that the Lawrence Livermore National Laboratory be plunked down in a sparsely populated bowl of scrubland framed by far hills, cut by service roads as straight and black as electrical tape. It's not the moon but it could easily be, say, New Mexico or Nevada.

Very Federal white-on-blue signs direct the persevering visitor to "Computer Museum, Pod F," a small, detached frame building that the museum shares with a dosimetry lab. While the museum is part of LLNL, the *building* it's in belongs to the Livermore School District, making the installation's status more precarious than it otherwise would be.

We were met by the Museum's curator, Barbara Costella; the registrar, Alice Pitts; and the Lord High Fixer, Roger Anderson — all volunteers or nearly so, and three-quarters of the Museum staff. (Docent Jim Tracy wasn't on deck that day.) This operation has been a labor of love for decades and is still considered somewhat marginal by Powers that Are in the Department of Energy. Which is too bad, because it's one of the most exciting computer museums in California. "*National*" here is no passing epithet; you won't see this collection of hardware, documentation and ephemera anywhere else.

Ever since it was established in 1952, LLNL has performed advanced computation considered to be in the most stringent national interest. This loosened traditional limitations that might have forced some big companies, or even other government agencies, to settle for less overwhelming devices. Livermore's computers have always been the fastest and crunchiest available, even if they were experimental at the time they were installed, even if they have *very* low serial numbers, like 5, or 6, or even One.

Case in point: The Control Data 6600, announced by CDC in August 1963, was supposed to be delivered to Livermore in October 1964, at a cost of $3.8 million. It inaugurated a firm tradition of teething troubles with supercomputers (not unreasonably, since it launched the category too,) and it got to the site six months late. But once it arrived, it must have liked the weather, because thirty years later, there it still is.

The main unit looks like a big, dull-gray bank vault; in fact, the resemblance is eerie, because you enter it by swinging open a three-inch-thick metal "door." But, surrealistically, behind the door there's another door, that swings open too.... These are the component planes for 350,000 hand-wired, individual transistors, mounted in frames that might survive geological eons. The whole box weighs three tons, and what it required for power, I can't imagine. Naturally it was meant to have its own room and a Praetorian guard of tape drives and printers; sitting in that little school building surrounded by its descendants, it looks almost aloof and pained, as if to say *Of all Real Computers I was the Most Real.* For a while.... The console is a Formica desk with plenty of wing space, a nice solid keyboard, and two big *round* green-on-black screens directly in front of the operator, like something out of a fifties s-f movie. At the operator's bidding, the fastest processors of the day, a gargantuan 128K sixty-bit words of fast core....I sat and imagined that Seymour Cray's looming maiden effort, the first, the *only supercomputer in the world*, was waiting for me to type in the bootstrap commands and spin the drives.

Dizzying. Wrenching! (Later on, the 6600 even acquired LLNL's first hard-disk array, a gargantuan Bryant with several platters mounted vertically on a common horizontal shaft; each platter was *three feet* in diameter and held 244 million words of data. The whole array must have really tried the patience of angular momentum.)

But all things must pass, and where more quickly than here? Because sitting next to the 6600, and not even five years newer (it arrived in January 1969) is a CDC 7600, looking absolutely audacious by comparison.... a tall column, shallow V in cross-section, sheathed in dawn-blue plexiglass and uninspired woodgrain. Behind the plexi are rows and rows of quick-change aluminum circuit modules, each a little bigger than a (US) pack of cigarettes, painted black, and with a robust multipin connector at the back end. These plug into the main backplane not unlike Legos, and did a great job of minimizing downtime, because they could be swapped out so easily. The 7600 has four times the main memory of its predecessor *and* probably four times the speed, but only cost about thirty-five per cent more. "Top that," it says, with every line.

Volumes could, and should, be written about these two machines alone. But walk a few steps....
and there's a CRAY-1....
which just Is.

A CRAY-1 doesn't even look like a computer, unless you know what you're looking at. The tall column, in a logical (but weird) development from the 7600, is a hollow cylinder with one quarter cut out of it; the wiring goes around the inside surface of the cylinder, to be short, and the access panels for the circuit boards go around the outside, for easy fiddling. Flanged around the outside base is what looks like a padded bench, which earned these computers the nickname of "loveseat" forever....it's the casing for the power circuitry and cooling hydraulics, readily visible in the example at hand, because Ms. Costella had two segments of the casing neatly replaced with clear plexiglass. Step back and be generally reminded of, say, a strange phone booth in an airport.

Fast? You bet. All chips and still couldn't be cooled with water, had to use peculiar pink Freon. Over twice the main memory of the 7600 — a million sixty-four-bit words — and up to forty times the speed, depending on the operation. Seymour's masterpiece; gonzo; long since replaced by faster machines, including variations on the same architecture, yet still considered sort of....*out there.* Always will be. It was just too different.

Also, not the computer you'd choose to add up the grocery budget — even of a small country. To begin with, programming was grueling even for experts, because the whole language was biased toward speed of execution. Secondly, the main computer (four tons this time) consumes *four megawatts* of power, or about $720 worth per hour at PG&E's current prices. The four tons got easier to understand when Tom slid a circuit board out of its U-channels and handed it to me; I almost dropped it because the components were mounted on a sheet of solid copper about five millimeters thick. Seymour Cray has ideas about computer design that have never been subscribed to by *anyone* else.

This in turn has led to folktales about his designs being Immaculate Conceptions, after a fashion, devoid of compromise and devoted to the speeding electron above all. Well....yes and no. Any time you get near people who actually worked on a Cray, you start hearing furtive whispers about *the mat,* and how *the mat* is why these computers could never be mass-produced, because *the mat* used to leave its own engineers red-eyed with fatigue and whimpering with frustration....

The mat is the web of wiring around the inner surface of the cylinder. Here again, in the name of truth, justice and insatiable curiosity, one of the opaque covers has been replaced with plexi — and behold, this dreaded mat in all its dire glory. Not just spaghetti, but *boiling* spaghetti, a bramble-thick mesh of overlapping loops covering the whole panel, uncountable thousands of wires that would be nightmarish to trace even with a total schematic. How this machine was ever repaired, I have no idea. Tim stood in front of that Rosetta Backplane, stock-still and gaping, as if he were waiting for something to move. This too, at the time of its creation, was the fastest computer in the world.

From here we need to step back and look at some theory, particularly as it applies to Livermore. The lab examines very large phenomena at very high resolution; thus it needs to process input as fast as it possibly can, if the results are meant to arrive in any reasonable time. But that's only half the story. Once these data have been collected and stored, they need to be *retrieved* as quickly as possible, lest these power-sucking, coolant-fuming CPU's get bored.

So LLNL's most pivotal question — with some of the most fascinating answers — became rapid access to information. Livermore began using computers in the days of punched-card data storage [see page 4] and progressed rapidly to tape; but with its unending need for vast blocks of data *NOW!!*, it must have been one of the first installations for which tape alone was flatly inadequate. Tape is reliable, dumb, and forever slow, because you spin the tape *to* every item you need, and if you happen to be nearly a whole tape's length away, it can take a while. Spin the drives faster, make the reels lighter, be ever more inspired about the sequence of records on the tape, and you only buy yourself breathers, because serial access is limited in its very nature. My friends the twelve-year-old Visual Basic programmers would pipe up with "Why didn't they just use hard disks?" and — they did and do, lots of them; but the Lab's need for torrential flows of information in real time meant that disk storage, classic nine-track tape, cartridge tape and optical storage all overlapped in a chaos of urgency.

Nine-track handling was expedited with many devices, including wonderful robot arms that searched through tape cabinets, grabbed the desired reel, drew it out of the cabinet, and auto-mounted it. CDC provided the cartridge tape, and IBM the optical storage, with devices so innovative (in very different ways!) that they honestly deserve to be called heroic. IBM's photo-optical storage memory, the Model 1630, held thousands on thousands of strips of what amounted to stiff microfilm carefully slotted into small gray plastic boxes; the boxes had spring-loaded covers and sat in an array of cells on a wall. When the computer whistled, the device swung into action, found the right cell in the array, drew out the box, popped the cover, pulled the right strip and read the data from it optically. Halfway between tape and a disk, it had one dimension of serial access and one dimension of random access, and it was faster than tape. Since this whole machine was finished, supported and documented to Big Blue's usual standard, and IBM only ever built three of them, it must have cost a [deleted] fortune.

CDC's MASS 38500 contained 16,384 plastic cartridges — not much longer or thicker than your middle finger — with shutters, that protected short, fat tape strips spring-wound on spindles. Each strip held a million of the sixty-bit words for the 7600. That's a *terabit* in the array.... And it could find any file in a second.

All these devices are on display along with a Concise History of the Hard Disk, starting with a single, millstone-sized, twenty-five-pound platter from the Bryant array. From there the disks got smaller and faster and smaller and faster.... development chronicled here by a selection of platters in several sizes, all flashing the glossy gold-bronze finish that is the highest aspiration of all rust.

So it is with the whole Museum. Bits of hardware, from the massive to the tiny, were plucked off the conveyor belt to the scrap heap, meticulously arranged and sagely explained. A full-house PDP-8 concentrator stands next to its ASR-33 Teletype, and you can almost hear the clatter; across the room, one wall is devoted to an anarchic-looking PDP-10 (originally used for file transport control) that had my fingers itching to flip dimly remembered switches. On the other end of the scale, there are tubes of core wire and little heaps of cores in three sizes: tiny, tinier, and where's-the-hole? Tim was startled to realize that core planes were assembled by hand; Tom said that the display board of core memory gave the best explanation he'd ever read, and I imagine he's read a few. Further over, a reel of UNIVAC steel tape hangs from doubled-up fishline, with an Alice-in-Wonderland sign that says "LIFT ME." In one corner, two Commodore PETs cower like kittens among cheetahs.

Yet older equipment includes a nice selection of IBM EAM hardware, including keypunches, summary punches, a sorter, and an early alphabetic tabulator, all finished in the invariable battle-ready gray. I took the control drum out of the 026 and remembered too much about odd jobs in college, including the way the insanely springy metal locking flap always chipped one end of the control card.... Control Data peripherals got rescued too. The purplish, stair-carpet ribbon of the band printer will still get your fingers very dirty. The T-handled dust covers of the disk packs still look like cake protectors. It's all here, clean and polished, none of it on a pedestal but most of it with intimations of bootability. In a world trembling on the edge of mania for virtual reality, a day's worth of *real* reality is a refreshing and startling change.

But the scavenger's apotheosis is the Programmer's Office in another corner. As Leo Damarodas recalled in last July's ENGINE, while you were coding in the fifties and sixties you *weren't* at the console, and this is where you were....at this long oak table, flanked by blue-on-brown boxes of IBM card stock....that's your dark cloth coat and fedora on the wooden coat-tree. Framed awards and pictures line the wall, OEM models adorn tops of filing cabinets, and a few "internal souvenirs" — like a nameplate from an IBM 7094 — are tacked to the bulletin board. Sitting at the long table, puzzling over a cork in your code, you might idly pick up the plugboard punch, no bigger than a screwdriver but superbly finished in gray and red with the IBM logo in white. Then it's back to the fanfold, as you try not to notice the clock, and reach for the pack of Camels in the ashtray. With the cigs, there are matches from a Chinese restaurant, emblematic of the days before ANSI Standard Pizza conquered the programming world. But *it's a pack of matches from a Chinese restaurant in the 1950's.* Only love could have accomplished this.

This is where you were. Maybe. Or maybe, like my pre-teen object hackers who don't know that a hard disk spins, you never were and only need to be. Back to FORTRAN, overpunches, absolute addressing, smudged fingers, the chewy chatter of paper tape, and the sickening thud of a card box hitting the floor. *Iron.*

Since the dawn of computing, LLNL has built unique systems — like the CHORS hard copy output service, the RJET remote job entry terminals, the TMDS video sub-network, and the 50-MHz, multichannel OCTOPUS backbone — to respond to completely exceptional needs. All of this had to be kept patched together by brilliant improvisational engineering. As much money as Livermore had, as much clout with the hardware companies, still its retrospective history gives a clear impression of scrambling to keep up — of building levees and dams to channel tidal waves of information that constantly threatened to overwhelm the whole network. Counting file data, print jobs, remote job entry, and output to televisions and CRT's, the two big trunk channels often handled over half a million messages an hour. There were few parallels to this, no matter where in the world. And all the history that makes this understandable, that makes it *live,* is packed tight into a tiny, borrowed school, protected — by four diligent volunteers — from the rote indifference of a government department on another coast. Somehow, the Computer Museum even seems miles away from the Western-redwood-serene-Zen architecture of the Lawrence Livermore Visitor Center, which the DOE *does* care about.

To speak plainly: This Museum needs protection — the protection of fame which arises from recognition. Visitors, ink, and word of mouth and keyboard can keep this unrivaled historical asset from declining to "hardware in storage" and slipping away.

Make the appointment, take the drive, prowl and exclaim, stand and stare. You'll love it. We did!

Lawrence Livermore Computer Museum
Pod F North
1401 Almond Avenue
Livermore CA 94550
Hours by appointment only
+1 510 447-6109 or +1 510 373-1373

LONG LIVE the APPLE II

April 1977 — November 1993

Apple Computer has announced the end of production for the Apple IIe, the last Apple II model still available from the company's educational catalog. After almost seventeen years and over 5.5 million machines, this dynasty is brought to its end.

When the Apple II was introduced at the First Annual West Coast Computer Faire, in San Francisco's Civic Auditorium, on April 16, 1977, it marked a risky departure for the fledgling computer company. Apple's earlier product, the Model One [see ACQUISITIONS] had enjoyed a modest success; it was powerful for its day, well-designed, and reliable. However, it was a hobbyist's computer that required the proud owner to add a case, a power supply, and I/O capability; it was also expensive, at nearly US$700 for the main board alone. Roughly 200 units were sold.

The Apple II was intended for a far wider audience. A revision of the "insanely great" Apple One motherboard, combined with all the bits that made it an operable computer, was housed in a sleek, tapering beige case that evoked fleeting thoughts of science-fiction movies. It was meant to appeal to hi-fi buffs and buyers of modern appliances, and at US$1,195, it could almost qualify as an impulse purchase. Apple's three top executives, business manager Steve Jobs, circuit designer Steve Wozniak, and president Mike Markkula, hoped that this would become (to borrow a later Apple slogan) the first-ever "computer for the rest of us."

It came close. So many people found it attractive; computer professionals who wanted a machine at home for recreation, executives who realized that an Apple II running VisiCalc™ was an analytical tool more agile than any minicomputer, students who wanted to edit papers without retyping, administrators of clubs and churches who ran their mailing lists.... An Apple II brought the power of computing to so many familiar activities, slowly perhaps, but easily too, and without being scary.

Roughly a year after the Apple II's introduction, Apple brought out the Disk II 5.25 floppy drive, a stroke of genius that may even have surpassed the computer itself. Earlier floppy drives had been hardware-heavy and complex, which made them expensive, finicky and fragile. The Disk II reduced hardware to an absolute minimum and trusted to software for control and timing, keeping the drive affordable (though still a major moneymaker for Apple) and reliable enough for the mass market. At a stroke it banished the bitwise mysteries of paper tape and the eternal frustrations of data cassettes, and brought speedy data retrieval to millions of delighted users.

Over the years — so many years — a procession of new models brought more capability to faithful users. The IIplus and IIe added memory and agility. The IIc made (or tried to make) an already small computer explicitly portable. The IIGS, by adding vastly improved color graphics and the beginnings of true digital sound, brought the family to the very edge of today's infatuation with computer-driven "realities." But while these descendants pushed the envelope, they never tore it. If you've ever run one Apple II, you can sit down at a different one and at least get off to a good start. Almost every model has its partisans — mention of the perennial IIe brings smiles from teachers, while some designers still call the IIGS "the best [deleted] computer Apple ever built" — but they're all inviting and ingratiating.

In the end, perhaps the II's greatest contribution was to education. Millions of children have encountered a IIplus or IIe on the same day they began primary school; and the magnitude of this contextual shift is hard to overstate. In the popular imagination of 1975, a computer was a vast, wildly expensive, unapproachable cluster of machines, hovered over by specialists in an air-conditioned room. Ten years later, a computer was something that a seven-year-old could walk up to, play with for ten minutes, and wander away from. Without giving Apple credit for the entire micro revolution, we can still admit that that dilatory child was *probably* playing (and learning) with a IIe. (And a few of those seven-year-olds grew into twelve-year-olds who could run MS-Windows or Finder, and are now sixteen-year-olds messing with Linux or hacking C++ ....but that's a different story and only begun.)

The educational market finally faded, the IIe accounted for only two per cent of Apple's shipments in 1993, and the II series is at last a closed book. With the turn of the century so close, it's a shame that we won't see an Apple II Millennium Edition. But no doubt a few hundred thousand of the originals will be pumping bits in the year 2001, proving that a 6502 chip and a pocket calculator's worth of RAM still add up to a useful, amusing and beautiful computer.

Long live the Apple II!

A DECADE OF MACS

While we're under the Apple tree, happy tenth anniversary of the Macintosh! which was introduced to the world on January 24, 1984. In those ten years the Mac has — time after time — set new standards in digital sound and graphics composition, video manipulation, and ease of use. Few feelings in the world of computerdom are as intense as the devotion of a hard-core Mac user.

We'll try to have a Mac article for April, but we don't know what's in it yet. Have faith.

(Speaking of the apple tree, here's a trivia question: What was the text, in tiny letters, that ran around the edge of the picture frame in the original Apple logo? First correct answer before March 28 gets published in the April issue.)

SPOTTER ALERT

On November 24, 1993, the CHAC office prepared a press kit that consisted of a release about INITIATIVE 1999 and the Association, a copy of the short piece entitled "Millennial Chaos for Computers" that appeared in the November 15th New York *Times*, and a copy of the October-December ENGINE. This mailing was our first contact with print media.

Kits were mailed to these publications:

Byte	Government Computer News
Computer Currents	Information Week
Computer Technology Review	InfoWorld
Computer World	MacWeek
Data Communications	MicroTimes
Datamation	PC Week
Defense News	Science
Digital World	T.H.E. Journal
Dr. Dobbs' Journal	Whole Earth Review
Electric Engineering Times	WIRED Magazine
Federal Computer Week	

If you spot any mention of CHAC or the ENGINE in one of these periodicals, *please:*

* If your copy of the piece is clippable, clip and mail to the El Cerrito address.

* If you can't spare the physical copy, send the text as net.mail to cpu@chac.win.net, or photocopy and fax to the El Cerrito address.

* If you're too busy for that, just send the publication name, date and page number and we'll do the hunting.

Thanks!

SPOTTER FLASH

At the moment before publication, our press campaign has brought its first results. Emeryville's *Computer Currents* (January 11-24, page 10) devoted a quarter-page to a fair and clear treatment of INITIATIVE 1999. We appreciate the coverage.

It was their editorial decision to publish CHAC's voice number — rarely used, to put it mildly — rather than our more popular e-mail address. We were startled when the garage got pelted with phone calls! Our callers had several interesting propositions or suggestions and, if this exemplifies the power of the press, we're all for it. Thanks again.

THINKING OF WRITING?....

....an article for the ENGINE? We'd be delighted to have some, but even more delighted to have some about:

1.) Minis. A sober assessment of our first three issues demonstrates that we've published a lot about big iron, a lot about micros, and not much at all about minicomputers — which have been crucial to all manner of research, simulation, programming, automation, process control, and hackerly weirdness. Minis are Good Things and we know that many of our correspondents share that opinion. So, dear readers, what interesting things did you do with one? In California, of course.

2.) Scarcer large machines. We're very fond of IBM and DEC both — having had forebears who were spear carriers on both sides of the Hardware Wars — but no less fascinated by machines that weren't quite as ubiquitous. Certainly there's every reason to write proudly and at some length about the roomful of Amdahl, AT&T, Burroughs, CDC, Cray, Data General, Datamatic, ERA, GE, Hewlett-Packard, Honeywell, NCR, Philco, PRIME, RCA, SDS, Sperry, Tandem, UNIVAC, Xerox, or What-did-I-Miss? iron that you cut your teeth on. So when can you start?

3.) Distinctly historical machines in current use. To take one beguiling example, a couple of ENGINE subscribers would *swear* that some large company in California is still using a System/360. Is this true? Who'd like to prove it?

4.) Languages. We recognize that it isn't easy to write about languages in a way that holds the interest of non-programmers, but we did get a terrific response from Aaron Alpar's Smalltalk article in October. Comparable treatments of other dialects eagerly solicited.

5.) Computer-related social and economic history. The tremendous impact of computing in California has comprised far more than hardware and software. Why did you go to work for a computer company, when you did? What were the effects when your hospital, or bank, or university adopted its first EDP? Just as a computer is more than the sum of its components, computing is more than the sum of its computers.

DESPERATE PLEA FOR MONEY

CHAC needs money. What else is new? Well, what's new is that we're getting some....not a tremendous amount, but enough to produce the ENGINE, pay for postage, telecomm and storage, and very, very cautiously purchase significant hardware. CHAC is in the black — for the moment — and here to stay.

When we take the strategic view, we realize — and hope you'll concur — that the need for ready cash is greater than ever. The process outlined in October, of "forging links with trade publications, industry executives, and foundations....in a word, being taken seriously," has begun; see this issue's "Acquisitions," "Spotter Alert," and "Land Of The Silent Giants" for examples. We've also begun to recruit our Advisory Board.

In the near future, we will be starting research into foundation support, filing grant applications, traveling throughout California to meet with industry representatives, and trying to rescue some larger hardware. We're considering a public, promotional event at mid-year to celebrate the first anniversary of the ANALYTICAL ENGINE; later in 1994 we may collaborate on a significant publishing project. This will all take money that we *don't* have now. But if we mean to fulfill our ambition of "getting much bigger over the years," we don't dare squander the momentum that CHAC has built up in only nine months.

To those who have donated: Thank you, you've kept us moving. To those who haven't, yet: Please give *soon* and make the biggest difference you can. Microeconomics is an unforgiving science, and tomorrow's donations have a hard time paying today's bills.

AND SPEAKING OF MONEY....

With respect to our nonprofit certification, the mills (and stores) of pertinent gods are grinding very slowly indeed — it seems like months since that paperwork went out of here. Happily, the CHAC can act like a nonprofit while it's still waiting to become one. Our accountant says that, since our application is correct and pending, all donations to the Association are fully deductible for the donor. This includes ENGINE subscriptions. (The $10 per year surcharge for paper copies can't be deducted because it's a reimbursement of our production and mailing costs.)

If you don't have an ENGINE subscription yet, but you're hunting for charitable deductions, all we can do is encourage you to subscribe. Today — did we mention today?

LIGHT A MATCH....

One thought about donations: Your gift to the CHAC could be augmented — even doubled — by your employer through a matching program. Computer-related companies offering to match charitable gifts include:

Adobe Systems, Inc.
Ampex Corporation
Cray Research
Digital Equipment Corporation
William and Flora Hewlett Foundation
IBM Corporation
Macworld Communications, Inc.
Microsoft Corporation
NCR Corporation
The Sun Microsystems Foundation
Tandy Corporation
TRW, Inc.
United Technologies Corporation

and, no doubt, there are many others. Ask your company's Personnel or Benefits office if matching is offered; if so, please take a moment to request the appropriate form, fill it out and mail it with your donation.

OVERVIEW OF BUREAUCRATIC PROCESSES

The last quarter of 1993 didn't produce much on this front — largely because the easiest work had already been done. Much is on its way to completion, visible results are scant. But here's what we hope to have accomplished by April:

* Certification of California nonprofit status

* Application for Federal ditto (which we can't do till the state's certified papers are returned to us)

* Application for a nonprofit postal permit (mailing the ENGINE is expensive)

* Research on grants and filing of proposals

* Contact with Bay Area colleges and universities to discuss a possible internship

* More formal accession and registration of our computer collection

* Acquisition of more storage space, somehow!!

Naturally, more will come to light between now and then. And no, we still can't take credit cards.

ABOUT YOUR OLD, DUSTY LAPTOP....

If you have an older 386SX or 386DX laptop computer sitting around, and you're not doing much with it, would you consider donating it to the CHAC so we can trade it for some fine old iron?

A nonprofit organization in Northern California has been given an elaborate, significant and bootable Compupro micro system, complete with a fourteen-inch hard disk. They can't really use it, because no one on the staff is familiar with it. They don't want to scrap it, for reasons obvious to us and to you. And — here's that bureaucracy again — because it's donated material, they can't sell it or give it away, except to *another* nonprofit organization.

They, on the other hand, desperately need a portable computer that they can use for on-site demos. They'd be perfectly happy with some sort of 386 that had about an 80MB drive and a mono screen. If we *had* such a thing, we could donate it to them ("another nonprofit organization") and trade it for the Compupro. Given that Bill Godbout's Compupro company spent its entire life in the Bay Area, it's thoroughly within our mandate to acquire this.

If you have a Toshiba 3100SX — or something like it — that you could donate to consummate this deal, please call us at +1 510 527-7355 or send e-mail to cpu@chac.win.net. We'll give you a tax deduction equal to the laptop's current AmCoEx close price, which should be about $650. Thanks!

Book Review: STAN VEIT'S HISTORY OF THE PERSONAL COMPUTER

Asheville, NC: WorldComm, 1993
Photos, Index, 304 pages, $19.95

Reviewed by N. C. Mulvany

Stan Veit's *History of the Personal Computer* presents and expands a series of columns that have appeared during the past eight years in *Computer Shopper*. Veit writes that "This history is intended to give the reader the feeling of the times when, in a few short years, the personal computer appeared and grew to be a mighty force for change," and *feeling* is a key word; this book succeeds exceptionally at conveying the atmosphere surrounding early microcomputing.

The charm of this book resides in its very personal account of personal computing, and of the industry that developed from it. This is no dry historical tome that outlines the progression of PC development machine by machine, but a chatty insider's account of some people, places, and technology that were most important to "computing for the people" in precisely its most dynamic, anarchic era.

Veit's story begins in 1976 with the optimistic opening of his Computer Mart in New York City — the first retail computer store on the East Coast and the second one in the world. "Started in the back of a toy store on New York's Fifth Avenue, it grew so quickly that the customers and shoppers filled the entire floor and interfered with the sales of Barbie dolls and wind-up cars."

The description of retail sales, assembly, maintenance and support of systems such as IMSAI 8080, South West Technical Products (SWTPC) 6800, SOL computers, and Apple computers gives a vivid picture of computer retailing at its very outset, constantly veering from excitement to frustration and back again.

Cash flow was a problem not only for the retailer, but for small manufacturers, who depended on cash to produce the systems ordered. Often the retailer had to pay up front for systems sight unseen and hope that they would be delivered within a reasonable amount of time. Once the systems arrived, technicians worked overtime to assemble them and make them bootable. This was indeed risky business! And for every computer like the IMSAI 8080 —the dark-horse bestseller that got Computer Mart up and running — a seemingly comparable machine like the Sphere M6800 might prove to be a near-total flop.

Veit's account is punctuated with anecdotes and many wonderful photographs of early systems, and his prior background as a technical writer is used to good advantage. Technical developments and specifications are integral, but presented in "plain English" so as not to disrupt the flow of the story. [Unfortunately, the book's most distracting faults are timid editing and slipshod proofreading, which could easily have been avoided. — Ed.] He also chronicles the chaos and thrill of early computer shows, followed by the maturation of an industry with the emergence of PC distribution channels. His tenure as publisher and editor of *Computer Shopper* gives him authority to delineate the important role that computer publications played in the development of the PC market.

This book is an unfolding, meandering, first-person story best read cover to cover, as if sitting in Stan Veit's living room and listening to him reminisce. Its allure is hard to describe in a review, but typified by Veit's memorable description of setting up at the first national computer show in Atlantic City in 1976. Computer Mart shared its booth with a "long-haired hippie and his friends" — Steve Jobs, Steve Wozniak, and Dan Kottke. As Jobs was readying the Apple display, Veit's formidable mother-in-law noticed that his jeans were torn. She looked him up and down and said, "Young man, your backside is sticking out of holes in those jeans! You are NOT going to be in *my* booth like that. Take 'em off and I'll sew them up, now!" Unusually meek, Jobs slid behind a curtain and handed over his pants for mending.

Particular companies and their products are given in-depth treatment. Proceeding from the MITS Altair and IMSAI 8080, Veit describes the SWTPC 6800, early Apples, the Cromemco S100 boards and whole systems, Sphere systems, SOL computers, TRS-80, Commodore, Atari, North Star, Osborne, Vector Graphic, and the rise of the IBM PC. Many other computers such as the DEC Rainbow, Sinclairs, Heathkits, and Morrows — to name a few — are considered more briefly. Even so, there are omissions and near-omissions — only three sentences are devoted to the notably popular Kaypro CP/M machines.

Printers were clearly Veit's favorite peripheral equipment, and we are reminded that early Centronics dot matrix printers, which cost at least $2,000 and as much as $6,000, could be an investment that dwarfed the computer itself. The arrival in 1981 of the Epson Model 70, selling for $600 and printing at 60 cps, was a key breakthrough and universally acclaimed.

This book wraps up with the introduction of the IBM PCjr in November 1983, but says comparatively little about IBM's entries in the field. This is not the definitive history of the personal computer, but a valuable addition to the collective history, a bird's eye view from inside the whirlwind of activity that spawned a revolutionary industry. In these days of telemarketing, credit cards, and overnight delivery it is easy to forget how much devotion and effort microcomputing consumed as it began. Stan Veit's unparalleled perception of the early days leaves us absolutely amazed at the changes and advances of the past seventeen years.

ACQUISITIONS

APPLE ONE

A generous donation from Larry Tesler, Chief Scientist of Apple Computer, underwrote the Association's purchase of an Apple One from Winston Gayler of Cape Coral, FL. Naturally this is any collector's favorite Apple, but it's also a printed-circuit design so pristine and uncompromising that it's still used as a teaching example in serious EE courses.

Gayler was as careful with this computer as he was with the IMSAI discussed here in October; the Apple arrived with a complete spare chipset, sealed original manuals with duplicates for reference, as well as cassette software, program listings, schematics, correspondence, articles, magazine ads.... It's all here, and to spare. We haven't booted it because we don't have the right kind of, er, TV set. Look for a full-length article by an appropriate Apple guru in a forthcoming issue of the ENGINE!

SOL-20

The Association purchased a Processor Technology SOL-20 from Dave Coughran of Turlock, CA, with funds donated by Tom Ellis.

Walnut side panels?! What is this, *stereo equipment?!* Actually, the adornment was less frivolous than it seemed. When Bob Marsh and Lee Felsenstein introduced Proc Tech's SOL computer, at PC '76 in Atlantic City, NJ, a year and a half had passed since the Altair 8800 was announced in *Popular Electronics;* and the rule of thumb about microcomputers, that a new generation would arrive every eighteen months, applied firmly even then.

The SOL-20, built — like earlier Altair and IMSAI machines — around the Intel 8080 CPU, needed to stand out from a growing herd of workalikes. Worse yet, Zilog's new and potent Z80 chip threatened to dent the sales of all 8080-based machines indiscriminately. Proc Tech's highly regarded memory and I/O boards proved that their circuit design was sound, but in the fiercely competitive market of microcomputing's Big Bang, good internals weren't enough to sway picky buyers. So Marsh, Felsenstein, and partner Gary Ingram broke new ground by making their computers....pretty.

Polished wood end-plates, a high-quality bright blue finish, and a CPU with an integrated keyboard all contributed to the SOL-20's taut and "businesslike" appearance. With the monitor on top of the CPU, and the Helios (Persci) twin 8-inch floppy drive next to it, the whole assembly would fit on a — somewhat lavish — secretarial desk, and without a dangling cable in sight. Proc Tech photographed just such a setup to use in their own advertising, with the caption "Introducing the Monday Machine."

But in May 1979 Proc Tech closed its doors forever. The unreliability of the Persci disk drives had wounded it; a long, damaging litigation over the ownership of the company's BASIC had brought it low; and aloofness from the SOL's user and dealer base finished it off. Lee Felsenstein and Bob Marsh went on to work for Osborne, where Felsenstein led the design team of the Osborne I.

The SOL-20 itself was largely without blame for Proc Tech's collapse. It was highly regarded for its reliability, compactness and good looks; the surviving examples have become some of the most sought-after of the pre-Apple micros. We're certainly glad to have ours.

ALSPA

A little-known ALSPA microcomputer has been donated to our collection by Jack Brown of Adaptec Corporation.

We haven't popped the case on this one and we know only that a Z80 CPU somewhere in the box talks to the standard 64K of RAM. The case format is unusually deep and narrow, leaving room enough in the front panel for two 8" drives and not much more. There's a nice assortment of ports on the backplate.

Minimal, or fewer, docs are part of this package, but there's probably a boot disk. At a rough guess we would date it between 1978 and 1980. The full and unrestrained gratitude of the CHAC will devolve on anyone who tells us more about this computer than is set forth here.

HP 150

Revenue from subscriptions to the ANALYTICAL ENGINE was used to purchase a Hewlett-Packard Model 150 touch-screen computer from Dave Lee of San Francisco, CA.

The year 1984 was marked by a creative high tide that has rarely been equaled in the micro world. Speaking of hardware alone, it saw the introduction of the IBM PC AT, the Apple Macintosh, the Sinclair Quantum Leap, the Coleco ADAM, and this HP 150, among many others. Naturally some of these machines were more innovative and successful than others; but few can have been more in-novative than this H-P.

When Hewlett-Packard implements a new technology, they generally pursue its development until they feel that the customer can receive maximum benefit from it. So it was here. The touchscreen was coupled with an unadorned, but effective, graphical applications suite that (for example) lets the user touch the "tab" of a Rolodex card to display its contents. Similar attention to detail is evident throughout the design and it's obvious that, by producing a touchscreen computer that was intuitive and rewarding to use, the company hoped to introduce a world-beater.

The 150 was not that. Instead, it became one of the last computers to be doomed by lack of "IBM compatibility".... But, ten years after, how fascinating it is to explore a micro so different from the common run! — because the touchscreen is only one of its idiosyncrasies. An optional thermal printer could fit on top of the CRT, under a hatch in the computer. The floppy disk subsystem uses the (then) scarce 3.5-inch disks, compact and rugged; 5MB and 15MB hard-disk subsystems were also available and could be daisy-chained. The keyboard has scads of color-coded function keys to facilitate its use as a diskless 2623A terminal. Clearly this is a "multi-environment" computer meant to be equally at home in an MIS department, a library, a laboratory, an examining room, or in the field.

This HP 150 is the Association's first Hewlett-Packard computer. It won't be the last and, if they typically have this much to offer, we may need quite a few.

[Note to MIS packrats: We have an abiding vision that the 15MB disk, model HP45660A, the 5MB disk, model HP45655A, or the wedge thermal printer, model HP2674A, are sitting in somebody's stockroom, dusty but functional. If you have such things and no longer need them, we would *particularly* appreciate donation of the rest of the bits for this box.]

MACINTOSH XL (MacLisa)

Al Kossow of Apple Computer has donated an Apple Macintosh XL to the Association's collection, and it's been hanging out on the desk in our office ever since! This mysterious machine, a vital way-station on the road to the Macintosh, was meant to bring the graphical, iconic, mouse-oriented Lisa interface to home and business users — but at a price that the desktop computer customer of 1984 would find attractive.

The XL has the same case as a Lisa, with an 11" (28cm) paper-white monitor on the left and the floppy on the right; but whereas most Lisas had dual 5.25 "twiggy" drives of dubious reputation, the XL has one double-density 3.5 drive. Ours also has an external, 5MB ProFile hard disk sitting on top. (At the moment, the ProFile won't cold-boot, but a patient approach will trick it into warm-booting. Once it's up, it runs indefinitely.) We have it set up with the surprisingly complete Lisa Office System — LisaCalc, LisaDraw, LisaGraph, LisaGuide tutorial, LisaProject, LisaTerminal, LisaTest diagnostics, and LisaWrite — but we could also run MacWorks XL, an integrated application written specifically for the hardware.

This machine is impressive, and the more so the more you look. First of all, its click-to-load windowing and its tear-off-the-pad file metaphor make it an uncorrupted descendant of the Xerox Alto and other PARC computers. Consider also that in 1984 this Mac competed in the marketplace with the IBM PC XT or some of the later, more powerful CP/M systems — which may have had bigger disks, but couldn't come near the XL's futuristic interface. Want to look back from today's perspective of MS-Windows, X-Windows or OS/2? Well, the whole Lisa Office System runs in 512K RAM and fits on *half* that 5MB disk.... *And*, when you're done for the day, you can hit the power switch without closing anything. The operating system will meticulously put everything away for you, and bring it back out when you return in the morning.

Someday, sadly, we will have to put this computer in storage, and some other intriguing box on the office desk. But we're in no hurry.

ATARI 800

At press time — literally on the eve of the upload — the Association received a fully equipped Atari 800 from Shellie Stortz of San Francisco. It includes a 410 cassette recorder, a Wico joystick, and one peripheral we hadn't seen before, a CX85 numeric keypad.

This Atari arrived in a bedraggled but still garish pink-and-silver box that proclaimed it to be "THE PROGRAMMER," so presumably Atari BASIC is its forte. We don't know a lot about it, other than that its dual cart slot and real keyboard make it a much more congenial machine than the smaller 400, and that it seems to have 48K RAM. Of the documentation in the box, some applies to the 400 and the rest is puff. If anybody has real Atari manuals that they're not using, we'd welcome the donation. Anybody with Atari manuals that they *are* using, please call us or leave us net.mail to discuss the box's capabilities.

LETTERS

COMPUTER HISTORY ASSOCIATION OF DELAWARE BEGINS!

➡ Well, I've started the process. I registered the name "Computer History Association of Delaware" this afternoon — it's funny, you've got to check a set of ledgers to ensure that the name hasn't already been registered. I would have been *very* surprised if I'd found a match in the 1901-1925 ledger :-)....

Would you be willing to forward me a copy of your Statement of Incorporation and organizational bylaws as a starting point for discussions? In Delaware, you only need a single person for incorporation and no assets.... It's occurred to me that if you get a flood of interest in starting other state organizations, it might be worthwhile for me to put together a set of boilerplate applications materials for incorporation in Delaware....

Let me know what you found useful (and not) in setting up the organization in California.

Now, where did I put those RK03 drives...

Thanks!

— Tony Eros, Digital Equipment Corporation

[Thanks to you, Tony! As I write this we've already sent you some material by net.mail, but as we look back over the process of assembling this organization, there's been a whole lot to it — even so far. As we build the CHAC, we'll put together — and try to update — a suggestion file which will be available from our request daemon.

PLATO AND SMALLTALK

➡ While we're on the subject of Smalltalk, here's a bit of history the world is forgetting:

In the mid 1970's, there were only two organizations in the world with a large body of experience working with bit-oriented graphics. The group we remember best today is the group at Xerox, working with the Alto computer, the Smalltalk language, and various exploratory windowing environments. The other group was centered on the University of Illinois PLATO IV computer system. This system supported close to a thousand interactive terminals, each with a plasma display panel where the rest of the world expected a CRT, and it supported the TUTOR programming language, a dismayingly mixed blessing, with very high level input output facilities geared to the bit-addressable plasma panel, and control and data structures straight out of the stone ages.

The two groups developed their ideas about how to handle bit addressable display hardware quite independently, but in the mid 1970's they got together and traded visiting staff members, hoping to learn what they could about each other's best ideas. Both sides clearly had some excellent ideas, too. Xerox had windows, mice, the object oriented paradigm, and the fundamental idea of bit-mapped CRT displays, while PLATO had notesfiles, input judging, touch-panel input, and the flat panel bit addressable display.

The exchange was lopsided, though. The PLATO people who went to Palo Alto found Smalltalk to be impossible to learn. The reason was that, as TUTOR programmers, with background in other languages like FORTRAN and BASIC, they found object orientation almost impossible to grasp. On the other hand, the Xerox people visiting Urbana picked up TUTOR very quickly, complained about its backward control structures and data structures, and very quickly came to appreciate the brilliance of its dialog management tools.

The other side of the coin is also interesting. The people at Xerox were being funded largely out of a hope that they would provide a new technology for the "automated office of the future". In doing this, they put in too much time trying to provide computer analogs of the paper tools of a conventional office. While the Xerox community talked about electronic memo distribution in very learned tones, they tended to miss the fact that digital communication could take off in an entirely different way that bore little resemblance to the way we communicate with paper and typewriters.

The PLATO project was intended as an experiment in computer aided instruction, and they were so set in this orientation that they used the word "lesson" for what all of the rest of us would call a program. PLATO had a large on-line user community, and interactive multi-user games were the single most intensive application through the 1970's, despite a string of official policies discouraging such use. In this context, there was no effort to mimic the paper and pencil world; instead, as user demand grew, and as tools succeeded, they were improved on.

The result was a world of inter user communication based on E-mail and notesfiles, where a notesfile is exactly analogous to a newsgroup on USENET today. From their start in 1973, Notesfiles were moderated, but the need for unmoderated notesfiles emerged very quickly. Because of the educational setting, the PLATO project ended up taking a very mature stand about the need for anonymous postings (a stand that is far more mature than the stands currently being taken by the majority of Internet sites today).

Another example of this was the PLATO online user's manual, AIDS. The AIDS system was entirely non-linear from its start in 1973. Today, we would call it a hypertext document, but that term had yet to spread from California to the interior. The PLATO manual was never intended to be linearized into a paper document (although that was eventually done), and the interconnected structure of AIDS was a marvelously effective way to present information.

I was at Illinois from 1973 to 1980, working with PLATO but not for it. My MS project, in 1976, was a re-implementation of the TUTOR language on a minicomputer; this was the first implementation of TUTOR on any machine other than a CDC 6600. This write-up centers on what I learned at lectures by the visitors from XEROX PARC, as well as being based on my own visits to XEROX research facilities and on my memory of what other PLATO people said about their experiences during the PARC PLATO exchange.

— from Doug Jones, via Internet

INVENTORY OF HAL LAYER'S COLLECTION

➡ Outstanding!! Wonderful Vol. 1, No. 2!! Enjoyed it immensely. I agree with other correspondents in feeling alone in the pursuit and rescue of artifacts before they were thrown out by companies too involved with survival and the future to be concerned with the industry's history.

I have been collecting in the categories of calculators, video games, and computers. for several years. If of value to your readers, here is my list of acquisitions, so far, in the computer category, with my best estimate of dates.

computers.........................

1956 Heath Electronic Analog Computer kit (front panel only), (Heath)

1964 EAI analog computer, Model TR-20 (EAI)

1971 Compumedic analog computer, (Compumedic)

1972 GRI Minicomputer, Model 99/IIB (GRI)*
1973 Intel Intellec-8 micro, CPU: 8008, (Intel)
1974 Intel Intellec-4-40 micro, CPU: 4040, (Intel))
1974 Scelbi-8H Mini-Computer, CPU: 8008, (Scelbi)
1974 IMP-16P. micro (front panel only), CPU: IMP-16, (Natl Semicond)
1975 HP 3000, Series II, minicomputer (front panel only), (Hewlett Packard)
1975 IBM 5100 Portable Computer , CPU: IC module, (IBM) w/cart dr & printer
1975 Altair 8800 micro, CPU: 8080, (MITS)
1975 Sphere-1 micro, CPU: 6800, (Sphere) *
1976 Altair 680b micro, CPU: 6800, (MITS)
1976 IMSAI 8080 micro, CPU: 8080A, (IMS Assoc.)
1976 Sol Terminal Computer—20, CPU: 8080A, (Processor Tech)
1976 SC/MP Development Sys., singleboard, CPU: SC/MP, (Natl Semicond)
1976 Intel 80/10 singleboard micro, CPU: 8080, (Intel)
1976 Intercept, Jr. singleboard micro, CPU: IM6100, (Intersil)
c.1976 Z-80 Starter Kit singleboard micro, CPU: Z80, (SD Sys., Micro Design)
1977 Byt-8 micro (front panel only,, CPU: 8080A, (Byte Inc.)
1977 Byte 8080 micro, CPU: 8080A, (Byte Inc.)
1977 COSMAC VIP singleboard micro, CPU: 1802, (RCA)
1977 E&L MMD-1 singleboard micro, CPU: 8080, with BUG Books, (E&L)
1977 Apple II, Model "0," with "Language Card", CPU: 6502, (Apple)
1977 Home-brew one-bit micro, CPU: MC-14500B
c.1978 Am-2900 micro (singleboard), CPU: 2901, (Adv. Micro Devices)
c.1978 Microcomputer-in-a-Suitcase Trainer, CPU: NEC8255,(Integrt Comp. Sys.) *
c.1978 IASIS Computer-in-a-Book, (singleboard), CPU: 8080, (IASIS)
1978 SPARK-16 micro w/cassette recorder, CPU: 9440, (Fairchild) *
1978 Instructor-50 micro, CPU: 2850 (Signetics)
1978 SYM-1 micro, (singleboard), CPU: 6502, (Synertek)
c.1979 Microcomputer/Terminal, Model ESAT-200B, CPU:1802 (ElectroLabs) *
1980 Sinclair Z80 micro, CPU: Z80, (Sinclair)
1981 Osborne Model 1 portable micro, CPU: Z80A, (Osborne)
1981 Z8 Basic/Micro Computer (single-board), CPU: Z8, (Micro Mint)
1982 Timex Model 1000 micro (Sinclair ZX81 design)
1983 TRS-80, Model 100, portable micro, CPU: 80C85, (Tandy)
1983 Sinclair 1500 micro, CPU: Z80A, (Sinclair)
1984 Apple IIC micro, CPU: 65C02, (Apple)

computer-related miscellany................................
1948-90 Library of computer literature, manuals, pamphlets, etc.
1966 Lockheed mechanical digital timer (USAF) *
c.1970 Dektak Inspection/Scriber machine [w/microscope for IC Wafers] *
1970 Comp-U-Kit 10 (Sci. Measure., Skokie, IL)
1971 Pulsar LED digital watch (Hamilton)
1972 Desk-top IBM card reader, Model D-150 (Documentation, Inc.)
1973 Pop Electronics Digital Logic Microlab (SWTPC)
1974 CPU board with 4004 (Pro-Log Co.) *
c.1975 Intel System Interface & Control Module MCB 8-10 *
1975 Microsoft black paper-tape programs, BASIC, etc.
c.1976 Processor Technology paper-tape programs, games, etc.
c.1976 Processor Technology & Godbout boards
1975 Paper-tape readers, mscl.
c.1978 Intel keyboard, Model MDS-CRT

c.1978 Pro-Log 80 (tester of 8080 CPUs) *

* If anyone has documentation or information for these items (*),I would like to hear from them.

Hal Layer, AV/ITV Center, S.F. State University 1600 Holloway Ave.
San Francisco, CA 94132
voice ph: 415 338-2637
email: hlayer@sfsu.edu

DETAILS OF STANFORD'S COLLECTION

➡ In the editorial of ENGINE #2, you wrote: "But at the moment, there's no such institution in and for California. That's the rationale, or part of it, for CHAC. Certainly Silicon Valley, in order to tell the story of what happened there since Hewlett and Packard built their first oscillator in 1938, could endow and support an institution comparable to TCM!"

In fact, Stanford has had a "Stanford and the Silicon Valley" project in the Department of Special Collections since 1985. We have dozens of archival collections relating to the history of computing, the semiconductor industry, physics, etc. Since you mentioned H & P, one should also be aware of the archives at H-P. Stanford's collections have been widely used and are well known to historians of science and technology.

We have a modestly informative brochure, which I can send to anyone who requests it. Also, see my article in ARCHIVES OF DATA-PROCESSING HISTORY: A GUIDE TO MAJOR U.S. COLLECTIONS for a description of the computer-related archival collections we have (as of 1990).

— from Henry Lowood, via Internet

IBM DISK DRIVES, AND OTHERS

➡ It is interesting how some generic terms creep into our language no matter how technically precise it is supposed to be. [In ENGINE #2,] Laurence Press refers to the IBM 1301 disk as being a "Winchester disk subsystem". If you check with the people at IBM San Jose where all IBM disk subsystems were designed from 1957 to the recent past, you will probably find out that the term "Winchester" applies to a single technology developed in late 60's. It is derived from the development project's code name. Each new system, or subsystem, developed at IBM was given an internal code name before it was given a unit number ID, like 1301 for a disk or 7094 for a computer.... During the late 60's IBM was developing a new series of disk drives with the main technical objective of storing at least 30 megabytes and having an average access time of 30 milliseconds or less, so it was known as the 30-30 *à la* "Winchester" rifle fame. The Winchester performance advance could only be achieved with a new read/write head technology, so any disks made with this head technology have commonly been called a Winchester disk. (What is strange is that newer head technologies have been developed since then, principally "Whitney" for the peak, as in storage/performance goals; but we still call the resulting disk a "Winchester". Why is that?) So, the 1301 wasn't a Winchester; the IBM 3340 was the first in a long family of IBM "Winchester" disks. Maybe someone out there knows what the 1301 development code name was; after all, the 1300 series disks provided the basis for the explosive growth of the IBM San Jose facility.

I hope that people affiliated with this organization might find a way to record the views of the disk drive pioneers who reside in this area, especially IBM veterans or Al Shugart, who worked for IBM and then went on to found one or more of the disk drive manufacturing companies in the Valley. I can still remember seeing Mr. Shugart's first 8" floppy disk drive at the San Jose Labs. Maybe he has one of them or the drawings. It was elegantly simple, especially the track positioner, and the reason it was designed at all is especially interesting, not what you would have predicted considering the industry that it spawned along with the single chip microprocessor. It would have made an apt segment of the "Connections" series.

— from Dean Billing, via Internet

MORE ON THE 1401

(passages headed with ➡➡ are from Damarodas part 2)

➡➡ The only way you could get the machine to do something was put a deck of cards in the card reader and hit the start button. And that would read the card deck, load the program into memory, and start executing it. It was slow; there was no multi-processing, no nothing. Just a really simple machine.

➡ As Leo well knows [and as he mentions later], this isn't right. What the start button did was read *ONE* card from the card reader [as he said into locs 1-80] and started executing at location 1. The first instruction was always "set word mark, 7, 13" or something like that. A word mark delimited the end of an instruction [the 1401 had variable length instructions]. By setting *two* [one was at the end of the first instruction, itself, of course] it marked the *second* instruction, which [as I recall] was also a set word mark. In fairly short order you got to reading in another card.

➡➡ Yes, in fact the bootstrap program didn't even take a whole card. The bootstrap program was about a dozen characters long. Somewhere I have a framed white poster, about four inches high and ten or twelve inches long, with that program written on it.

➡ It'd be neat if he could find the bootstrap and post it! I'd be tickled to see that old code again! But I think he has it wrong about the length. I quite clearly remember that the first two instructions in the bootstrap were 'set word mark' instructions, each seven bytes long.

— from Bernie Cosell, via Internet

➡➡ *Did the IBM 1401 use the ASCII system, or was it EBCDIC, or did it have...?*

➡➡ The memory locations were set up looked just like an 80 column card — plus two more bits. So there was a bit that represented zero through one, eleven and twelve, which were the zone overpunches, and then there were what was known as the record mark and the word mark. They were two other memory... well, what we would consider bits. They weren't called that, but memory looked like a punched card with two additional positions. Each memory location was like a column on a card. The addressing structure used three positions to represent 1K. But then you had overpunches, and I know the overpunches were used on the left and the right... there's a combination of four overpunches, so you can... Is five enough to get up to sixteen? Yeah. If you had no overpunches, it would be zero through a thousand. or zero through nine-nine-nine. I can't remember exactly what the scheme was, but they used the overpunches to make up the difference.

➡ The 1401 used a 6 bit "byte", appropriately named BCD for binary-coded-decimal. The core memory in the 1401 was actually an 8 bit system because it included a parity bit and there was a Word Mark bit in each character that defined field length. Six bits was enough to encode 64 characters or enough for the standard 48 character set that was a product of the TAB machine days, 26 alpha characters (CAPS), 10 digits, space and 11 special characters such as comma, period, dollar, $ * ( ) - + =. (Which is enough to do accounting clearly.) The other character was the record mark. Word mark was a bit in each memory position, but record mark was a specific bit combination.

The bits were labeled:
C — (Check or Parity bit)
B — (I think these were called zone bits, but they didn't really correspond to the "zone"
A — punches of the tab card, rows 11-12.)
8
4
2
1
M — (Word Mark)

on the machine lights. You would need a 1401 programmers card to convert from the 12 rows of the tab card to the 6 bits of BCD. Mr. Damarodas' recollection of addressing is accurate. The 1401 used "decimal" addresses using 3 "bytes" from 0-999, then used combinations of the B & A bits to extend addressing up to whatever the maximum installed core memory was, [which] I suspect....was 16 or 20K (and this K=1000). The 1410/7010 series was the same architecture and I have heard of them having 40K of core. Obviously, if you used all 18 bits available in three characters, you could address 256K characters, but there may have been some other limitation on the bit combinations. I remember that it was a rather arcane system and it seems to me the limit was 100K.

— from Dean Billing, via Internet

➡ What was the origin of the convention that a column binary card was identified by the presence of a 7-9 punch in column 1? It was well-established by the time I first met a binary card in 1962, but I've never run into any comments about *why* that bit pattern was chosen. Was it just an arbitrary pattern selected because it cannot occur in the BCD character set?

— from Joe Morris, via Internet

MORE ON SPACEWAR

(passages headed with ➡➡ are from Robinson)

➡➡ Each ship could be rotated clockwise or counterclockwise, fire reaction engines that eventually ran out of fuel, and fire missiles of finite range and finite number. The ship obeyed Newton's laws, accelerating and decelerating under the influence of its engines and of solar gravitation....

➡ But one thing it *didn't* do was do gravity on the torpedoes, and so there were a LOT of sexy techniques that took advantage of that anomaly. Also, Scott didn't mention the wonderful Starfield. Peter Samson had added it to the original SPACEWAR. IT was a *real* star field, generated by some incredibly clever code so that it had real constellations in their real positions and they slowly drifted across the background.

➡➡... Collision of two ships produced a vivid, graphically depicted explosion on screen, and both players were out, whereupon the game restarted.

➡ One should probably note that for folks weaned on 'Star Wars' and Super-VGA PC games, it wasn't really 'vivid'. Kind of a little star-burst. Very nice, and crystal-clear what had happened. But nonetheless fairly simple.

➡➡ The display was a vector-type CRT and the quality of the graphics exceptional. The motion was perfectly smooth, with no aliasing artifacts noticeable.

➡ This is just wrong. The display was a *point*plotting*, no memory scope. ALL displays were 'animated' since there was no display memory: if you wanted something to persist on the screen, you had to be in a loop constantly redisplaying it. The scope had a neat, special phosphor which displayed green when fired, but then faded for short while in yellow. This made the display flicker a *lot* less, and it also meant that things left 'trails' as they moved around. It made for some quite wonderful 3-D effects.

— from Bernie Cosell, via Internet

➡ The SPACEWAR to which I refer was run on a PDP-1/B at BBN in Cambridge. ((one of the) first Timesharing machines — but that's a different thread)

I believe this was the identical SPACEWAR to that run on the MIT PDP-1; certainly many of the same MIT programmers worked at BBN too. (See hakmem threads also).

SPACEWAR at BBN was probably the first "object oriented" program (nothing new under the sun), the program had translate, explode and rotate, etc. generic object functions that would operate on whatever object you fed to them (mostly the two ships).

The DECScope had 64(?) intensities (6 bits?). Peter Sampson programmed a rather remarkable Starfield over Cambridge, that rotated a 24 hour day (in about an hour of play time) as the background. (when last heard from, Peter was at System Concepts who were making -10 -20 clones)

Standard (no bit diddling) SPACEWAR was 2 ships, sun with gravity for ships not torps, 8(?) torps with life about 3/4 screen (about 2-3 inches/second); hyperspace survival probability started at about 75% and decreased per use to about 20% (?), everything wrapped, torps could be shot down by other torps. Torp speed was additive to shooter's speed (by some function) but you could shoot yourself down if you fired ahead whilst going too fast, or you could "leave mines" by firing opposite the way you were going. All this in 4k of 18-bit PDP-1 words (including Peter's Starfield database)

Control was accomplished using testword switches (I/O instruction readable) the 4 on the left for one ship, the right 4 for the other. (order may be wrong, but...)

rotate left rotate right torps thrust
(Actions a whole lot like Netrek)

left ^ right = Hyperspace.

Program had patchable locations that controlled number of torps at a time and their spacing, life, and speed. Also, rotation could be "by thruster rocket" or "by gyros" — Gyro would rotate while the switch was thrown and stop when off, whereas Rocket rotation would start and increase angular momentum while the switch was still thrown. To stop, you had to try to thrust the other way for exactly the same time.

The sun had switchable gravity and I think you may have gotten a choice whether torps were affected by gravity. SPACEWAR ships and torps would wrap, although that may have been another option. For a challenge, there was billiard SPACEWAR; single shot on the screen at a time, no kill counted unless it had wrapped at least twice.

PDP-1 SPACEWAR was the source of the first computer-induced medical problem (well before Carpal Tunnel Syndrome), "Spacewar Elbow." Occasionally Cosell (Bernie) and I would spend a night playing SPACEWAR, only to find that leaning on the elbows for 7 or 8 hours straight would leave us unable to straighten our arms for quite a while.

BBN outlawed SPACEWAR occasionally, mainly because switches died. The life of testword switches was shortened by this game. (it took me 5 hours to replace the first switch that needed fixing; I got it down to 22 minutes by the time the machine left.)

Someone posted that the PDP-1 at the computer Museum was one of the MIT machines, I believe that too. (It has joystick control boxes)

— from Paul M. Wexelblat, via Internet

➡ I ran into SPACEWAR when I was a freshman at MIT in 1962/63, and added a couple of lines of code to it. (I have no idea what those lines were, nor if they were included in any versions after I left. I do have the source listings (promised to the Computer Museum) but I hadn't yet learned the concept of footprints to mark changed code.)

When I first saw it the user interface to SPACEWAR was a pair of wooden boxes about the size of a small file card box, each of which had two telephone key switches (turn left/right, rocket on, go to hyperspace) and a button (fire torpedo). When we got the second PDP-1 someone went over to Eli Heffron and Sons (motto: "We have Surplus Surplus") and bought a pair of Air Force drone controllers to serve as input devices.

And the PDP-1 we ran it on was really an amazing box: Memory of FOUR K! (well, actually that's 4K words of 18 bits each), and a blazing memory cycle of 5 uS.

The game was so popular that it "signed" the console log itself: You might see entries for an hour or two for the staff programmers, a block here and there for a student, an occasional Big Name (Marvin Minsky, for example), and huge blocks of time merely noted as "Spacewar."

When we got DEC's first drum (Wow! 32 tracks, each of which held exactly one coreload of 4K words!) one of the tracks was instantly dedicated to SPACEWAR, and the console load tape for it shrunk to a bootstrap a couple of feet long.

— from Joe Morris, MITRE

COMPILATION PROJECT

➡ For the entire 1960's, most of this information [requested for the Compilation Project] can be gleaned from the June issues of Computers and Automation — that was their annual "directory" issue that printed a directory of the entire computer industry.

— from Doug Jones, via Internet

LOGO'S TURTLE

➡ ....as near as I can tell, the original turtle was a remarkable little robot that crawled around the floor under LOGO control! It had a hemispherical plexiglass top, two wheels, and a pen, and it could drive forward, rotate, and lift or lower its pen under command of the LOGO system. I've seen photographs. As I understand it, the split screen came later. I'd love to program a real LOGO turtle!

— from Doug Jones, via Internet

APPLE II DISK CONTROLLER

➡ I have often read about the supposed unique simplicity of Steve Wozniak's disk controller for the Apple II. According to most of the material on the subject, Woz created the basis of his controller long before he actually studied the standard methods of floppy control. Apparently his resulting controller used far simpler methods to handle disk functions than any other controller on the market. Can anyone out there give me a good, technical explanation of Woz's method for controlling disk drives as opposed to the more conventional approaches?

— from Don Congdon, via Internet

EARLIEST NETWORK TOPOLOGY CITED

➡ Concerning the citation of the Pierce Loop in Aaron Alpar's article, ENGINE #2: A timeline for network history that I have been developing includes the entry :

1969 NewHall LAN topology (token ring)

as the earliest instance of token ring LANs. I believe this was some British work based on Cambridge slotted ring networks. Unfortunately, I do not currently have the reference for....this citation.... Anyone familiar with sources for these LAN developments? I have it that Ethernet (the term coined 22 May 1973 by Robert Metcalfe) was based on Aloha radio network protocols, and token rings descended from Cambridge rings, which tried to remove the media contention in Aloha by assigning each station a unique time slot for data transmission. Verification would be appreciated.

— from Stan Kulikowski II, via Internet

GUI ON A XEROX STAR?

➡ I have just prepared a class lesson on the GUI design and its place in human-computer interfaces....in this lesson I describe how the GUI was developed at Xerox PARC circa 1970-73 on the Alto. is there a source for getting screen images of the original Alto GUI? I would like to show how this evolved into the standard designs we see today. I understand that the Xerox STAR was in this line of descent, but I have no sources on how the GUI figured in there.

— from Stan Kulikowski II, via Internet

[Before our press time, Lee Wittenberg had suggested "Designing the Star User Interface" by David Canfield Smith, et al. originally published in BYTE, April 1982, and reprinted in *Perspectives on the Computer Revolution*, edited by Pylyshyn and Bannon (Ablex, Norwood NJ, 1989). We'd like to suggest getting in touch with Larry Stewart at the DEC Computer History Project, stewart@crl.dec.com.]

RE: DAVID HEMBROW'S OLD-IRON QUERY

➡ Concerning David Hembrow's request for "Old Iron" specs (ANALYTICAL ENGINE, Vol. 1, No. 2, October 1993), you should be aware of the surveys of computer hardware done by the military. They appeared in three separate editions:

Office of Naval Research.
A Survey of Automatic Digital Computers.
Office of Naval Research, Washington, 1953.

I have the second printing, with revisions, of this, which is dated November 1954 and specs nearly 100 computers in 109 pages. The later editions were:

Martin H. Weik.
A Second Survey of Domestic Electronic Digital Computing Systems.
Ballistics Research Laboratory Report No. 1010.
US Department of Commerce, Office of Technical Services, June 1957. 439 pp.

Martin H. Weik.
A Third Survey of Domestic Electronic Digital Computing Systems.
Ballistics Research Laboratory Report No. 1115,
Aberdeen Proving Ground, Maryland.
Department of the Army, March 1961. 1131 pp.

This final version is a massive work, fully illustrated. These are hard to find in the second-hand book arena, but are all readily available through inter-library loan.

— from Dr. David B. Sarrazin, University of Colorado, via Internet

[Thanks, Doctor! You may be interested in this card from our reference database:

A FOURTH SURVEY OF DOMESTIC ELECTRONIC DIGITAL COMPUTING
Weik, M. H.
Ballistic Research Laboratories Report Number 1227
Aberdeen Proving Ground, 1/1964

This is as cited in H. H. Goldstine's PASCAL TO VON NEUMANN, page 120 in both the 1972 hardcover edition and the 1980/83 paperback; Princeton University Press.]

COMPUTER MUSIC ON A PDP-8

➡ Some hackers at MIT in the middle 60s actually wrote a note generation system for a PDP-8. With the system, you could input sheet music and it would play on a standard AM radio.

WTBS (the ORIGINAL WTBS — broadcasting with 5 watts from high atop Walker Memorial at MIT) used to play Petula Clark's "Downtown" recorded via the above.

— from Jim Ebright, via Internet

MUSIC ON A CDC 3300

➡ The CDC 3300 had a loudspeaker under the console/desk, and it was wired in to the top three bits of the A-register. You could get a max-volume sound, even a clean note, by toggling the A-register (bits 23, 22 and 21 — it was a 24-bit machine) all on, then all off, at a frequency you could adjust. The system was entirely designed around multiprogramming, so a non-operator running such a job might produce distracting sounds or just garbage, depending on what else was in the machine running.

On the CDC 3300 (and other machines in that series), the real purpose of the loudspeaker was as an operator aid, and it was very useful that way. The printer de-spooler made the speaker chuckle a little, the reader made so much noise that the speaker didn't matter, and most programs that we ran frequently made characteristic patterns of sounds. And, of course, we did have programs designed specifically to produce music. CDC used the feature to make the expansion and shrinking of certain system tables very obvious — when one table was changed in size, the system would "whoop" up or down very noticeably.

— from Edward Rice, via Internet

APPLE II CIRCUIT DESIGN BOOK AVAILABLE IN QUANTITY

➡ I am the author of *The Apple II Circuit Description,* Howard Sams & Co., 1983, which has been out of print for several years. I....would like to donate about 200 copies to schools or computer clubs. Here is my offer: Available for the cost of surface UPS only: new copies of the book (second printing); 1 carton minimum order, 28 copies to a carton.

The book is 8.5x11 inch format, plastic comb bound, with 194 pages (172 standard-size pages plus 22 fold-out pages....which display schematics, timing diagrams, etc. Cover price: $22.95. The book is a very complete, clock-edge-by-clock-edge, circuit description of the Apple II Plus (and earlier) motherboard's CPU, memory, video (text, lo-res, hi-res, color), I/O, etc. Great for anyone troubleshooting an Apple II to the IC level, or who wants to understand the workings of the Apple II specifically or similar computers in general. Sorry, it applies in general to the Apple //e (and later), but does not contain specific Apple //e schematics or description. My favorite part of the book (to research and write about) was the way in which software and TTL chips combine to create an NTSC signal for color graphics display on a standard TV set.

— from Winston Gayler, via Internet

FOOTHILL MUSEUM IN TRANSITION

➡ A few years ago I visited a wonderful little museum—I think it was called the Foothills Electronics Museum—on the campus of a small college above Silicon Valley. I recall a modest but interesting collection, including some things from Nolan Bushnell's garage/attic/ whatever.

Did this museum close? If so, what happened to its collections?

— from Dr. Paul Ceruzzi, via Internet

[We have heard from Dr. Seymour Stein, treasurer of the Perham Foundation in Los Altos, that the Foothill Electronics Museum is "in containers but very much alive — 40,000 square feet of materials." Their old building at Foothill College was taken over for classroom use, but they're negotiating for a 99-year lease (no fools they) on a new building in Kelly Park in San Jose. These negotiations have made it out of committee and the proposal will be made to the City Council of San Jose shortly.

So, no, it didn't get scattered to the winds...]

MORE ON ELECTRONIC MAIL

➡ Hi Kip, I have one suggestion about the ENGINE. Have you considered including email addresses in the attributions of articles? I might like to correspond with some of the authors or letter writers if we had acquaintances or interests in common.

— from Tom Van Vleck, via Internet

[I take your point, but nothing is simple on the net — where "uninhibited communication" is as loaded with contradiction as "paperless office" — and this is actually a holy skirmish of no mean order, kept alive by the dedicated followers of fashion for whom an unlisted net.address is as cool as, say, an unlisted pager number, so to speak. Read the letter and reply "Attribution of Electronic Mail" in the October ENGINE, but the kernel here is, we print e-mail addresses only with pre-existing permission.

Now, certainly we can print *yours* and personally I wish we could print *everybody's*, but to say so would be flame-bait, which we avoid....not only are we a Respectable Publication, but net.kickboxing takes time we don't have, he said yawning....]

QUERIES

[Queries are sorted by subject, and within that, by model if applicable.

If the person querying has permitted us to publish an e-mail address, we have done so, and please reply directly to it; otherwise, reply to cpu@chac.win.net or the El Cerrito address, and we will store and forward.

Necessary warning: Income from subs keeps the ENGINE robust and lack of same, unfortunately, makes it lose weight. Currently we try to publish queries that we receive from anyplace in the world, on the premise that, even if the subject and author aren't in California, the answer well might be. If the ENGINE has to get thinner, we may be compelled to require a California source or tie-in for published queries. Vote *against* this dire possibility by subscribing today! EOPlug]

ALTOS: NEEDS A HAND WITH A BOOTLESS XENIX SYSTEM

➡ I have recently acquired an old Altos 486 computer running Microsoft XENIX 3.1. The set of install disks is incomplete so I need to know how I can make a bootable system disk and set of backups so I can restore the system if something gets trashed. If anyone remembers this particular XENIX implementation and knows how to do this, please email me with particulars. Thanks in advance.

Don Congdon, dcongdon@delphi.com

ATARI 2600: REALLY GETTING INTO IT

➡ I would like to read the contents of a Atari VCS cartridge by constructing some type of interface that will read the contents into my computer. I remember several years ago that one of the electronic project magazines published a article describing how to construct a device that would allow you to save cartridge contents to a tape. If anyone has that issue or has the pinouts of a cartridge please send mail. Thanks in advance!

— from Patrick Fleming, wiz@apple.com, via Internet

ATARI x00: STRANGE ERROR MESSAGE

➡ On the old Atari 400/800 computers (c. 1980), if you had the BASIC cartridge plugged in, it generated error messages like "ERROR 12 AT LINE 1320". You then had to look up the error number in the manual to find out exactly what the error was. The first entry in the lookup table was "ERROR 0: Power not on." Since it hardly seems possible that you're going to be seeing any error messages at all if the power isn't on, I've always wondered whether this was a joke or whether it could conceivably have referred to something else, like a peripheral device.

— from David P. Mikkelson, via Internet

BASIS 108: QUERY

➡ Does anyone know of or have experience with a Basis 108? It is/was an Apple II compatible (6502?) with a Z80 (CP/M) as a second CPU. I think it was made in Germany.

— from Peter F. Bastien, via Internet

BUGS 'N' LOOPS (GAME) QUEST

➡ c. 1973-1976, my co-workers and I used to amuse ourselves at lunchtime with a game that ran on our IBM/360/370. The game was called "Bugs 'n' Loops," and it was based on the concept of a Turing machine emulation. When your turn came, you had to code the next instruction in the program; one which would execute without forcing the pointer off the end of the tape (a "bug"), or one which would force the instructions to reiterate indefinitely (a, well, you know ...). You were given something like 45 seconds to figure out what your next instruction would be, and if you overran your allotment, you lost however many subsequent turns were necessary to make up the deficit. It remains one of the most intellectually stimulating and challenging games I have ever played on a computer. Oh, yeah, it was written in APL.

Does anyone else have recollection of or experience with this game? More to the point, does anyone have a copy of the source that can be made available, either in the original APL (I'll refresh myself) or, even better, in some more contemporary, IBM-PC compatible language?

Eagerly and gratefully awaiting your replies.

— from Steve Gross, via Internet

BURROUGHS 205: THEN WHAT DID THE PENGUIN USE?

➡ Was the (Bat)Computer used by Batman & Robin on the TV series ('60s) a real Burroughs Datatron 205 computer?

— from Marcelo Savio, via Internet

CANON CX-1: CALLED "OBSCURE" BY NEW OWNER

➡ I have been assaulted with a CANON CX-1. So far I have only read one of the manuals. And I wonder if the OS called MCX is related with CP/M or is it some other obscure beast. Any info is appreciated.

— from Lennart Sandberg, via Internet

CDC CYBER 180: POWER RATING WANTED

➡ I once had to use a CDC Cyber 180 machine for a few months (180/640 or some such detail). It had a UNIX emulation (VX/VE), and the oversize(?) NOS/VE native operating system — SCL programming was fun in a macabre sort of way because it was, IMHO, so disgustingly complex....

It was a regular monster, but I never did learn very much about just what kind of machine it was.... I don't really miss it, except for a certain nostalgia that any such beast would surely bring about.

So here are my questions: Would some one out there know just how "powerful" these machines were? How fast? How would they compare with mainframes from their time periods, or minis like the VAX series? And how would they rank against the 32 bit RISCs?

— from Shyamal Prasad, Department of Computer Science, Southern Methodist University, via Internet

CIMLINC: DEPENDS ON YOUR DEFINITION OF "OLD...."

➡ I've come into possession of an old Cimlinc PowerCim 68020 workstation. It has a 19" Hitachi color monitor, 8Mb of RAM, and an external chassis with 70Mb disk and a 60Mb tape. It's built on (gag) a Multibus chassis.

The problem, as usual, is that no one will admit to having a manual for it. Cimlinc is still happily in business, but hasn't made hardware in 6 years, and the guy I talked to couldn't locate anything. Xerox, on the other hand, wouldn't admit to knowing anything about it at all.

A friend's dad is a regional muck with Xerox, and rescued it from a warehouse in Atlanta somewhere, but apparently, while I *did* get a boot tape, there were no docs around for it (so I don't know how to *use* the boot tape).

I refuse to let a workstation with 24bit graphics and a 19" tube go to waste... if I can get docs on the video card, I'll port X11 to it (it runs 4.3 BSD, so it shouldn't be *that* hard....) Help??!!

— from Jay Ashworth, via Internet

CROMEMCO S3: EXPERIENCE SOUGHT

➡ I live in the Washington D.C. metropolitan area (Charles County, Maryland to be exact), and I am looking for someone with Cromemco System Three experience and a kind heart (that means I can't pay :-)) to help revive this part of computer history.

The S3 has two of the original Persci 8" drives which use voice coils and I understand were a bear to keep working. I would be willing to reimburse gas cost and price of a decent meal to someone who can help me fire it up. After turning the key, the drives spin up (yes, with a boot disk in A), but I never get anything on the screen. I plan to keep it regardless, so buyers need not approach me (both of you! ;-)). Anyone who can help, please respond via private e-mail. Thanks!

— from Allan Hamill, p00722@psilink.com

DATA GENERAL MP/20: WHAT ARE YOU ASKING ME?

➡ I recently added a Data General MP/20 to my computer collection. The system has a cartridge drive, 5.25" floppy drive, and a 5.25" form factor hard drive. Unfortunately, I know very little (nothing might be more accurate) about the machine, and the point in the boot process at which I'm stumped isn't addressed in the docs I have. When I boot the system and type "26h" at the bang prompt to (attempt to) get it to boot from the hard drive, it responds:

SPECIFY EACH DISK IN THE LDU

DISK UNIT NAME?

I can't find this in the docs, and have no idea what to type. Typing anything here gives me the following:

DON'T UNDERSTAND '{whatever}'.
AVAILABLE TYPES ARE:

DKB, DPD, DPE, DPF, DPG, DPH, DPI, DPJ, DPK, DPL, DPM, and DPN

DISK UNIT NAME?

I'm also looking for a set of the customer diagnostic floppies and an AOS boot set, if anyone happens to have these and could loan me a set. If anyone from DG reads this, I'd be happy to buy a set (if they're still available) — please send me a phone number to call!

As always, Thanks!

— from Bill von Hagen, via Internet

DATA GENERAL NOVA DISK CONTROLLER: SPECS, OR MORE, WANTED

➡ As part of the historic machines project (to create simulators for machines of historic interest), I am looking for a specification, users manual, or even an O/S driver for the NOVA moving head disk controller (mnemonic DKP under RDOS, device 033 or 073). This controller handled a variety of drives, including the Diablo 33 and 44, the Century 111 and 114, and DG's first floppy disk drive.

(If I could only find MIMIC (the mini simulator system that ran on DEC-10's), I'd have sources not only for the 8, 11, and Nova, but DEC's whole 18b line as well.)

Please reply by e-mail.... Thanks.

— from Bob Supnik, supnik@human.enet.dec.com

DEC SBC-11: SLIGHTLY PUZZLING

➡ Stashed under my desk I have an SBC-11, which also seems to have been known as a "Falcon" (whether by DEC or others, I'm not sure). According to the manual, its single-chip processor is called a micro-T11.

Apparently this chip contains a "configuration register" which is loaded during power up and controls various operating modes of the processor. The manual briefly mentions that in the SBC-11 the chip is set to operate in "user mode" with "addressing restricted to 16 bits". This suggests that the chip is capable of operating in other modes or with more address bits, but the manual gives no explanation. There only seem to be 16 address lines coming out of the chip.

Does anyone out there know more about this chip and what it is capable of? Thanks for any info,

— from Greg Ewing, via Internet

DECWAR (GAME): IN SEARCH OF

➡ I am looking for the source to a game, which ran on a DEC-10, called DECWAR. It is a multiplayer Trek-type game developed at the University of Texas, in FORTRAN. If you have played Megawar on CompuServe, that is it, but rewritten with slightly more functionality.

All my leads have turned up negative. I heard that one of the implementors was in Minnesota, but I have not been able to reach him [since] he is not on [the] net.... Anyone with any information, please contact me at hsnewman@wixer.bga.com, or 512-322-3841.

Thanks!

— from Harris Newman, via Internet

DYNASTY SmartALEC: BOY, THAT Z-80 SURE GOT AROUND....

➡ I'm trying to locate former users of an old Z-80A PC, the Dynasty SmartALEC, that was manufactured by Dynasty Computer Corp. in Dallas, TX, during the '80s. Thanks.

— from "TORAIDHE@DELPHI.COM"

GNAT: ALL WE GOT

➡ I've heard of a GNAT. The floppy format is compatible with some other systems of the same era (Intertec Superbrain comes to mind) but the boot disks are not the same. I don't have any disks for it, unfortunately.

— from Terry Kennedy, via Internet

[Further note: We are trying to track down Thomas Lafleur, a co-founder of the GNAT Corporation, in hopes that he might have some tech ref. — Editors]

HP 9000/3xx: NICE SAVE AT THE LAST MINUTE

➡ A co-worker has come to me looking for advice on the identity and usefulness of an HP 9000 300 system which a friend of his caught before it hit the dumpster at the local nuclear plant. It is apparently a series 300 with a 68010 processor and 2.5MB of memory. (1mb on the system board, 1mb on an expansion board, and .5mb on another expansion.) It is also equipped with a HP98546A Display Compatibility Interface and a 35731A monitor, a keyboard, and a 9122D dual floppy drive. On the keyboard is a BASIC template. There is, unfortunately, no hard disk, software, or manuals.

1) What is it? I assume it predates a 330 which is the oldest 9000 I had seen.

2) What does/did it run? Will this thing run some version of HP-UX?

3) What more would be needed should one be inclined to turn it into a system? Software obviously, but any additional hardware?

— from John Ruschmeyer, via Internet

HP 9810: HELP AND DOCS WANTED

➡ I have an HP 9810A calculator (1971 vintage, about the size of a large VCR....) which almost works, but not quite. I get the display to light up and it sort-of responds to keypresses, but every numeral you type produces a '0' digit on the display. Typing 3 digits for example produces '000' on the display. Does anyone know anything about this beast? Does anyone have any schematics for it? Anyone know any tricky things about it (assuming I get it to work again)? The pinout of the peripheral bus (it has 3 peripheral slots, as well as 3 cartridge slots)? It came with 3 cartridges : Mathematics, Peripheral II, and Printer Alpha. Anyone have any manuals that I might be able to copy? Anyone even heard of it?

Thanks in advance....

— from Brian Murray, via Internet

HOME COMPUTERS: HOW HEAVY WAS IT?

➡ For reasons better left unexplained, I'd like to hear about the heaviest PCs or peripherals that you have run across (or been run across by?). I'm looking for things that could conceivably have wound up in someone's home which is the only reason for the PC qualifier ("Aye, lad. I worked on the Univac Model 0 with the Strategic Air Command. Thirty tons of lead shielding she had, and ran on dilithium crystals..."). "It was so heavy that..." would be great. Come to think of it, "It ran so hot that..." would be fun too.

— from Eric Valentine, via Internet

IBM 029: I'M SURE WE ALL REMEMBER....

➧ I have just acquired an 029 Keypunch in working condition to use in my History of Computing course in January; does anyone know of sources of other EAM equipment (such as a sorter)?

Tim Bergin
Department of Computer Science and Information Systems
The American University
4400 Massachusetts Ave, NW
Washington, DC 20016-8116
202 885-3863

IBM 610 "AUTOPOINT": FOLKLORE OR DOCS WANTED

➧ Can anyone tell us about the IBM 610? I remember wiring the 602 and 603, but this does not ring a bell. (I saw it discussed in Computing Review 9008-0469). Anyone have anything written on the 610?

— from Laurence I. Press, via Internet

IBM 709, 7090, 7094: DINOSAUR HUNTING

➧ Are there any restored/living 709X boxes on Earth, and, if not, could one be built?

— from M. Edward Borasky, via Internet

➧ I have a 7094-I and a 709, both complete with peripherals, spares, documentation and software and in pretty good shape. Neither has been powered up since I deinstalled them about 7 years ago.

There is a rumor of an intact 704 in a closet at Argonne.

IBM has at least one of almost every machine they ever made in a warehouse somewhere in New York state. My understanding is that they are not in general complete and probably could not be brought up.

Does anyone know if BMEWS and/or the DEW line is still up and still run by 7090's?

Any more out there?

— from Paul Pierce, via Internet

IBM PROGRAMMER APTITUDE TEST: DREAM OR NIGHTMARE?

➧ Reading an old (1971) journal article, I saw a reference to the IBM Programmer Aptitude Test. The reference in the article was:

McNamara, W. J., & Hughes, J. L.
Manual for the revised programmer aptitude test.
White Plains, New York: IBM, 1969.

From the (brief) description in the article, the test apparently has 3 parts: completion of number sequences, geometric paired comparisons, and word problems similar to those in junior high school mathematics.

My questions are: Has anyone out there actually taken this test? How would I go about getting a copy?

Thanks in advance.

— from Paul Palmer, Department of Mathematics, Oregon State University, via Internet

INTEL 8008: HLL's WANTED

➧ There were high level languages for this ingenious construction: PL/M-08, and SCELBAL, a very BASIC-like language. I'm looking for these two languages for my homebrew 8008-system. Is there anybody out there, who has one of these languages?

You can write a cross-assembler, which translates a 8008 assembler source to 80x86-code, so that you can run your old programs in the year 2007 on an Intel Nonium. I did this for the 80486.

— from Klemens Krause, University of Stuttgart, via Internet

[Editor's note: !!!!!]

INTEL MDS: INFORMATION NEEDED

➧ I'm working on a project on the history of microcomputer development systems, and need information on Intel development systems for 8086, 80186, and 80286 systems. In particular, I am interested in locating any Intel MDS systems or MDS system documentation for these chips or even just information about them. I believe that the systems I am interested in are follow-on products to the Intellec 8/80 system.

Note: I am not looking for information about the chips themselves.

— from Jeremy Brest, via Internet

LEEDATA MINI: HELP WANTED WITH BAD DISK

➧ I own a LeeData System 2000 mini computer [with] a problem. I think it has a bad sector on the HD. Every time it boots it asks me if it should repair the filesystem because it wasn't shut down properly. Then it starts repairing but....gives "READ ERROR SECTOR xx" (I can't remember the number)

Also some important parts of the system have disappeared : the /usr directory is empty, mkdir isn't there and so on.. Can someone help me with this ? Most important I think is to mark the bad sector but how can I do it?

System specs : it has a 80Mb HD, 5,25" DD, +/- 12 serial ports, parallel port, Tape-streamer. It is running a XENIX version and the machine is dated about Sept '85. I can get an old backup but I haven't got ANY manuals.

— from Wim van der Brink, via Internet

MOTOROLA VME/10: ANY ADVICE?

➧ Anyone out there familiar with the Motorola VME/10 computers? I just managed to acquire a working one not too long ago. It runs something called VERSADos—a very strange operating system indeed.... Comments/advice welcome.

— from Kevin Fisher, via Internet

NIXDORF PC-05: DOCS NEEDED

➧ I recently picked up a Nixdorf PC-05, a hand-held computer with a rubber-key keyboard and a graphics LCD screen that is capable of displaying 8 lines of text. It features an 80C88, 128KB RAM and, according to the startup message, it is programmed in FORTH. Since it does not have any mass-storage, files are kept in RAM and programs are added by inserting EPROMs into slots in the bottom of the case. You can fold the display onto the keyboard (just like a notebook). The only modules that were included in my PC-05 were for a demo to calculate some insurance fee. I would like to write some software but, alas, I do not have any documentation! Although this thing was marketed by my company, there seems to be nobody (who reads news) who does remember the PC-05. Furthermore I think that we only re-painted the case (grey was the "color" to go) of another company's product.

Does anyone remember such a beast? Any documentation I might be able to get? Any hints would be appreciated.

— from Josef Moellers, via Internet

PHILIPS P8xx: MATERIAL WANTED

➧ Looking through the latest ENGINE....I was reminded of an omission in almost all lists of computers, that of Philips.

In the early 70's, Philips made a series of computers — the P800 series. The P850 was a small, 16 bit (to the programmer — 8 bit in hardware) machine with 1 or 2K words of core (there were 2 cabinet sizes, 3U or 6U rack), I/O slots, and a processor built from MSI TTL. All ran off a large linear power supply at the back. The instruction set was weird, sort of RISC-like (although most instructions needed several processor cycles to complete), and was something like 5-bit opcode, 4 bit register, 2 bit addressing mode, 4 bit register, 1-bit load/store flag or 5-bit opcode, 3-bit register, 8 bit operand.

The registers were split into 2 banks of 8, called A0-A7 and B0-B7, and the second format of instruction could only use the A registers. Register A0 was the program counter I think. I/O instructions could set processor flags directly depending on the I/O result, so it was quite common to have an OT (out) instruction followed by a RB (relative backwards) branch to keep on trying until the I/O succeeded. The Most significant bit of the word was called bit 0.

The P855 was a larger machine, with up to 32K words of core and....extra instructions. For example, the P850 could only do 1-bit shifts, but the P855 could do multi-bit shifts in 1 instruction. The operand field of the instruction was always 1 on a P850, but could be set to other values on the P855 I think.

The P851 was basically an LSI-chipped (2 custom chips, PLANET and SPALU. SPALU was a 4-bit cascadable data-path chip, PLANET was the control sequencer/ROM) P850 with some of the P855 upgrades. The system was now built on 6U Eurocards, and the memory was semiconductor RAM. There was a battery-backup option for this. There were also P852, P857 and possibly some others, but I have no documentation on these.

Does anyone else remember these machines, and have any nice tricks for them?

— from Tony Duell, University of Bristol (UK), via Internet

PIED PIPER: NEEDS TO KNOW WHERE IT'S AT

➡ I have a Pied Piper Z80-based computer. Does anyone know anything about it, or have a bootable disk for it?

— from Magnus Y. Alvestad via Internet

RADIO SHACK TRS-80: ANALYSIS PAD?

➡ I am looking for any old TRS-80 people that recall a product called 'Analysis Pad'. I need to know when it was released, and who wrote it, and what company produced it.

— from Taylor Hutt, via Internet

RICE UNIVERSITY COMPUTER: WANTED, USERS OF

➡ I'm looking for former users of the Rice Institute Computer, also known as the Rice University Computer, or, more simply, the R1.... If there are any R1 hackers out there reading this, please drop me a line. I'd like to interview you for the project I'm doing. Also, does anyone know what happened to J.K. Iliffe after about 1972?

— from Adam Justin Thornton, adam@rice.edu or +1 713 630-8884, via Internet

SAGE: MULTI-MEDIA PROJECT

➡ Is anyone out there sitting on any information, pictures, or film of the old Air Force SAGE (Semi-Automatic Ground Environment) system ? It ran from around 1957 to 1984 and handled the air defense for all of North America. I am doing a multi-media project on it. I called NORAD and even they are looking for stuff on the system. Any help would be great, even folklore. Thanks.

— from Alan Spurgeon, CTIS Project, via Internet

STRIDE 460: IN NEED OF ATTENTION

➡ Recently, at an auction....I picked up a Stride 460 (10MHz 68K, 1M memory, 80M disk (having recently been a DEC person I took one look and screamed 'RD53! Argh!' but that's another story...)) Anyway, the machine currently has BOS installed.... For very obvious reasons, I don't want this.

So, are there any alternatives? A UNIX-derivative would be a bit much to ask I think, given the hardware. I'm pretty sure that the UCSD p-system was available on these machines (I have space for 4M if 1 is not enough) and my preference is to get the system running rather than cannibalise it... I have both cartridge tape and floppy drive, and I can probably master a tape on another system if you give me enough details.

Also, any documentation on the machine — operating manuals, hardware manuals etc would be great. I have no problems paying postage, or making you a reasonable....offer for the stuff.... Thanks for any help/ideas.

— from Michael Smith, via Internet

TANDY 6000HD: DOCS WANTED

➡ I've recently been given a dead Tandy 6000HD XENIX computer with all the XENIX reference manuals and system disks, but without a hardware reference manual. These manuals are the 'puffy' woodgrain-looking books circa TRS-80 Model IV. Around this time, Tandy was putting out pretty useful hardware reference guides, so I assume one is available for this 6000HD. Does anyone have one that they'd be willing to sell/give/trade to me? I'd really like to get this computer working. Currently it displays just a raster scan, and doesn't spin either the 8" floppy or the 15mb HD, so I'm assuming it's gonna take a lot of work to resurrect again... Thanks bunches for any assistance.

— from Xyanthilous Harrierstick, Student Computing Facility, New Mexico State University at Las Cruces, via Internet

TEKTRONIX 8550: DETAILS WANTED

➡ Does anyone know anything about the Tektronix 8550 microprocessor development system? One was being thrown out here....so I rescued it, and would like to know a bit more about it. So far, I've found out that it consists of 2 modules, the 8501 Data Management Unit, and the 8301 (Can't remember, but emulator would be a good name for it). The 8501 contains a DEC LSI11/2 CPU card, a floppy controller (Z80-based), some RAM, and a couple of I/O cards. That box looks complete and untouched. The 8301 contains a system controller based round the 2650A, some more RAM, a 'language processor' (A Z80 I think), the RTPA (A logic analyser/bus grabber), and slots for a PROM programmer, and emulation processors. Unfortunately I don't have any emulation processor cards, and am wondering if they have been removed, or whether the above configuration would be useful without them.

I have user manuals for some of it, but no service data.

— from Tony Duell, University of Bristol (UK), via Internet

UNIVAC M642B: HISTORICAL BACKGROUND SOUGHT

➡ Does anyone have any information or historical background on the UNIVAC M642B? It was used as a communications processor until recently in the NASA ground network (satellite tracking stations). The computer uses discrete transistor logic and core memory. I think it also had a small amount of plated wire memory. The I/O devices were a bank of 7-track mechanical tape handlers that were later upgraded to pneumatic operation. Two CPU/memory units were connected to an EMU (expanded memory unit?) in a typical configuration. It used 6 bit field code instead of ASCII or EBCDIC. I was told that it had been used as a U.S. Navy fire control computer in a previous incarnation. It had a "Battle Short" switch on the front panel and a really loud fault horn that was turned on whenever the system crashed. The instruction set and architecture were really weird. Software was developed in a language called SYCOL.

The SCE (Spacecraft Command Encoder), another old NASA system, used the Honeywell 316.... There are still a few of these that are in use. Wasn't this computer used as a node in the original ARPANet?

— from John A. Limpert, via Internet

VOLKER-CRAIG: FOLKLORE WANTED

➡ How many of you remember using Volker-Craig terminals at some point in your hackish careers? Did you love 'em, hate 'em, tolerate 'em; were they good for their day? And whatever became of the company that makes 'em? I know little more than that, at one point, Volker-Craig *was* a small outfit created by two guys named Volker and Craig, in a rented office near the University of Waterloo in Ontario, Canada.

— from "Royal Nuisance," via Internet

WHITECHAPEL WORKSTATIONS: FORGOTTEN BUT NOT GONE

➡ At home I run a couple of Whitechapel Workstations (WCW) MG-1s. They are NS32016-based graphics boxes running 4.2BSD. Until recently, I thought that the MG-1 (and its colour version, the CG-1) were the only models that WCW ever made — they went bust in 1988, just like 80% of all 1980s workstation startups. However, I was recently told that they also made a couple of other machines: the MG-2 (also NSC32k based?) and the HITECH-10 (MIPS R2000 based?) which seemingly ran UMIPS.

Can anyone give me *any* information on either of these machines? Has anyone ever seen either of them? Is anyone still using either of them? Does anyone know where I can lay my hands on an example of either? Thanks.

— from Iain A. F. Fleming, via Internet

ZILOG TAPE DRIVE: GETTING IT ROLLING AGAIN

➡ I acquired a 1980-ish Zilog ZEUS 2000 system 80.... Everything worked fine until I attempted a backup using the tape drive, whereupon the rubber bit that turns the gear thing on the cartridge tape fell apart; old age, I guess, and less than ideal storage conditions.

I took the tape drive out and attempted to make a replacement rubber part. Unfortunately I don't know how big the roller was to start with. So, a few questions:

1) On the tape is a bundle of numbers and names. Can someone tell me if the company that made the drive is still going and would be willing/able to show me how to fix the thing? (The roller appeared to be an integral part of the motor shaft, although I could be mistaken, but it seems silly to have to replace the whole motor just to fix the rubber roller on it.)

On the motor:

DATA ELECTRONICS INC
301386 24VDC
8133 12207

On the ribbon cable connecting the drive to its controller board:

59-0117-00
REV-A

On a plate on the chassis:
DATA ELECTRONICS INC,
sn 34-12813
pn 301091 rev S
mn 3447-44ABDEF-S2

Somewhere (I didn't note down where exactly—probably the read/record head):
American Magnetics Corporation
Carson, California
serial no 4241
part no 301178

2) Would somebody that knows about tape drives please give an outline of how they operate? Would I assume that the motor is driven at some well defined speed and that if the roller is the wrong diameter, or is "too" eccentric, that the data written will be useless? Is there some kind of read after write check? I only noticed the one head and not that many connections, so this seems unlikely.

Basically, if I want to get the drive functional again, what are the important things to get right about a replacement roller? I attempted to turn one out of a rubber washer, but the lathe didn't like it, and I can't file very accurately.... Bear in mind that this is just for fun and I that I'm a poor research student (whose subject has nothing to do with fixing up old computers, and whose colleagues in the department think the only use for the machine would be to replace the heating.)

thanks,

— from Jonathan H. N. Chin, via Internet

NEXT ISSUE

Interviews. Macintosh, the Computer for Lots of Us. Turing's Contradiction. Letters. Queries. And more and more and more....

PUBLICATIONS RECEIVED

Hewlett-Packard Journal, Volume 35 Number 8, August 1984 (photocopy). Complete details of the HP 150 Touchscreen Personal Computer [see ACQUISITIONS]. From Karen Lewis.

Historically Brewed, newsletter of the Historical Computer Society.

Issue #1, Aug/Sept 1993. History of the GUI; Influence of *Star Trek* on personal computers; A look at PARC; Altair and Cromemco; Review of *Stan Veit's History.* 12 pp.

Issue #2, Oct/Nov 1993. Apple Lisa; VIC-20; COLOSSUS; War stories; Coleco ADAM; Review of Steven Levy's *Hackers.* 16 pp.

Issue #3, Dec 1993/Jan 1994. Apple II's beginnings; Art of Computer Collecting; Computer Generation; Review of Dr. Thomas F. Haddock's *Collector's Guide to Personal Computers and Pocket Calculators.* 16 pp.

US$15.00 per year. From David Greelish.

Miracles in Trust, newsletter of the Perham Foundation. Volume 5 Number 1, first quarter 1993. The first Silicon Valley garage; Background of the Perham Foundation; Chronology of West Coast Wireless, part 2. 8 pp.; available for US$20.00 annual membership. From Dr. Seymour Stein.

The Computer Museum News, Computer Museum, Boston. Autumn 1993. Global Networking Exhibit; 1994 Computer Bowl; Interactive exhibits; Events calendar. 8 pp.; available with US$25.00-50.00 annual membership. Also: *The Computer Museum Annual Report 1993.* Summary of the Computer Clubhouse and other outreach and educational work. From Brian Wallace.

"University Courses," Martin Campbell-Kelly, Department of Computer Science, University of Warwick, presented at the ACM/SIGPLAN Forum on the History of Computing, April 20, 1993. Discussion and guidelines for teaching the history of computing at the university level. From the author.

The Z-Letter, newsletter of the CP/M and Z-System community.

Number 27, September/October 1993. Xerox micros; Script programming; Radio Shack Model 100; correspondence and technical discussion. 20 pp.

Number 28, November/December 1993. ReformaTTer 8" diskette system; Bondwell luggables; correspondence and technical discussion. 20 pp.

US$18 for 12 issues (2 years) From David A. J. McGlone.

ADDRESSES OF CORRESPONDING ORGANIZATIONS

The Computer Museum, 300 Congress Street, Boston MA 02210. Brian C. Wallace, curator of historical computing.

Historical Computer Society, 10928 Ted Williams Place, El Paso TX 79934. CompuServe 100116,217. David A. Greelish, director and editor.

The Perham Foundation, 101 First Street #394, Los Altos CA 94022. Donald F. Koijane, president; Mike Adams, editor-in-chief.

The Z-Letter, Lambda Software Publishing, 149 West Hilliard Lane, Eugene OR 97404. David A. J. McGlone, editor and publisher.

THANKS TO....

Al Kossow for the Mac XL.

Allen Baum for FTP space.

Hal Layer for the great tour of his collection!

Ilya Galitzen-Weiss for wizardly Apple hacking.

JAN Lee for the list of 701 sites.

Karen Lewis for the HP Journal photocopy.

Kevin Frank for proofing.

Lar Press for FTP space.

Larry Tesler, Robert Praetorius and Tom Ellis for donations.

Lauren Weinstein for FTP space and gopher access.

Nancy Mulvany for that quick (?) drive to the Outer Sunset....

Rayanne Waggoner and Win Gayler for agreeing that CHAC needed an Apple One.

SUBSCRIBE!

Okay, we blew it in October. We put the sub coupon on the back of the last page and didn't realize that our subscribers, being conservative in a highly literal sense, wouldn't want to cut up their copies. Guess how many of those we didn't get back? New subscribers just sent in personalized checks or addresses on scraps of paper.

However, the information we ask for on the sub blank is information we need to service your sub properly. Therefore we'll make you a promise. Until further notice (which translates to "until the ENGINE changes format,") the coupon of the on-line edition will be on the last page, separate from the rest of the issue. The coupon of the paper edition will be part of the stiff top sheet, which you're supposed to remove and recycle anyway. Either way, you can use the coupon and your ENGINE will remain inviolate.

GUIDELINES FOR DISTRIBUTION

The ANALYTICAL ENGINE is intellectual shareware. Distribution of *complete, verbatim* copies through online posting, Internet mail or news, fax, postal service or photocopying is encouraged by the Computer History Association of California.

Excerpting or brief quotation for fair use, including review or example, is also permitted, with one exception: Any material copyright to or by a third party and reprinted in the ANALYTICAL ENGINE by permission shall not be used in another periodical or context, unless the permission of the copyright holder is separately secured for the new use.

Alterations, abridgments or hacks of the ANALYTICAL ENGINE which change the intent or meaning of original content; or which contrive to bring income to any person or organization other than the Computer History Association of California; or which contrive to injure the Computer History Association of California, its officers, contributors, volunteers or members; are PROHIBITED. Reproduction of the ANALYTICAL ENGINE without its subscription coupon is abridgment in this sense.

GUIDELINES FOR SUBMISSION

The ANALYTICAL ENGINE solicits manuscripts of 600 to 1500 words on the general topic of the history of computing in, or with significant reference to, the State of California. Articles should focus on one interesting or illuminating episode and should be written for a technically literate general audience. Submissions are welcome from both members and non-members of the CHAC. Issue deadlines are the first of each month prior to publication: June 1 for July, September 1 for October, December 1 for January, and March 1 for April.

Each author may publish a maximum of one signed article per year. This restriction does not apply to letters, queries or interviews. Thank you for cooperating to protect diversity of voices and topics. We regret that we cannot republish previously published material, except in the case of clearly attributed quotations or citations.

Decision of the editors is final but copyright of all published material will remain with the author.

The preferred document file format is Microsoft Word for DOS or Windows, but almost any DOS or Macintosh word processor file will be acceptable. Submit manuscripts on DOS 5.25" or DOS or Mac 3.5" diskettes. Alternatively, please provide an ASCII file attached to Internet mail. Please avoid submitting on paper unless absolutely necessary.

NINES-CARD

This agony column comes to us from USENETter Lance R. Buckley:

When I worked for ADPNS, we had a major power outage (our substation blew up). I was the bozo in charge of the machine room at the time (4 triple-CPU DECsystem-10's, untold PDP-8's and 11's, and a heap of washing-machine disk drives and a zillion other things scattered throughout the building). The power-out happened at the very end of my 12 hour night shift. The next shift in had no one who could bring it all up again. So....I had to wait for the power to come back. When it did, I spent the next 8 hours booting machines (from paper tape and front-panel switches mostly) and getting peripherals back online. By the time all the machines were running reliably, it was time for my shift to start again. I spent most of that time repairing the damage done to the various filesystems by the crash, and re-establishing recalcitrant network links.

No sleep. No breaks. Very little food. No drugs apart from gallons of coffee. I was starting to see little black furry things in my peripheral vision, and odd people were whispering in my ear. By the time I got home, I'd been awake for over 44 hours, and working hard for a solid 36 of those. And I *couldn't* get to sleep. You've got to laugh, ain't ya?

CONTENTS

The ANALYTICAL ENGINE
Volume 1, Number 3, January 1994
ISSN 1071-6351

newsletter of the Computer History Association of California, is published four times a year — in January, April, July and October — at El Cerrito, California.

Subscriptions are available with Association membership at $25 per year individual, $75 per year corporate or institutional, or $15 per year low-income, student or senior. Use the coupon to subscribe, or contact the Association at:

1001 Elm Court, El Cerrito, CA 94530-2602

FAX: 510 528-5138

Internet: cpu@chac.win.net

Kip Crosby, Managing Editor
Jude Thilman, Telecomm Editor