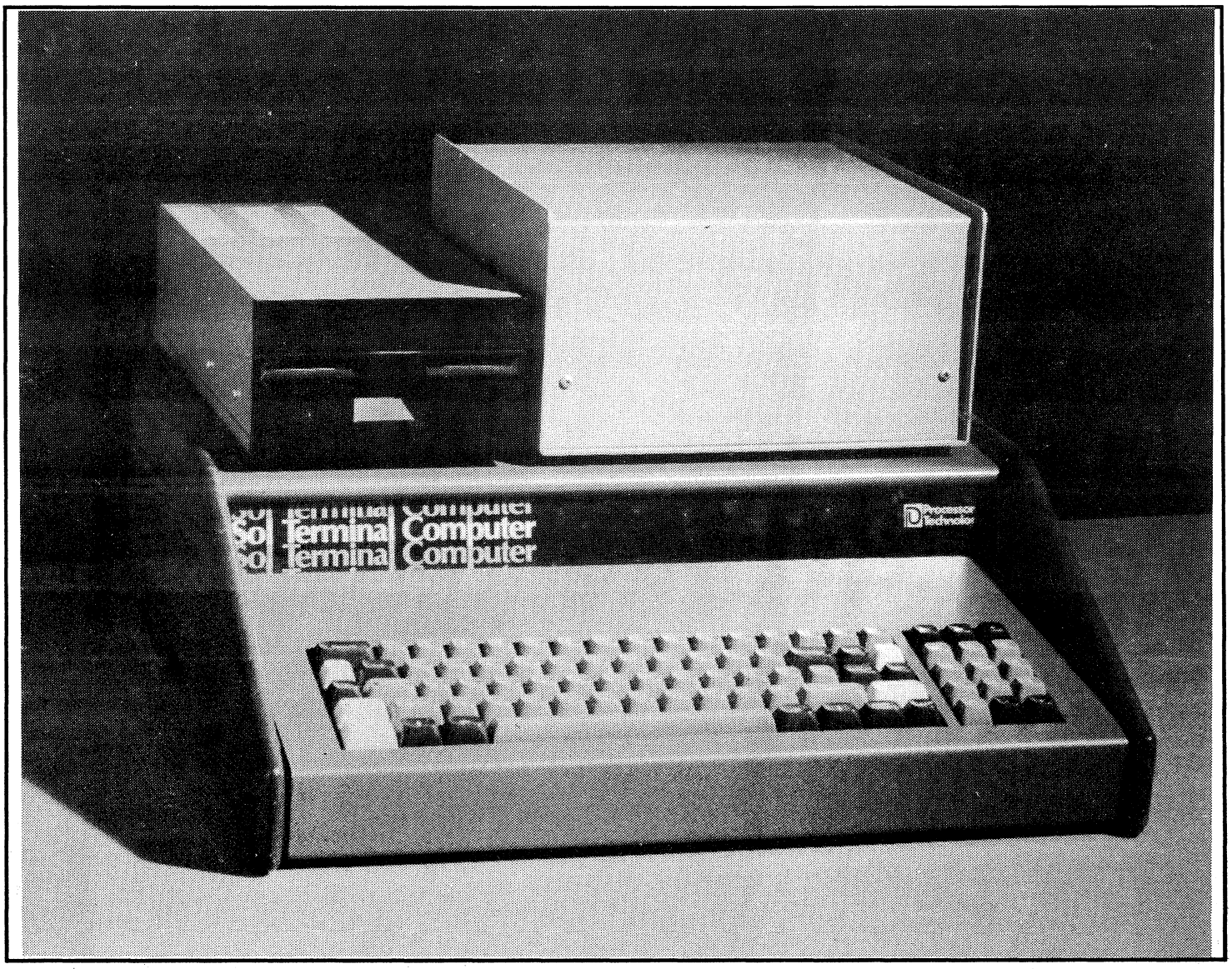
The Analytical Engine

JOURNAL OF THE COMPUTER HISTORY ASSOCIATION OF CALIFORNIA



Processor Technology SOL-20 *Schopplein Studios*

Volume 2.1 July-September 1994

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Editorial: WHAT'S IN IT FOR YOU?

Quite a bit, actually.

Dr. Tom Haddock, author of the fine *Collector's Guide to Personal Computers and Pocket Calculators*, makes a handsome offer to CHAC members: His unique and valuable book will be available from the publisher at a 20% discount. Order directly from:

Books Americana
Box 2326
Florence AL 35630 USA,

mention the Association, and pay only US$11.95 plus $3 shipping for this indispensable reference.

We hope that this will be the first of many such co-operations; as the CHAC grows and makes connections, we look forward to being more generous with our subscribers and benefactors. The process has already begun. Remember when the hard-copy edition of the ENGINE was a stapled sheaf of copier paper? It's become a proper magazine with cover art; before long we'll add illustrations inside. Remember when the electronic ENGINE was a 30K file? The newest issues are six or seven times that size — and growing fast. And your ENGINE sub costs you *less* than it did last July, because this year $25 of your remittance is a tax-deductible donation.

There's so much we could do, in coming months and years, to bring you *more* and *better* computer history. We'll put more resource files, like Doug Jones' widely admired repair instructions for docs, up on our request mailer. We'd like to offer history books and tapes at special subscriber prices. Down the line, we hope to take advantage of technologies like CD-ROM and digital video — to bring the real, perennial liveliness of computer history to whole new generations. And then, in 1999, the Museum....with luck, the most vivid and spectacular showcase that California computing could ever have.

If you're a member of the CHAC, stick with us and these benefits will be yours. If you *haven't* joined yet, joining now will mean more than ever before — to you and to us. The *more* subscribers we have, the *more* we can offer with every subscription.

What's in it for you? Right now, plenty. Before long, even more!

HEY! MATCH THIS!

When you donate to the CHAC — as many of you have — take a few minutes to find out if your employer offers matching grants to charitable organizations. It can make a big difference.

A matching grant is the purest win-win situation imaginable. First, of course, every dollar you give can mean up to two dollars for the CHAC. But it's also true that charitable generosity makes you look good to your employer. *And,* when we receive matching money from companies, we can thank them in the august pages of the ENGINE — which is good publicity for them *and* for us.

Make a matched contribution and you win, your company wins, and the Association wins twice. What could be better?

NEW ADDRESSES Next Issue

CHAC is moving to Palo Alto, CA, in September. We will have new snail-mail and e-mail addresses, which will be published in the October ENGINE. Mail to the El Cerrito addresses will be forwarded.

(Classic. Start in a garage, move to the Valley.)

IN MEMORIAM: GARY KILDALL

Dr. Gary Kildall, programmer of the CP/M operating system and co-founder of Digital Research, Inc., died on Monday, July 11, 1994, in the Community Hospital of the Monterey Peninsula, Monterey, CA, USA. The County coroner's office is investigating his death, and at our press time, foul play had not been ruled out.

Kildall was born on May 19, 1942 in Seattle, WA, where his parents operated the Kildall Nautical School — for which he did his first programming. He received a bachelor's degree in mathematics and an M. S. and Ph. D. in computer science, all from the University of Washington.

In 1972, while a teacher at the U. S. Naval Postgraduate School in Monterey, Kildall purchased an Intel 4004 microprocessor. His experiments with arithmetic routines for it drew him closer to Intel's fledgling programming efforts, and he began contract work for the company, developing code for the Sim-04 singleboard development system. Proceeding to the Intellec 8 Mod 8 [see "Dawn of the Micro," ANALYTICAL ENGINE January 1994,] he developed the first high-level language for microprocessors, PL/M. A port of the IBM mainframe language PL/I, PL/M was eventually offered by Intel for both the 8008 and 8080.

He crucially influenced the history of the microcomputer in 1973-74 when he wrote CP/M as a speculative operating system for a microprocessor-based computer using floppy disks for program and data storage. With his wife, Dorothy McEwen, he founded Digital Research (DRI) to market CP/M in several versions; it remained the dominant micro operating system for almost a decade, until Microsoft Corporation's MS-DOS overtook it in the marketplace. DRI later developed the GEM graphical operating environment, which was used on Motorola-based Atari computers and in several Intel-compatible applications — notably the widely used page composition program Ventura Publisher.

Dr. Kildall continued to teach at the Naval Postgraduate School for several years following the establishment of DRI. More recently he founded other computer-related companies including KnowledgeSet, which produced the first CD-ROM edition of Grolier's Encyclopedia, and Prometheus Light and Sound, a developer of advanced computer telephony. His last project of record was *Computer Connections*, a history of the computer industry, which he published earlier this year in a small edition for family and friends; a larger commercial edition is anticipated.

Gary Kildall will be remembered by the world's computing community as a gifted teacher, a consistent innovator, and a developer who took great personal risks but disdained the aggressive and litigious tactics of his competition. The Computer History Association of California extends condolences to Dr. Kildall's son, Scott, and daughter, Kristin; to his former wife, Dorothy McEwen; to his mother, Emma Kildall, and sister, Patricia Guberlet.

LET'S SEE, THIS PIN IS +5V....

While we were talking to Dr. Tom Haddock (above,) he came up with another idea of considerable merit: a Master Index of integrated circuits, with manufacturers' names, schematics, pinouts, production dates, and any other salient details, all keyed to the legend on the chip cap.

Such an index would be useful to people in many walks of life, and especially for collectors and restorers. Not much is as frustrating as stumbling over a dusty box of IC's stuck into foam, and having no idea what they are. A comprehensive cross-index would also make it much easier to determine equivalency when the original chip simply isn't available. Modern machinery of almost any type — from a computer to a pickup truck — can be forced out of service indefinitely when a scarce or obsolete IC fails.

Such an index would be voluminous, but CD-ROM technology would make it practical. At a time when American business derives new productivity from (for example) comprehensive regional and national databases of telephone numbers, it's clear that computing and computer history could benefit from organizing information on the same scale.

We have to wonder if this task has been begun by the electronics industry itself. Has any attempt ever been made to collect and cross-index the IC catalogs or databases that already exist? If so, details please to the El Cerrito address or cpu@chac.win.net.

FOG EXITS (on little cat feet)

The FOG International Computer Users' Group, one of Northern California's earliest and most ambitious micro support groups, has apparently ceased operations, after months of conflicting reports.

FOG was established in Santa Clara, CA in September 1981, as a clearinghouse of information and support for users of the phenomenal Osborne micros. Original members and directors included Frank Morton, Byron McKay, Bob Kavinoky, Leo Grandi, Jim Schenkel, David Oates, Jack Brown and Gale Rhoades, among others. Practically from its inception to its end, FOG published the FOGHORN, a newsletter which grew to embrace all of CP/M computing, and was one of the most respected and technically astute of all user-group newsletters. FOGLIGHT, a companion publication for the MS-DOS platform, was produced from late 1984 to mid-1991.

FOG survived Osborne's shattering bankruptcy in September 1983. Building on a mailing list provided by micro software developer Sorcim/IUS, the organization grew to 10,000 members by January 1984, and probably to 30,000 — in almost every country of the world — at its peak. "In its heyday, FOG was the world's most comprehensive source of information about micro hardware and software," says Gale Rhoades. "A comparable resource simply no longer exists. It was unique for its insistence on networking, on sharing knowledge of *how* the system worked — not just information on *what* the computer was supposed to do, which is the focus of technical support today."

Like many other West Coast support groups, FOG declined unrelentingly as the CP/M operating system faded from the micro marketplace. Its remarkable accumulation of hardware, software and documentation is scattered throughout Northern California, and we must assume that some of it has been sold. CHAC is cooperating in an effort to salvage any remaining FOG assets. We invite any principal of FOG, particularly someone with significant involvement between 1981 and 1984, to describe this history in greater detail for publication in the ANALYTICAL ENGINE.

MOTOROLA'S MIDWESTERN MUSEUM

Motorola processors have been the speedy, spacious hearts of so many of California's best-known computers — SUNs, Apple Macs, NeXTstations, Atari ST's, and lots of others — that certainly the history of Motorola's electronic development is of interest to our readers. All the better to discover, as we recently did, that Motorola has its own Museum of Electronics.

Founded in 1991, the Museum traces the evolution of Motorola, Inc., and its product lines from its beginnings as a maker of car radios in 1930, through historical exhibits bolstered by audiovisual presentations. It also uses interactive computer displays to highlight Motorola's widespread uses of contemporary electronics technologies. At 20,000 square feet, this facility is tidy but well-appointed, and the pictures we received suggest that a rigorous visit would easily consume a whole day.

This museum has won significant awards in its brief career, including the 1992 Dibner Prize for museum exhibition and presentation from the Society for the History of Technology. It hosts many educational programs in cooperation with Chicago-area school districts and in conjunction with Motorola University, which uses the Museum as a "three-dimensional textbook" for graduate courses in management and business administration.

The Museum is located in Schaumburg, IL, 30 to 40 minutes' drive northwest of O'Hare International Airport and less than an hour's drive from the Chicago Loop. Admission is by appointment, Monday through Friday 9 a. m. to 4:30 p. m. and on some Sunday afternoons. For appointments or information contact:

Conference Planning
Motorola Museum of Electronics
1297 East Algonquin Road
Schaumburg IL 60196-1065
+1 708 576-8620

(And be sure to request their excellent map.)

EXPANSION OF UNUSUAL SYSTEMS

Kevin Stumpf sent us this release:

The Commercial Computing Museum Project is dedicated to the acquisition and preservation of artifacts and memorabilia from the commercial use of electronic digital computers (data processing and office automation). Without a proper and complete account of the practical, if not routine and mundane side of computing, its history would consist solely of a series of terrific and exciting technological leaps....that highlight the machinery instead of also recognizing the importance of the people, processes and procedures that harnessed and actually used the machines.

The Commercial Computing Museum Project replaces and continues the work started by Kevin Stumpf under the name of the Unusual Systems Collection of Computer Control Panels and Consoles.

Eventually the Project will become a "place" where people can go to be educated and entertained as they wander past or participate in displays that will.... exhibit and demonstrate the tools and techniques of data processing and office automation.

The museum will also be a repository of information, especially about Canadian companies, for student and professional historians of computing technology to write splendid histories of this vital aspect of the North American workplace, yet unglamorous aspect of the computing industry.

For more information contact:

Kevin Stumpf
Unusual Systems
220 Samuel Street
Kitchener ON N2H 1R6
+1 519 744-2900
unusual@kstumpf.waterloo-rdp.on.ca

NO JOY ON LISA DEVELOPMENT TOOLS

We've had several — say, three — inquiries recently as to whether Apple plans to release Lisa development tools and source code into the public domain; certainly a question well posed by developers and historians alike. But according to highly placed sources at Apple, the answer is a firm no, at least in the foreseeable future. Oh, well!

SPOTTER ALERT

The publicity boom that began with the New York *Times* and *Forbes ASAP* pieces in April simmers along at a gratifying level. We've been mailing copies of the ENGINE, the FAQ, and other background information to any newspaper, magazine or online service that requests them.

Of course we ask for tearsheets, and we've been in this business too long to assume they're always sent. Therefore, once again: If you spot any mention of CHAC or the ENGINE in any periodical, *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! particularly to spotters who have given us invaluable help with keeping up.

SPOTTER FLASH

Mike Malone's fine (if we do say so) article from the April 17th New York *Times* spread the good word still further as it was republished in syndication. Thanks to Joel Willard and to Quintin Christophe from Chicago, IL, for sending us the clipping from the May 19th Chicago *Tribune*, and to Dr. Dominic Verda of Scottsdale, AZ, for letting us know that it appeared in the Arizona *Republican*.

DESPERATE PLEA FOR MONEY

Even the most casual computer watcher (not you, we know,) has to be amazed at the effect of computing on banking and securities trading. How much of the money in circulation exists only on DASD and display screens? Ninety per cent? Ninety-five? Who says cash is king!

If there's that much money in cyberspace, we wouldn't mind a little more of it in *our* cyberspace. In the last fifteen months the CHAC has earned a reputation; built a network of contacts; collected hardware and software; and, of course, put out five issues of the ANALYTICAL ENGINE. Nobody could give us that. We had to create, collect and earn it all.

The only thing we don't have is money. Isn't it lucky that you *can* give us money?

One $35 sub to the paper ENGINE:

* prints and mails ten more copies of the ENGINE, or
* prints and mails about sixty letters, or
* pays our Internet expense for a week, or
* pays our locker storage for two weeks.

When you subscribe to the ENGINE, your cash doesn't vanish anonymously into some vast river. It's serious money that does serious work — and gets seriously appreciated. Not to mention that *you* get four big, fact-packed, query-laden, trivia-prone issues of the ANALYTICAL ENGINE — *and* a tax deduction.

Think about what thirty-five dollars can do for you. Then think about what it can do for the CHAC. Then subscribe — and make it work for us all. Thank you!

OVERVIEW OF BUREAUCRATIC PROCESSES

Even in the few weeks between the delayed April ENGINE and this one, CHAC made important gains in the real world.

FEDERAL TAX-EXEMPT STATUS

In April's ENGINE we noted Bruce Rice's prediction that the IRS would ask for more information, and they did; but one round of clarification sufficed, and on June 21 the IRS Exempt Organizations department "based on information you supplied.... determined you are exempt from federal income tax.... as an organization described in section 501(c)(3)" of the Internal Revenue Code.

The struggle for corporate and tax-exempt status, which occupied huge blocks of time between September 1993 and June 1994, is now finished. With this pre-eminent hurdle behind us, we can get on with the grass-roots business of building a staff, an organization, and a reputation.

NONPROFIT POSTAL PERMIT

Of the two post offices we approached, one said it was too small to authorize the permit, the other promised to send us the paperwork but never has. Since we're moving to Palo Alto (see first page) we'll try again at a post office down there.

FUNDRAISING, GRANTS RESEARCH AND PROPOSALS

Our fundraising prowess has been greatly enhanced by the Association's newest staff member, Ms. Nancy Wiltsek of San Francisco.

Ms. Wiltsek has been a professional consultant in grants planning, fundraising and charitable contribution for several years, and has published articles on corporate philanthropy for the Applied Research Center and the Nonprofit Management Newsletter. She is a member of the Board of the Center for Electronic Arts, and of the Program Advisory Board of the Institute for Nonprofit Organization Management, University of San Francisco. She received her M. N. A. degree from that institution in 1990.

As fundraising manager for your Association, Nancy will bring significant experience and skill to the launching of our capital campaign and corporate donor campaign — helping to establish a sound fiscal footing for the CHAC while she brings us ever closer to the founding of the Museum.

INTERNSHIP

With our nonprofit status accomplished, we can recruit an intern to help with typing and filing. Since the funding for a stipend hasn't appeared yet, we'll wait (again) to advertise until we've set up shop in the South Bay.

IMPROVED STORAGE

The Association's hardware and software collection, all except the two minis and the library, has been moved to secure storage in Redwood City. It's still a locker, it's still expensive, but for the moment, it works. When we move the minis from San Francisco, we'll need to rent the next larger size....

No doubt there are a few things we haven't thought of. And guess what, we still can't take credit cards.

FLAMING DORADOS AND OTHER STORIES:

Herb Yeary and Charlie Sosinski talk about Computer Support at Xerox PARC

Interview by Kip Crosby and Max Elbaum

[On March 5, 1994, Max and KC stopped by Herb's comfortable place in the Valley to interview these two support specialists who maintained the in-house Xerox Altos and Dorados during the glory days of Xerox PARC's personal computer development. The result is a revealing look at the inner workings of an unparalleled R&D lab — not only at its hardware and software, but at its politics too.]

KC: Herb tells me that you and he were two of the people who did assembly and production work at Xerox PARC.

Charlie Sosinski: I consider we were mostly in service, for the staff and for prototypes — the Dorados, the biggies. Herb and I built the first ten or so Dorados, before they went into a production mode.

KC: What about Altos, Dandelions, some of the others?

CS: We serviced those. Our main function at PARC was to provide service for the software people.

KC: In other words, you were keeping the development machines up and running....

CS: Right, and everybody happy.

KC: I've never met anyone [in field service] who could keep everybody happy.

CS: Herb and I were a good team, we kept a lot of people happy, and got compliments for it. It was a good time in our lives. Isn't that right, Herb? I mean, rarely would they have anything bad to say about us.

Herb Yeary: Just so long as we could keep the hardware going!

KC: So this was basically in-house field service. What period are we talking about? Roughly starting in '72, or earlier than that?

CS: Probably later. I started work at PARC in the middle of '74 as a contractor and I became an employee in early '77. Herb I think started in '76, and we both left in '85. So this was the golden era of the personal computer — or the start of it.

KC: I was going to say, it was certainly the golden era of PARC.

CS: I think PARC then had three separate labs. They had Basic Sciences, and then the systems lab, and we were in the computer lab.

HY: [And] a graphics lab at one point.

CS: Since it was in this great era of personal computer developments, we sort of outshone the other labs. We were sort of....

HY: I think they saw us as having more notoriety.

CS: Other labs didn't like that too much. They were a little envious.

KC: I wonder, ultimately, if Xerox ever knew quite what a tiger they had by the tail, because so far as PARC was concerned — I know there was a lot of organization and re-organization, and there was no small amount of friction between PARC itself and management elsewhere. We can sort of pivot off this book [Alexander and Smith's Fumbling the Future] *because in a lot of ways it resembles an org chart — it'll be great at filling in the names. As for what it actually felt like, we'll trust you gentlemen to fill us in on that.*

Max Elbaum: Xerox PARC was one of the earliest participants in what later became known as the computer revolution. But hindsight is one thing and being at a particular point in time is another. What was it like to be in so close to the beginning of it? What were your motives for starting to work at PARC? When you started to work at Xerox, what did you expect?

HY: I had been working in field service for Scientific Data Systems. I expected this to be similar work, and up to a point it was — maintaining computer systems. But when I got involved in debugging new ones, too — the Dorado — it was a much more exciting place than I had worked before. There was a lot of excitement in the air there and a lot of very gifted people, scientists and others. Just a tremendous amount going on.

KC: Did you come to Xerox from SDS as part of that deal, or was it an independent thing? I don't know whether Xerox inherited any of SDS's employees....

HY: It became XDS when Xerox bought them. But when I came to PARC it was actually a new job, I didn't transfer there or anything like that. And at that point I was working for Honeywell, Xerox had split off to Honeywell.

KC: Xerox had spun XDS off to Honeywell to get rid of the mainframes.... but then you came back to PARC. Okay; Charlie, what about you?

CS: I was a contractor at the time for a small Texas company that made very early computerized telephone systems. PARC bought one of these to experiment with and I was assigned to take care of it there, which I did for about two years. At first I didn't think PARC was a real place. It reminded me of the Disneyland of computers. I just couldn't believe the people and all the perks they had. When my job vaporized for the [communications] company, I went on at PARC because I knew it was a marvelous place. There were some very intelligent people there, plus Xerox funded it very well. So it seemed like a wonderful career move to work for them.

KC: I think it must have been, in its own way. What was PARC hoping to do with the computerized telephone system?

CS: They wanted to combine everything with the terminal — so that while you were typing away at your computer terminal, you could answer the phone through it, dial numbers through it, everything. Sort of an early attempt at multi-media, your whole office installed in your terminal.

KC: So they were building on what they had already created with EtherNet, and trying to go from local area communication to wide area communication between computers?

CS: Yes, I think this was the forerunner of their EtherPhone, which actually let people talk over the EtherNet. It was a D-machine system. I think they competed with Rolm at that time, with what they called CBX, computerized basic exchange units. Since PARC was using the Data General computers at that time, they were very interested in it because it seemed to fit right into their software.

KC: EtherPhone as a separate product is not something I ever heard of. I knew there was some experimentation along that line. Did it ever get beyond....

HY: As far as I know, no, it remained a prototype system.

KC: But it was their hope that they could take the EtherNet protocol and by tying it in to something like a PBX system, go as far with it physically as was necessary.

HY: I don't know the goals myself. But the principals involved were Dan Swinehart, mostly, and Larry Stewart.

CS: It was part of that everything in one computer. You get to do all of your communications by voice or by data.

KC: So that the strategic goals of the system were not unlike what people are trying to do, for example, with the AV-series Macintosh [Quadra] now, 20 years later. Voice, modem, any kind of way you want to interact through the computer, the protocol — if you will — is built in.

Now, you mentioned Data General computers. PARC has to have been backed by a bunch of mainframes. Was PARC using XDS, were they using their own computers?

HY: In the early days when I got there they had a bunch of Data General 800s, I believe in the SSL laboratory. There were racks of these in the lab and terminals going into various offices.

KC: So they had a bunch of Novas or Eclipses connected to a terminal in each office and they were running a network off a minicomputer backbone?

HY: Right.

CS: See, when I first came there I worked for SSL lab as a contractor, but [later] I hired on through the computer science lab, and they had a computer called MAX which was kind of built in the image of — a PDP-10, was it? Which was a time-sharing machine used for developing the Alto.

HY: Well, when I came they had the Altos, and MAX was still in use. I think they built MAX first and probably used it as a time sharing system.

KC: MAX was basically a copy of a PDP-10, and the way I heard it was that PARC built MAX because Xerox wanted them to use either an XDS 940 or a Sigma 7, which was their own product, and PARC didn't want to do it because all the software they wanted to run was for a PDP-10. So they said, "Well, if Xerox out of its own mislaid corporate pride won't buy us a PDP-10, we'll just build one from scratch!"

HY: I believe that's accurate. I wasn't there when it happened, but in fact I've heard that said.

KC: That just speaks to the tremendous reservoir of engineering talent, of screwdriver and soldering talent that these guys must have had, because I can think of very few labs in the early Seventies with the nerve to try to duplicate someone else's existing architecture from the ground up. Especially to the level of software compatibility.

HY: These fellows didn't lack for engineering talent and they were well-rounded men. The printing machine was developed along the same time, and EARS — that was Gary Starkweather...

KC: Gary Starkweather built a thing called the SLOT, which stood for Scanned Laser Output Terminal.

HY: That was the spinning prism — rotating prism.

KC: Rotating prism in what sense?

HY: A laser was aimed at a rotating prism. The prism reflected the light and turned it into a raster scan.

KC: The interesting thing to me was that, through some wizardry I've never understood, they managed to make a laser printer with throughput as high as the copier it had been converted from. I think it was good for one page per second.

HY: That's correct. That was the original design.

CS: When I came in they already had EARS, and that was in '74.

HY: That was the first one I had ever seen and it was already running.... I know that it was developed there and it was that scanning laser thing that made it go. It's the heart of most laser printers today, isn't it?

KC: Pretty much so. Some people have tried to replace the rotating prism with arrays of LED's, but they can't get the same reliability. Now EARS was an acronym, right? It stood for EtherNet, Alto, Raster character generator, and Scanner.

HY: That's right. I remember it used a Diablo 44 disc drive.

KC: What's this about a Diablo disc drive?

CS: We got the privilege to work on the EARS several times when it broke down. We didn't work on the engine so much but we worked on the computerized part.

KC: When it broke, how would it break?

HY: Generally disc drives. They weren't so good, they had head crashes and things like that.

CS: Or the computer got too hot. I think the main problems with the printer was the toner dust. They had to keep it clean.

HY: They had other fellows to do that.

CS: I think Ron Weaver did that, or Gary Swaggert. The engine was kind of unique since it was the only one around. So the [copier] engineers had to do most of the maintenance on the engine itself.

KC: When you say the engine, what do you mean?

HY: Was it a 3100, is that right?

CS: Something like that — 3100 Copier Plus — modified to a printer and they put this laser in it. 60-page-per-minute copier.

KC: They were never small, it's true. And then what they did was build a laser engine and couple that to it — laser head. So the laser that had been built for this machine was unique and when it had to be maintained — where would you get the spare parts for something like that?

HY: They made them there — as far as I know that stuff was all made there. PARC had a huge machine shop downstairs.

KC: When you went to repair or maintain, for example, the laser engine, would you have to go into it, see what was wrong and....

CS: We didn't do that.... other people did that. People who worked for Gary Starkweather were Xerox copier experts who came to PARC and did nothing but that.

HY: I think Dan Putnam was one....

CS: Yeah, who is now the vice-president at Adobe.

KC: People hop around! But you were maintaining computers, and these were the computers that, for example, Smalltalk development was being done on?

HY: That was yet another group of people and we didn't maintain that particular hardware, but it was the same kind of computer.

CS: Several labs had ongoing development — responsibility — for the Altos and Dorados, and the computing machines were the same for each group, after the labs were initially set up. When Alto was developed it spread throughout PARC and a few outside of PARC.

KC: As soon as the Alto was developed, what they tried to do was get one on — or under — pretty much everybody's desk, right? Because they needed to know if EtherNet worked, and that was the best test, was to put an Alto everywhere and hook them all together.

HY: I'm trying to think of how many machines they had there.

CS: I think we had a hundred.

HY: Sounds right. On our net — we were Net 3, and we had the most Altos.

CS: And different areas and parts of the building had other nets of Altos as well, but our main lab was covered by this one net, and this was our domain.

KC: In your estimation, about how many Altos did they have up and running at PARC?

HY: Would you say two hundred?

CS: Yeah, I would say a couple hundred. The Alto 2 was developed, which was much more reliable, and had more memory....

HY: It had more memory because much more dense chips became available.

KC: What was the point of a Dorado? What would a Dorado do that an Alto wouldn't?

HY: It's very fast. It was several times as fast as the Alto.

CS: Since PARC did a lot of graphics stuff they really needed the computing power to do that. And it was least an order of magnitude faster than the Alto, it was a ten-MIP machine.

HY: Well, maybe three to five.

CS: Three to five MIPS, and three thousand watts of power! That's almost 20 years ago.... And that was dumped out on the building, and if you put a watt in the room, you've got to take a watt out. And it costs more to take that watt out.

KC: You bet it does. You notice my office is rarely cold. Back to the Alto and the Dorado, the first implication of what you're saying is that the Alto was good for about half a MIP?

HY: Along that order, maybe.

KC: It's a rather stunning amount of computer power for 1973.

CS: Yes, if the Dorado was an order of magnitude higher, that sounds about right.

KC: So now, I have never seen this anywhere. Of the integrated circuitry in the Alto and the Dorado, what proportion was Xerox in-house development? Were they developing their own processors at that point?

HY: Everything was off the shelf. They were working on other machines later, on the Dragon, where they did do processor development. I never was involved in the Dragon, and we left before that was finished. But people were working on IC designs.

KC: So for example, in the Alto, who built the processors? They weren't Intel processors.

CS: They were ALU chips — a garden variety part.

KC: Fairchild maybe?

HY: It could have been Fairchild, or Signetics maybe....

CS: ALU 181's. And there were two of them in there —

HY: I think, 4-bit chips.

CS: In a 16-bit machine.

KC: So they got a 16 bit word width by stacking four 4-bit chips? They were cascadable?

HY: That's what I remember.

KC: Here again, that was incredible for the time — for 1973.

CS: One of the companies I worked for before PARC was Four Phase Systems, and this fellow there was designing....his goal was the single-chip processor, and we're talking about 1972. He was very well known, I think he came from Fairchild to develop this single-processor chip.

KC: When you talk about a Fairchild or a Signetics 4-bit chip, that would fit for the period, because — take the Intel 4004 as an example, or one from General Instrument whose designation I forget — a lot of people between 1971 and 1973 were investing heavily in 4-bit processors. And a 16-bit word width by comparison was an accepted mainframe standard. Shrunk down into an Alto, that was quite an achievement.

CS: Do you guys [CHAC] have the Alto [in your collection] or not?

KC: I just hope I can find one that somebody will part with!

HY: If you find one outside the lab it's probably a 2. Most of the ones that left PARC were 2's. The 1's weren't as reliable, mostly because of the memory, and almost all of them stayed inside PARC.

CS: Which meant they were the ones we ended up working on! (laughs)

HY: That's what we were there for. When one breaks you take the boards, you get it running again, and you might work on the boards a half a day, however long it takes. And the disc drives, we spent a lot of our time on disc drives and moving stuff. We moved stuff all over the place.

CS: And we had to reconnect the EtherNet every time....

HY: I would guess a third of our time was spent moving computers around.

CS: Fortunately they were on wheels.

KC: But still when you consider you have to reconnect stuff....

HY: Everything, not just the network. It took a couple of hours to move one from one office to the other. And we didn't just move one, maybe a pair or three or four.

CS: They had this neat software that would run every night, called DMT. And we had a dedicated Alto called Peeker, remember? And each machine would be left with a kind of screen saver running, a square that moved around and checked the memory in all these different locations. And if it got an error when it was doing this little test, the Peeker would log it.

HY: It was a memory diagnostic that ran overnight. I'll tell you this. The first Altos had these Intel.... I didn't think it was going to make it. The 4K chips when they came out were really okay, reliable, but the 1K Intel chips — 1130's — weren't.

CS: Every morning we would check, and anyone who had a bad chip, we'd go in. The nice thing about it, so many of these software people didn't know they had a bad or a flaky memory chip, and a lot of times we'd say "We have detected a bad chip in your computer and we'd like to change it." And they'd say "Oh, wonderful!"

HY: They would fail, but luckily the diagnostic would catch it before.... And memory was doubly important because the Alto was the first bitmap-display machine — at least that I'm aware of. It took about half the memory to run the bitmap display.

KC: It wasn't like you'd have memory on the motherboard that was CPU memory, and another bank off somewhere else that was video memory.

CS: It was all one hunk of memory and partitioned, half video — half CPU.

HY: That's right, that was all in the software. The hardware was just a bank of memory.

CS: [Peeker] was a neat system. You could look at all the computers in your lab or even the other labs and tell who had a potential problem.

KC: It sounds like they were actively trying to make these machines easy to maintain. Was there anything else like that?

CS: One nice thing about working there was the attitude that maintenance and service were integral. In a lot of places you work, manufacturing and service don't really get along that well and they don't cooperate. Whereas PARC was a single community that knew what had to be done. They put great reliance on diagnostic procedures, and if you discovered a problem, they'd find the engineer who designed the component and require him to sit down with us until we all understood the problem.

HY: I wouldn't even say it was required, they just did it. If anyone was having difficulty, they were on it right away.

KC: Sounds like heaven, guys. Getting a problem with a computer and being able to sit down with the design engineer right there. You couldn't do better than that.

CS: Absolutely.

HY: Of course not. It was new to me.

CS: It was marvelous. Most of the engineers liked to talk to Herb and me because we never suggested better ways that they could design stuff — or not usually. Often their colleagues would say "Why did you do it this way?" Whereas we just said "Oh, that's great!"

KC: So there was some question of hardware unreliability, but there was a degree of fail-safe. Did you mention you also had a de-bugging computer?

CS: They were named Smaug and Bilbo. From the trilogy by Tolkien. Smaug was the dragon and Bilbo was the Hobbit. I'm pretty sure Mike Overton built those, so he might have named them.

HY: I wasn't there at the very beginning of the Altos. I came along after the Altos were pretty much deployed but they needed somebody to help maintain them.

KC: So this debugging computer for the network, how would it work, what would it let you do?

HY: It was a normal [Alto,] but it was mounted in an open rack so we could get to it — we had it accessible, and we had a scope on it. Open frame. We took the chassis out and put it in a rack and it was there about 4 feet off the ground.

CS: Since we had a spare set of boards of two in there, if someone had a problem we could just swap their board out.

KC: So that you had a couple of spares of pretty much everything.

HY: Oh, sure, they were very generous with us in giving us spares. We always had plenty of spares.

KC: It's deadly. You talk about off the shelf parts. Those strange portrait mode black and white display tubes.... were they off the shelf?

CS: Ball Brothers Incorporated. I think they were built especially for PARC. Maybe they weren't.

HY: You're right. Maybe they had the monitors made and we just bought the tubes. PARC designed the frame for the thing.

CS: But I think the parts that went in it were standard Ball Brothers monitors.

KC: So there was nothing special about the pieces, it was the way all the pieces fit together?

CS: Absolutely, yes.

HY: Didn't Sun do a similar....

KC: They sure did. Now where was the manufacturing done, the board-level manufacturing?

HY: They did it somewhere else.

CS: Was it Twin Industries that built some of those early boards? Herb and I were there mostly when they were manufacturing Dora-

dos. We had our board built by either Twin or.... initially they were called the Stitchwell boards. The first couple of Dorados were Stitchwell. Then they hired a person and she sat there with a Stitchwell machine and made boards.

KC: Just before we leave the Alto, one question largely from personal curiosity: What were the differences between the Alto 1 and the Alto 2?

HY: Repackaging mostly. And I think some minor design changes.

CS: Actually they had to take larger memory chips. The Alto 1's could only have 64K memory in them and the Alto 2 went up to 256K. They were using the 4K chips....

HY: They came out with 4K chips, the Alto 2, and then went to 16[K].

CS: Some of them went to 16. Those 1130's were not reliable chips and the Alto 2 never used those. So it made the Alto 2 more reliable right off the bat.

KC: But the Alto 2 was the customer machine, the machine that was sold.

CS: Right. The White House bought some.

KC: As a matter of fact, one of the ones I just missed was one that had been installed at the House of Representatives. One of those did not happen to fall into my hands, too bad.

CS: One of the things about the Alto that made it easier to work on was that if the disc was dead — in most computers — you could never boot, but this had this magic switch, in that you hit a certain key and you booted off the network. Even with a dead disc you could still do some diagnostics. If you had a dead part in the memory and it was right in the boot area, you could flip this switch on the front and it would swap the memory around so you could boot using the other part of it.

KC: Oh, make bank two into bank one....

When we get past the Alto 2 we're up to the Dorado, and one thing I don't know is, were any Dorados ever sold?

HY: At least a couple.

CS: The Dorado was a very complicated machine and they thought it would take design engineers to maintain them. But Herb and I proved them wrong, that we could maintain them, so they re-thought that.

KC: Was it about the same size computer?

HY: The size of a large oven.

CS: The first ones we tried to put in offices were about the size of that stereo cabinet. It was so noisy. It had these high-speed fans on it, five of 'em. And it had to have a lot of sound deadening. We found that they were such an efficient heater in the office that the guy just about had to work in his underwear because it was so hot.

HY: I know we put one in Butler [Lampson]'s office.... It's been 10 years since we've worked there, and we worked there for almost 10 years, so this was quite a ways back.

CS: We worked so hard on reliability with the Dorados, then we decided they were unreliable just because they got so hot.

HY: You couldn't get the heat out of them very well.

KC: Even with 5 fans?

CS: Yeah, they had to put all that sound deadening material in there....

HY: The fans were like a hurricane. They were really big high volume fans.

KC: What made all the heat?

CS: ECL chips. The power supply, minus 5 volts, put out 300 amps. They had a +5 and +2V — they were 150 amps. It was easy to set a board on fire because you had this unlimited amount of current, and you'd have a short on the board.... We saw several of them just literally burn up. The fans were so powerful you couldn't see where the smoke was coming out. You could smell it and you knew that there was something seriously wrong, but you couldn't tell. And you had to shut each machine off and pull the boards out to find out.

HY: I remember one day — this was probably the third or fourth machine we put together.... We'd plug each board in, turn it on, watch it a little, and turn it off, because we had to be very careful. But we plugged this one board

in, turned it on, and it smoked a little bit so we turned it off. We decided that Charlie would watch to see where the smoke was. I turned it on, he leaned over the board, got real close to it, and about a dozen little capacitors went off like incendiary bombs! They flew all over! We took the board down and it turned out the capacitors had been installed backwards — tantalum capacitors — and it blew them up.

CS: Like fireworks going off! That was the problem with the Dorados, more than anything, was the unlimited current. It could be very destructive. So we had to make sure we had smoke alarms. We ended up putting all the Dorados in the computer room, in racks, two in a rack so that we could have a lot of air conditioning. We had about 20 Dorados in this one room in the early days, all connected to the terminals in the offices through the seven-wire interface. We'd go through stages of increasing the air conditioning to handle it . But they were very much in demand; people just loved that machine because it was fast. They would say, I could get my work done in an hour, and it would take me all day on an Alto.

KC: It sounds like the improvement in the Dorado wasn't just in raw processing speed, but comprehensive — all the way up. Was there different software, or did the Alto and Dorado run the same software?

HY: The Dorado ran the Alto software in addition to its own.

CS: Mesa. Then they developed Cedar on the Dorado.

KC: What was that?

CS: That was one of these multi-window operating systems. You had the computer power there to do multi-tasking.

KC: And it would do cooperative multi-tasking, it was an OS/2 style system where you could run several tasks at once with each task claiming a processor slice?

CS: That was all embedded in the software. Somehow I got the feeling it was a little more powerful than OS/2.

KC: With an operating system tailored to a five-MIPS machine, I don't doubt it. Was the Dorado also a 16-bit computer?

CS: Yes.

KC: Different processors, though?

CS: I think they just went to the ECL version.

KC: That was what made all the heat?

CS: Emitter-coupled logic is more current-driven than voltage-driven architecture. If we didn't have CMOS today I can't think of the problems we would have had building some of these microprocessors. You'd need a smoke stack on them!

*KC: Pretty much. I'm sure you gentlemen realize that even with CMOS, there have been problems in the industry lately with some very-high-speed processors and the heat they put out. [*Great rumor about contemporary superscalar processor deleted by fact checker.*]*

HY: Meltdown time!

CS: Sounds like the only way out of that is to go to a point-six-micron [etch trace] technology. Then they have to go to lower logic voltage, to 3.3 [volts] rather than 5.

KC: We can foresee that, but I'm not sure it'll solve the problem. So eventually you had 15 or 20 Dorados sitting in this machine room where presumably you could keep an eye on all of them....

CS: We set up several different labs that had Dorados.

HY: I think they built over a hundred Dorados, and we had [responsibility for] maybe 60 of them....

CS: The other lab had some guys who started maintaining theirs.

HY: They built so many of them with the multi-wire boards, and those were probably the worst attempt at a board I've ever seen in my life.

KC: What do you mean by a "multi-wire" board?

HY: It wasn't a PC board, it was a process where they strung wires somehow.

CS: It was varnished wire with a layer of poured epoxy over it. The wires could meet at 90 degrees on the same level, something you can't do on a PC board — you have to change levels. You could actually intersect these wires and they called the intersection a knuckle. But a lot of the boards developed shorts at the knuckles.

HY: They could short when they were hot and be okay when they were cool — they were a disaster.

CS: So we went to a PC after that. It was from Stitchwell, to multi-wire, to PC.

KC: Was the same level of internal diagnostic on the Dorado that there had been on the Altos?

HY: Even better!

CS: The way we de-bugged a Dorado was, we'd use an Alto. This fellow Ed Fiala developed a system called Midas, which was built into the Dorado boards, where it had all the pertinent signals listed. And by hooking up this Alto and running this program Midas, we could look at all these signals on the Dorados, so when the Dorado stopped we could look at the result of all these mufflers — as they called them — or MUXes. That restored a signal and we could tell the state of all these signals.

KC: It was basically a real elaborate Sniffer. Now if you had the Alto jacked into the network could you diagnose any Dorado on the network?

HY: No, this connection [to the Alto] was a hard wire....

KC: It's a "tell me where it hurts" connection?

CS: That's right. For each bank of Dorados we had an Alto, and we'd jack it in as soon as we had a problem reported.

KC: One Dorado, which sounds like a decently powerful machine, was connected to how many terminals?

HY/CS: One! The personal computer! That's why everybody loved it.

KC: It was a personal computer, except nine-tenths of it happened to be in the basement, so to speak.

HY: Oh, I'd say ninety-nine per cent, was off where the users didn't have to worry about it. All they had on their desks, really, was a terminal and keyboard, but they were hooked straight to this powerful machine.

KC: It was like having a dedicated minicomputer.

HY: That's what it was, exactly.

CS: The thing that always amazed me — some people were prone to static, and you'd think you'd be immune to that having a computer in the basement, but some people would come in there and touch that keyboard and they'd damage a board. With the computer 200 feet away.

KC: You say that the first boards were hand-laid-up, and then came the multi-wire, and finally they went to PC boards as we understand the term. It sounds like....

HY: The PC Dorados were quite reliable. The multi-wires just weren't, because of the underlying technology.

KC: It sounds like kind of a long development cycle. How long were Dorados produced?

CS: We built the first couple in 1978, and we were still building some when we left in '85. They were starting to go to SUNs, but I think probably we were still making them — or we weren't, but the garage was. I would say the Dorados were built for at least five years, at least until '82. The first couple of years you [HY] were doing most of the Altos and I was on the team that was building the Dorados.

HY: [laughs] You were the team, Charlie.

KC: Most of the Dorados were for use inside Xerox?

CS: At first CSL was going to have the only Dorados, because none of the other labs wanted to get involved in building them. It was a major effort. We had some 12 engineers for 2 years.

HY: It didn't seem like the lab wanted to do it at first, and [Bob Taylor] persuaded them to do it, I think. I don't know exactly how he did it, or how much was public and how much never left his office....

CS: Bob Taylor is a unique individual. He managed all these brilliant people and kept them together. They called it some type of democracy, but I always felt it was benevolent dictatorship. Once the other labs saw this Dorado, everybody wanted them. They'd say "My God, this is unbelievable."

KC: It sounds pretty unbelievable.

HY: They were about $50,000....

KC: In parts or finished?

HY: Probably thirty to fifty thousand in raw parts. That doesn't count if you sell the thing, it's got to be 3 or 4 times that. It had to cost $150,000 to $200,000 to the customer.

KC: Still, for 5 MIPS that wouldn't have been a bad price, at that time.

Now, one other thing before we get to the social and political history. Another machine that I've always been curious about was called the NoteTaker?

CS: Yes, that was Alan Kay's machine.... We didn't get involved that much, that was built in the other lab actually. I know it was originally Alan Kay's dream because we used to talk to him about — he called it "Dynabook"....

KC: He called it the Interim *Dynabook. He has never conceded to this day that anything is actually the Dynabook. There's got to always be one more little improvement.*

CS: That was the ultimate, right — you'd never get there.

KC: So you were not involved with anything beyond the Dorados.

CS: The Altos and the Dorados. We did do some service on the Dolphin.

HY: It was a scaled-down Dorado.

KC: Scaled down in what sense?

HY: In speed, power and all that.

CS: They were mostly built in the garage. It was about the size of an Alto — or a little bigger, but it was the same kind of push-under-the-desk [form factor].

KC: It was an attempt to put some sizable fraction of a Dorado's power and functionality in an Alto's case.

HY: I think that's a fair description. It was called a D-machine.

KC: What was the Dandelion?

HY: Dandelion was an actual product that went through a couple of development cycles...

CS: and was called the Star.

KC: Oh, Dandelion became the Star. Now I got it.

This just goes to show you that computer history has to be taken care of, to be moderated, to be curated if you will, at a lot of different levels. And that's a lot what we're about — striking a balance between nuts-and-bolts history and political and organizational history. But in the broad sense it's all part of the same thing.

So, now — what about the exodus?

CS: You field that first!

HY: I remember the day Bob Taylor resigned. I had no clue there was anything wrong, but there must have been something going on for a few months. Bill Spencer was putting pressure on Bob of some kind. Anyway, Bob called a meeting one Monday morning at nine o'clock. And he walked in and resigned, and it caught me flabbergasted. I didn't know what was going on. Then immediately Chuck Thacker resigned and I guess they both left — I know Bob did, I think Chuck did — and Bill Spencer was addressing the group. And I thought maybe they were going to lynch him. He was a big man, a big imposing guy. I'd never seen such hostility. These guys were mad, they were fuming.

CS: I understand they offered him a good retirement if he would promise not to set up a lab in competition to PARC.

HY: There was a lot of loyalty to Bob Taylor. I remember Bill Spencer saying something about, what can I do to rectify this.... and one guy yelled "You can fucking resign!" They were just furious and they were all yelling. Some of those people I had never seen angry before, in all that time.

CS: There was probably no work done for the next couple of months, in some of the labs.

ME: Did they have some idea of why he had left?

HY: I'm sure some of the senior people did. I don't know about the rest of them. I was pretty far down looking up, and things were really murky. Later on we saw a copy of a letter that Bill Spencer had written Bob and it put a lot of pressure on him, saying he had to do things a certain way. He just wasn't that kind of person and wouldn't do it. It just angered everybody and they started leaving right away. Within two or three months, I bet sixty to seventy per cent of the people had left.

CS: That was somewhere in the middle of September, and by the first week of January the doors opened, I guess there was some milestone on the first of January — and people really started rolling out. I think 40 or 50 people left.

HY: I'm sure they were all deciding where they were going to go. Just a handful of the original guys stayed.

KC: But you stayed.

HY: It's not the same for me, I'm a technical support person. I'm not a scientist, I'm talking about all the scientists who left.

KC: I know fairly well who left at that point. But you have an unusual perspective, from the public standpoint, of having been there after the exodus. Most of what you might call the public history of that whole event ends with the day it happened. So what happened after the exodus — how did they try to build PARC back up?

HY: I don't know what the management actually tried or decided. I remember Doctor [George] Pake addressing the group a couple of times, and one time in particular he looked to me like me was almost in tears. I think he really regretted seeing the people leaving. You didn't see that in Bill Spencer, as far as I know.

CS: Spencer eventually took George Pake's place.

HY: Quite a bit later.

ME: How rapidly did they try to bring new people in?

CS: They started to reorganize the labs. They moved some people....

ME: Consolidation-type thing?

CS: Yeah, CSL was just totally gutted.

HY: Most of the major people left. A lot of the big guys left.

CS: A lot of them didn't go to DEC either.

HY: Certainly quite a few people did.

CS: Even Herb and I could see the writing was on the wall for us. What we had done in the past.... what gradually happened to us, within about a year, they sort of moved us out of the lab and put us in a service group.

HY: The hardware people were mostly gone, and so [management] didn't know what to do with us, or they didn't care so much about us. We were just a necessary part.... whereas before when the hardware guys were there we felt somewhat integrated into the group.

KC: And so the standard of internal cooperation went downhill and it wasn't the same after that.

HY: It didn't happen immediately. I'm not privy to management, I don't know all that went on in every place, but the productivity certainly went down.

CS: They had to re-evaluate some of their projects because so many people left.

I think they still continued development on the Cedar [multitasking environment] and the Dragon. When you lose all that talent —

HY: Even the Dragon, I'm sure, was slowed down a lot after Thacker and Butler Lampson left.

KC: It's amazing to me from what I know. I've come at this from another angle. I've talked to people at places like ParcPlace, where there were Xerox PARC alumni who were more trying to continue the traditions of software development, rather than hardware development. After the people like Thacker and Lampson and Adele Goldberg, people like that, Alan Kay, after they scattered all over the place it was difficult to

understand how enhanced the processes must have been by having all these people in one building.

HY: Right. Dr. Kay and Adele Goldberg, though, didn't work for CSL and weren't part of that group. I don't know when they left.

CS: This was a CSL group — there were about 50 scientists.

KC: When the exodus happened it was mostly at CSL, so far as people who left immediately, but that was only the epicenter of the explosion. It went through the other labs and a lot of people left — not then, but six months or a year later. It blew the whole place.

HY: Gary Starkweather left. I've heard a story about that. As far as I know his work is the only work that ever benefited Xerox. They made lots of money off his work, and for him to leave had to be sort of the crowning touch.

KC: Anything else?

CS: One unique experience over there. We were working in a Dorado lab called the Purple Lab, and there was this group that Larry Tesler was showing some of the software. One fellow was Steve Jobs, and there was a whole entourage. Somebody said "Oh, these people are from Apple Computers," and we said, "Who would ever buy a computer called 'Apple?'" Talk about underestimating. [copious laughter] Apple! What a dumb name for a computer!

KC: The funny thing was that you were looking right at Larry Tesler showing Steve Jobs around, and Steve Jobs went back to the office, burst in on Mike Markkula, and said roughly "I have seen the future and it works!" And it's true that Jobs took that vision and made it work, but look at how much more time and money he spent.

HY: Kip, I really appreciate your sense of the history.

KC: And yours! There's so much of it, gentlemen, we've barely begun.

THE APPLE LISA COMPUTER: A RETROSPECTIVE

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INTRODUCTION

This paper is an attempt by a long-time Lisa user to clarify the significance of the Apple Lisa personal computer for the computing industry. The audience is anyone who has an interest in innovative computing technology, and wants to learn a little about Apple Computer's brief foray into this area via the Lisa computer.

This paper hopes to show why the Lisa was significant in its time, and how some of what was called "Lisa Technology" is slowly migrating to other computer systems, notably the Apple Macintosh computer series.

The author has never worked for Apple, and so is not privy to any "insider secrets" about this machine. All information contained herein was obtained from Apple's cornucopia of Lisa and Macintosh literature, from discussions with other Lisa owners, and through my personal involvement with and observation of both machines since 1984.

This paper is loosely based upon the excellent article "The Legacy of the Lisa" (MacWorld magazine, Sep. 1985) as written by Mr. Larry Tesler, one of the Lisa's main designers and currently Chief Scientist at Apple Computer.

A LITTLE BIT OF HISTORY

Apple began developing the Lisa in 1979. The Lisa's charter was to build a revolutionary device that was truly easy to use, and thereby mitigate the limitations of existing computers. Developing a computer which was an order of magnitude easier to use than traditional computers required several major departures, not all of which were obvious.

Even the name "Lisa" has always been rather enigmatic for most computer users, including Lisa owners. To set the story straight (as far as I know) here are the facts: Officially, Apple states that "Lisa" stood for "Local Integrated

Software Architecture." Unofficially, "Lisa" has been associated with the name of a child fathered by one of the Lisa designers.[2]

The Lisa had several design goals:

* Be intuitive,

* be consistent,

* conform to the ways people actually work,

* have enough performance to do the jobs that need doing,

* provide an open software and hardware architecture,

* be reliable,

* be pleasing, and

* fit into an everyday work environment.

The Lisa was based on sophisticated hardware technology. The single compact desktop unit contained a 12-inch black-and-white screen, and two revolutionary floppy disk drives called "Twiggy" — after the English supermodel of the day, because she, and they, were so thin. The Lisa contained a Motorola 68000 processor and 1 megabyte of memory, expandable to 2 megabytes. Cabled to the Lisa's case were a keyboard, and a (then) uncommon peripheral called a "mouse," which was a key element of the Lisa's design.

Apple introduced the Lisa to the general public in January 1983 at a price of $9,995. In April 1985, after only one and a half years, Apple discontinued the Lisa in favor of its sibling, the Macintosh.

Lisa development was a tremendous undertaking for Apple and basically required most of the company's resources, both financial and personal. Apple reports that Lisa cost $50 million to develop and required 200 man-years of development effort. The story behind the development is fascinating and should be more fully recorded, but this paper can provide only a "Reader's Digest" version of the development history; a more complete history can only be written by the developers themselves, and this author, sadly, believes that such a treatment will never see the light of day.

The Lisa may be considered a computer that sprang from the loins of a host of predecessor systems, and many of its "revolutionary" ideas were not really new — notwithstanding the cries of Apple marketers, who think everything Apple does is new. Work by many computer companies over decades (yes, decades) was drawn on by Apple to design the Lisa. For example, Apple borrowed several key ideas from Xerox and its early Alto system.

In 1979 Mr. John Couch, Apple's head of software, was made General Manager of a new Apple division called POS, Personal Office Systems. Mr. Couch's charter was to develop and promote the Lisa for the office system market, and provide a return on Apple's substantial Lisa investment.

From meager beginnings, POS blossomed into a 300-person division, with around 100 people devoted to the software and hardware development effort. The Lisa had begun as a rather humdrum text based system, not a good sign for a "revolutionary" computer. Couch assembled a team of very talented people from within Apple and throughout Silicon Valley. After some field trips to neighboring Xerox PARC (Palo Alto Research Center), the developers (and some ex-PARC people who became Apple employees) embarked upon what became the Lisa computer as known to the public. Perhaps the key change at this point was the migration from a text-based system to a window-based system inspired by Xerox's Smalltalk development environment.

Apple unveiled the Lisa in late 1982 to selected outsiders. On 19 January 1983, after repeated delays and two years beyond the originally projected introduction date, Apple officially declared Lisa a working system that would be deliverable in May 1983. Apple at this time hoped to mark the beginning of a new era in personal computers & establish the software technology standard of the 80's.

Apple's comprehensive Lisa introduction also included a suite of revolutionary and sophisticated programs called the Lisa Office System (later renamed "Lisa 7/7" by Apple). This suite consisted of seven application programs — LisaWrite, LisaDraw, LisaCalc, LisaGraph, LisaProject, LisaList, and LisaTerminal — and was bolstered by extensive well-written documentation and an innovative self-paced training

course for new Lisa owners, based upon the LisaGuide program, which Apple called an "interactive manual." For hardware diagnostic purposes Apple provided the LisaTest program, though Apple appears to have discontinued the release of this program to owners in favor of referring them to the local friendly Apple dealer for Lisa servicing. For a user "operating system" Apple created the Desktop Manager. This program was a file organizer and program manager which created the illusion of a "desktop," on which users could place, move, rename, and delete files, and run programs.

Apple supplied three different printers for Lisa, all capable of printing exactly what the user saw on the screen. The dot-matrix printer could print both high-resolution text and graphics. The daisy-wheel printer was unique in that it could also print graphics, though the ribbon was used up very quickly for this task. Later in the Lisa's life Canon provided a color inkjet printer for it. Apple appears to have had plans to support a laser printer with the Lisa, but these plans were abandoned, although Apple did have a $30,000 in-house laser printer which was used by the Lisa developers.

Apple's internal software development centered around the Lisa Monitor environment, which was text-based, and resembled the environments Apple provided for its Apple II and Apple III computer systems. The majority of Lisa programs were written in the Pascal language by Apple, except for a few written in 68000 assembler. A COBOL and a BASIC were also available. To give an idea of the size of this effort: The Lisa operating system source contained about 90,000 lines of Pascal, and the Office System applications contained approximately 50,000 lines each. The programmers used a wonderful window- and mouse-based editor called LisaEdit. Outside developers were offered a development kit called the Lisa Workshop, a descendant of the Lisa Monitor environment. With the Workshop a programmer could develop rather sophisticated programs, primarily in Pascal.

A major software development effort by Apple focused on the Lisa Desktop Libraries, a collection of about 100 software modules which provided the software foundation for Lisa Technology. These modules were used by all Lisa programs and were the mainstay of the Lisa's consistent user interface. A key component of the Desktop Libraries was QuickDraw, a fast and versatile graphics module written in around 40,000 lines of 68000 assembly language.

During the Lisa's rather short life, very few programs were written for it by outside developers who could exploit its revolutionary user interface. The main reason for this was the lack of any fairly simple development environment that would allow outside developers to write "Lisa-like" programs without a tremendous amount of technical knowledge. After Apple developed the major Lisa programs, they attempted to develop a universal "framework" for programming called the Lisa ToolKit; but development of this, though basically finished, was halted when Apple withdrew resources from Lisa software development to accelerate Macintosh development. Apple had also not documented fully, nor designed in an easily understandable fashion, the code which formed the basis for the software component of Lisa Technology. Finally, third-party developers hesitated to commit to the Lisa given its high perceived price and its low sales numbers.

A major headache for Apple during the development effort was the pair of Twiggy disk drives in each Lisa. The single 5.25-inch high density floppy (860K bytes) with software-controlled automatic ejection and micro-stepping technology proved a little too revolutionary, and held back the Lisa schedule. After introduction Apple wisely abandoned Twiggy in favor of the new, more reliable 3.5 inch Sony micro-floppy drives with 400K bytes per disk. Complementing the floppy drives was a ProFile hard disk drive with 5M bytes capacity, originally offered for the Apple III. A 10M byte ProFile was later developed by Apple for the Lisa 2.

Apple spent a lot of time during Lisa's development testing Lisa features with real users. Apple's literature on this topic shows that the Lisa developers were occasionally surprised by the user testing results, but the end product of these tests was a better Lisa system. Apple also gave high priority to understandable foreign

language translations for the Lisa software, developing a useful technical solution to the problem of "localization" through Phrase files which contained all the phrases that a Lisa program could display to the user. With access to the Phrase files, a translator with minimal computer skills could translate the program's messages and create a national-language version, without having to delve into the highly technical underlying source code. The Lisa at power-on also supported foreign language diagnostic messages, which could be keyed in from the keyboard.

Apple projected sales of 10,000 Lisas in the last half of 1983 and 40,000 in 1984. In retrospect, Apple was able to sell around 80,000 Lisas during its 18 month life — an average of 4,500 units a month or 13,000 per quarter, figures very close to initial sales projections. (I believe Apple's sales were less than expected in the first months after the Lisa's introduction, but sales picked up near the end of the Lisa's life).

DEVELOPMENT RISKS

Apple confronted several significant risks with Lisa's introduction.

On the technical front, the software development effort was immense, and could easily have delayed the introduction. The Twiggy disk drive proved barely workable, but the more reliable Sony 3.5 inch disk drives were substituted. The Lisa's printing technology was a risk, since Apple was basically trying to get dot-matrix and daisy-wheel printers to emulate a high-resolution laser printer. Font and printer problems were eventually resolved.

On the business front, Apple had several very high hurdles to jump. The company was unable to invest enough time in helping outside developers. The seven programs of the Office System were basically all the programs Apple had for the Lisa's introduction. Product planners were on the dangerous edge of confusing the Lisa and Macintosh product lines. Finally, Apple's data communications strategy appeared primitive; Apple did develop a network for the Lisa, called AppleBus (later AppleTalk,) but Lisa networking never achieved popularity with users.

After a year with the Lisa product line, Apple's management came to the conclusion that Apple could only support one line of computer with a graphical interface. Lisa lost out to the Macintosh. The Lisa's name was changed to Macintosh XL (quoted variously as standing for "Extra Large" or "X-Lisa"). In April 1985 the Lisa was discontinued and the Macintosh became Apple's top-end computer; after the discontinuation Apple supported the Lisa hardware with a 5-year program of spare parts and repair services.

To ease the transition to the Macintosh, Apple developed a program called MacWorks that allowed the Lisa to run most contemporary Macintosh programs. MacWorks supported Apple's strategy: to sell its remaining inventory of Lisas to the Macintosh public, which desired a Macintosh more powerful than the original 128K and 512K models.

The bulk of Apple's remaining Lisa inventory was sold to a Utah company called Sun Remarketing.[3] Sun continues to sell the Lisa today as a Macintosh. Apple's final Lisa collection was placed in a landfill by Apple several years ago; I'm not certain of the reason for this, but believe it may have been a result of a lawsuit concerning the Lisa brought by several Apple stockholders.

The Lisa legacy at Apple is still somewhat alive, at least in a physical sense. The Apple Corporate Museum houses a few functioning Lisas for display purposes, but I believe they may be running Macintosh rather than Lisa software. [Unfortunately, the Apple Museum is currently closed indefinitely. — Ed.]

LISA TECHNOLOGY

The Lisa has proven to be one of the most underrated personal computer systems in the industry's history. When Apple introduced the Lisa in 1983, very few people seemed to understand the revolutionary concepts implicit in its design. In retrospect, we can say that Apple itself shared this lack of understanding.

Apple's revolutionary "Lisa Technology" combined tight integration of hardware and software with a simple design goal: to make the computer as easy to use as possible, without

sacrificing power that would enable the user to accomplish significant computing tasks. In Apple's words, Lisa Technology was based upon "the extensive use of graphics, consistent user interface, and pointing device (the 'mouse') which together emulate the way an individual works in the office".

To quote one of Apple's Lisa documents, the Lisa hardware and software combination "must be seen to be believed;" but in fact it must be used, extensively, before it can be appreciated. Discussing Lisa's important differences will only bring on skepticism; demonstrating the system is some help, but often not a lot. The non-Lisa user meeting a Lisa for the first time will perennially ask, "Can something that looks so gimmicky really do serious work?" But I think that most people who spend several hours with a Lisa accomplishing something real — aside from those few who have tried it and really don't like it — will come away with positive conclusions about the Lisa's value, or at least the value of its technology.

One effective presentation tool used by Apple for Lisa customers was the Lisa Concept Pyramid. The apex of this pyramid represented the solutions required by the target customer, the information professional, who was called a "knowledge worker" by Apple). The generic applications are all tools which can be used by almost anyone.

The middle layer of the pyramid represented the underlying technology of a truly "easy to use" system. The prototype of this technology was created within Xerox PARC, but Apple's refinement of it consumed the bulk of Lisa's 200-man-year development effort. Many contributions by Apple were enhancements of integration and of the user interface; keys to that accomplishment included the one-button mouse and its driver software. Another cornerstone is Visual Fidelity, or the correlation between screen image and printed output now referred to as "WYSIWYG."

The bottom layer is the foundation for the layers above. The major design issues were all dictated by the needs of the software, rather than the traditional domination of the design by the hardware.[4] The Lisa operating system needed to be multi-tasking, to allow multiple programs to co-exist on the screen. The Graphics/Mouse technology was the key to making the Lisa's user interface possible.

All Lisa user actions were centered around the one-button mouse. The user moved the mouse pointer (usually a small arrow-shaped pointer) to the screen object of interest. For example, to activate a menubar command the user moved the mouse pointer to the appropriate command group label, e. g. Edit, and pressed the mouse button. The selected menu would then "pull down" showing a list of the specific commands the user could work with. Still holding the mouse button down, the user dragged the mouse pointer to the desired command, e. g. Copy, and released the mouse button when the mouse arrow touched the Copy command and the command name in the menu was highlighted. At this point the selected menu command was activated and performed its function on the selected window object. For example, if you were using LisaWrite, the Lisa's word processor, you could copy data from a LisaWrite document by first selecting with the mouse pointer the text to copy, and then activating the Edit menu Copy command.

The Lisa's technology has now been copied extensively by other systems, both within Apple and elsewhere. But in my opinion several aspects of the Lisa's design made it unique. These aspects have not, so far, been adopted to any significant degree by other microcomputer systems.

SOFT POWER-ON AND POWER-OFF

The Lisa was powered on and powered off by a button on the front plate of the computer case, but its power button was not a true "hard" power switch; a Lisa, once plugged in, was always running. When the Lisa was "off" it was really in a low-power mode (what might now be called a sleep mode) that toggled to full power when the user pressed the power button. Conversely, if the user pressed the power button to turn the Lisa "off," the hardware called to the operating system (really to the Lisa Desktop Manager) which commanded all executing programs to save their documents. When all programs indi-

cated that they had committed their documents to disk, the Lisa toggled to its low-power mode.

SELF-ORGANIZING DESKTOP

The Lisa maintained an orderly desktop for the user. At power-down, the Desktop Manager would save the state of the desktop as well as all open document data. When the user powered-up the Lisa, the Desktop Manager restored the desktop state as it was on power-down.

DOCUMENT-CENTERED VIEW

The Lisa supported a document-centered view which gave priority to documents, not programs. To start a new document in any application, the Lisa user tore off a sheet of "stationery" from a pad icon that resided on the screen. When "opened" by the user a stationery pad automatically duplicated itself, set its name and the current date, and created a window on-screen for the user. (Stationery pads survive in Macintosh System 7, but the Macintosh does not use a document-based view.) Lisa program icons rarely came into play except to move the program file to another disk. Generally, Lisa users kept document stationery pads easily accessible on the screen and kept program icons in a folder, which they opened only to add new programs or delete old ones.

RELIABLE FILE DATA STORAGE

Several design decisions made the Lisa's file system unusually reliable. To reduce the impact of a system crash, the file system maintained distributed redundant information about the files, in different forms and in different places on disk media. For example, information about a file in the central disk catalog was repeated in a special disk block at the head of that file. Also, each block on the disk specified the part of the file to which it belonged, in a special string called a "block tag." Since all files and blocks on a disk were able to identify and describe themselves, there were several ways to recover lost information. A utility called the Scavenger was able to reconstruct damaged disk catalogs from the redundant information stored in and about each file.

The Scavenger is activated automatically whenever the Lisa determines that a disk has problems. At this point the Lisa's low-level operating system informs the Desktop Manager, which displays a dialog for the user. The user may elect to have the Lisa repair the disk or eject it. In my experiences with the Lisa I've only had one disk that the Scavenger could not fix.

The Lisa's ProFile hard disk and Twiggy floppy drives also included extensive reliability features. One such feature was disk block sparing. When a disk block (of 512 bytes) was detected as beginning to fail, the Lisa's disk drive (whether ProFile or Twiggy) moved the data to a spare area of the disk and marked the failing block as "bad". Whenever a program attempted to access a bad block, the drive automatically substituted a "spared" data block.

The original Macintosh supported block tags at the hardware level, but Apple never provided a Mac Scavenger program to monitor and use these tags. Neither did Apple's Finder program (the Desktop Manager equivalent for the Mac) support checks for failing disk blocks. After several years Apple abandoned disk block tag use. Newer Macintoshes have introduced block sparing for high density floppies and hard drives.

UNIQUE SYSTEM SERIAL NUMBERS

Each Lisa contained a unique serial number, stored in a special electronic chip, which the Desktop Manager could read. The Lisa used the serial number for program protection, and to establish uniquely identified communication nodes within Lisa data networks.

PROGRAM ANTI-PIRACY AND DATA PROTECTION

All Lisas provided a simple and effective method of protecting user programs from piracy, and data files from overly curious coworkers.

When the user installed a new program, the Lisa "serialized" the disk copy of the program by writing the ROM-based serial number to the program floppy disk. The user of this disk would then be unable to copy this "protected master" program file to another Lisa. The user could still execute the protected program from the floppy disk, but this was tedious, given that Lisa programs tended to be large and floppy-disk-based program execution would try the patience of most users.

Document protection was provided by passwording. The user could select a document icon with the mouse and, through a menu-driven dialog, obtain general information about the document. This information included the document's size and a field for the protection password. If the user typed a password into this field, the document was protected. When any user attempted to open a protected document, the Lisa displayed a dialog asking for the password.

NON-PHYSICAL FILE NAMES

The Lisa did not display physical file names to the user. Instead the Desktop Manager presented a "document name view" which allowed descriptive names with up to 63 characters. The underlying filesystem allowed file names up to 31 characters long, which could not contain the directory separator character "-". For each document the Desktop Manager maintained a user document name (e. g. "Vacation Plans - 1983") and a physical low-level file name (e. g. "{T3D456}").

This non-physical file name scheme allowed the use of multiple documents with the same user-defined name, whose underlying physical file names were different. In this regard the Lisa mimicked the physical working desktop, where a worker might have five photocopies of the same document at the same time.

To the best of my knowledge, no other currently available microcomputer supports non-physical document names.

PULL-OUT HELP CARD

The Lisa keyboard contained small pull-out firm plastic sheets of helpful information. The first sheet showed the keyboard itself and a layout of all the keys that the could be typed in combination with the Option key. Other cards gave concise information about Lisa operating features and techniques, such as how to copy documents. Another blank card allowed users to write down important personal information pertaining to the Lisa; for example, the phone number of the local Apple service center or representative.

HARDWARE BASED MEMORY MANAGEMENT

The original Lisa contained 1 megabyte of physical memory, with about half of it used for the Lisa Desktop Manager and the Desktop Libraries. A sophisticated hardware-based memory virtualization allowed Lisa programs to access more memory than was physically installed. This strategy also allowed the Lisa to segregate executing programs so that they could not access other programs' data at inappropriate times. If memory protection was violated, the Lisa would stop the errant application and alert the user that the program had been terminated.

ENVIRONMENTS WINDOW

Through the Environments Window, Lisa provided a simple method for the computer to run radically different operating environments. On boot-up, Lisa ran a special low-level program called the Environment Selector, which located and ran a default operating environment, if one was present. Otherwise, the Selector displayed a window allowing the user to select a run-time environment. Apple supplied two different environments: the Office System environment for non-technical end users, and the Workshop environment for programmers. Other companies supplied additional environments, e. g. an implementation of UNIX.

ADJUSTABLE SCREEN CONTRAST AND DIM DURATION CONTROL

Lisa screen contrast could be adjusted by the user with a special program called Preferences. This program also allowed the user to define a duration of inactivity, after which the screen would automatically dim and lessen contrast. This feature prevented screen "burn-in," which happens when screen images at high contrast "burn into" the screen's phosphors. The Lisa automatically, gradually dimmed the screen in pleasing increments — a nice touch on Apple's part which prevented a jarring change in screen brightness and contrast.

SCREEN PRIVACY FEATURE

For users who dealt with sensitive data, the Lisa provided a simple screen privacy feature. The user could press Option-Shift-[numeric keypad zero] at any time and the screen would immediately dim.

SELF-TEST AND FOREIGN LANGUAGE USAGE VIA KEYBOARD

The Lisa, when powered on, ran a special hardware self-test which made certain that it could safely run user programs and manipulate user data. Hardware failure would trigger a specific failure error number which could be used by an Apple service center to isolate the defective part.

During these diagnostic tests (which took around 3 minutes to execute) the Lisa displayed icons and messages to the user. The messages could appear in either English, French, or German, according to which keyboard was attached; Lisa keyboards were self-identifying and provided the Lisa with information including the keyboard "language". For example, if the keyboard was a German keyboard, then all diagnostic messages appeared in German.

Unfortunately, this language-sensing compatibility didn't extend to the menus of Office System applications and programs like LisaWrite!

SPECIAL SERVICE MODE

Lisa firmware contained a "service mode" which could be activated when the computer was powered on; this special feature allowed the knowledgeable user to run additional diagnostic tests. Also supported was a cross-hatch display pattern which made it easier to adjust the screen contrast.

EASY SYSTEM DISASSEMBLY

Any subassembly of a Lisa, except for dangerous portions like the monitor CRT, could be disassembled by the end-user, readily and with few if any tools. For example, users could remove and replace a disk drive with ease by just gripping the tabs at the base of the front panel, popping the front off, and unscrewing a single screw which held the drive in place.

MACINTOSH XL, MACWORKS, LISA-TO-MAC MIGRATION KIT

When Apple planned to discontinue Lisa, the company was left without a high-end system. All Apple had to offer at the time was the Macintosh 128K or 512K models, which were more compact than the Lisa but lacked the appeal of its bigger screen, bigger memory, and hard disk.

Apple's hardware and software engineers quickly developed a special program named MacWorks that allowed a Lisa owner to turn that computer into a "big" Macintosh. Apple produced three versions of MacWorks before turning over all MacWorks development to Sun Remarketing (see endnote).

Apple combined the new MacWorks with a renamed Lisa called the Macintosh XL. This gambit sold a rather surprising (to Apple) number of Lisas. MacWorks is still a commercial product for Sun Remarketing, which went on to develop an enhanced MacWorks Plus that lets a Lisa emulate a Macintosh Plus. (I wonder how many Lisas/Macintosh XLs Sun really sells now, but the company has been prodigious in developing and producing XL hardware peripherals, including larger hard disks and a board that allows SCSI devices to work with the XL.)

Apple solved the problem of transferring Lisa data to a Macintosh with the Macintosh XL Migration Kit, consisting of a special Lisa program called Lisa-to-Macintosh and a set of Macintosh data conversion programs. The Lisa program (primarily) wrote Lisa data files to a Macintosh disk; the Macintosh data conversion programs took the resulting files and converted them to Macintosh data files in an appropriate format. For example, LisaWrite documents could be converted to either MacWrite or Microsoft Word files for use by the Macintosh.

MACINTOSH: BACK TO THE FUTURE

Though the Lisa is now over a decade old, Lisa Technology still influences the Macintosh. As the Macintosh product line matures, it has in many ways circled back to approach the Lisa of 1983.

When Apple introduced the Lisa in January 1983, the Macintosh was already under development. In January 1984 Apple introduced the Macintosh which, at a casual glance, resembled a physically smaller Lisa in many ways. But underneath, the Macintosh and the Lisa were totally different. The Lisa depended on a multi-tasking operating system, the Macintosh only on single-tasking. The Lisa's extra memory (8 times that of the original Macintosh 128) and hard drive allowed use of comparatively sophisticated Lisa programs and larger data files. The Lisa's Desktop Manager and its distinctive user interface were drawn on by the Macintosh developers as a foundation for the Macintosh Finder.

A short list of Lisa legacy items from Mr. Larry Tesler's article "The Legacy of the Lisa" (MacWorld magazine, Sep. 1985) appears below (I've added the Software development list):

* User interface
  - Menubar, pull-down menus, keyboard-activated menu commands
  - Printing dialog boxes
  - Appearance, structure, and operation of windows and scroll bars
  - Ability to move windows and icons by dragging with the mouse
  - Windows that zoom to open and close
  - Dialog and alert boxes with buttons and check boxes
* Applications
  - QuickDraw graphics package
  - LisaDraw converted to MacDraw
  - LisaProject converted to MacProject
  - LisaWrite, LisaCalc, LisaTerminal influenced Macintosh applications
  - Lisa Desktop Manager influenced the Macintosh Finder design
  - Lisa printing architecture influenced Macintosh printing
* Software development
  - Lisa Pascal converted to MPW Pascal
  - Lisa Clascal influenced MPW Object Pascal
  - Lisa Workshop influenced design of Macintosh Programmer's Workshop
  - Lisa Workshop editor (LisaEdit) influenced editor design
  - Lisa ToolKit influenced heavily the Macintosh MacApp framework
* Hardware
  - Single-button Mouse design
  - ImageWriter printer

The Lisa legacy may also be seen in its influence, through the Macintosh at least, on environments for non-Apple microcomputers, including Microsoft Windows, Digital Research's GEM, and Commodore's AmigaDOS. Close examination of these systems will show a superficial resemblance to the Lisa (and Macintosh) environments. But many times below the surface one finds behavior that is reminiscent of the PC-DOS and CP/M systems from (relatively) long ago.

Other Macintosh technical areas influenced by the Lisa were:

* System 7 Stationery
* System 7 Apple Events
* Finder's Print Monitor

When I work with the Macintosh (e. g. a Macintosh II series machine) in 1993, I notice two prominent differences from the Lisa of 1984.

First, the Macintosh is much faster than the Lisa. Editing complicated images in LisaDraw is almost an exercise in futility. Apple has made excellent progress in enhancing the speed of its Macintosh series. If Apple had kept the Lisa product line one could only assume that hardware speed improvements would have followed advancing technology. I've heard that Apple developed a prototype Lisa based upon the 68020 processor, but canceled this project along with the Lisa as a whole. This might have made the Lisa a much faster machine.

Second, the Macintosh seems comparatively incomplete in some ways. For example, the Macintosh Finder does not save the desktop, open application location, and data states, as did the Desktop Manager. I miss being able to press the Lisa's power-off button and just walk away from the computer, knowing that the computer would save all my application data and turn off automatically. Whenever I wished to resume work, I just pressed the power-on button and the Lisa showed me a screen matching the one I had left.

I don't mean to criticize the Macintosh unfairly, since it has in its own right contributed much to the field of personal computing. But the Lisa benefited in general by resulting from a total system approach that delivered integrated functions with a consistent and high quality user interface. I can only speculate how this "total approach" originated, but think it may have something to do with the experience and age differences of the Lisa and Macintosh development teams. From my readings it appears that the Lisa developers were about a decade older than their Macintosh counterparts. The Lisa developers came mainly from large computer companies like Xerox, HP, and DEC, which had created and manufactured minicomputer systems, while the Macintosh developers came mainly from within Apple's II and III computer divisions. The Lisa developers also appear to have had a different programming philosophy than the Macintosh developers. The Lisa's core software was primarily written in Pascal, a high-level language. Macintosh core software, on the other hand, was written in 68000 assembly language.

I can only hope that Apple will resurrect some Lisa Technology that is appropriate for Macintosh (and newer) systems. This hope assumes that Apple will preserve the Lisa development materials as best it can. Unfortunately, my experiences in this area suggest that Apple has lost some Lisa materials already and does not put a high priority on saving (what many there may consider) the "antiquated" Lisa technology that remains. I see the preservation of Lisa design notes and Lisa Office System source code files as crucial for the continuation of the Lisa's legacy.

Hopefully Apple will remove the confidentiality status of its Lisa materials in the upcoming years so that outsiders like myself may have access to this body of knowledge.

SYSTEM 7 LISA DEDICATION: THE LAST WORD?

The Lisa was considered by many at Apple to be a failed experiment. Even so it appears that some people working there understand, and wish to commemorate, the Lisa's legacy to the Macintosh. These people provided a short dedication to the Lisa Desktop Manager and its designers in the Macintosh System 7 operating system, which first appeared in 1990, almost a decade after the Lisa's debut.

On a Macintosh running System 7 you may obtain a dialog showing a Lisa dedication. Hold down the Option key and select the menu item "About the Finder" (this item is called "About this Macintosh" if the Option key is not held down). You should see a pretty mountain scene with a list of names at the bottom edge. Wait about 15 seconds and the bottom names will scroll, showing more names of contributors to various versions of the Macintosh Finder. Eventually you will see a dialog describing the Lisa Desktop Manager.

REFERENCES: GENERAL

Many reference materials for the Lisa exist but, unfortunately, most have become difficult to obtain. Fortunately, the author of this paper

appears to have almost everything ever written about the Lisa, both in the general press and by Apple Computer. All my Lisa materials are available to others if they pay for the copying and shipping.

This discussion of Lisa references mainly covers reference works pertaining to the original Lisa, not to the "Macintosh version" Macintosh XL. The original Lisa ran its own operating system (called the Lisa OS) while the Macintosh XL ran the Macintosh OS.

For general Lisa information I recommend the following books and articles:

* The Complete Book of Lisa (Kurt Schmucker, 1984)
* The Lisa Computer System (BYTE magazine, Feb. 1983)
* The Lisa 2: Apple's Ablest Computer (BYTE magazine, 1984)
* A First Look at Lisa (*Personal Computing* magazine, Mar. 1983)
* Apple's Lisa (The Seybold Report on Professional Computing, Jan. 1983)
* Lisa Makes the Scene (*Apple Orchard* magazine, Mar. 1983)
* Background Information: How Lisa Works (Apple Computer, 1983)
* Introducing Lisa: Apple's Personal Computer for the Office (Apple Computer, 1983)
* Apple Introduces Lisa: A Revolutionary Personal Computer for the Office (Apple, 1983)
* The Apple Lisa (*Officemation* Product Reports, Apr. 1983)
* Lisa/Mac XL Handbook (Michael Posner, Lisa Lives User Group, 1992)
* How Apple presents Lisa (*Softalk* magazine, Sep. 1983)
* Personal Computer Series: Apple Lisa 2 (*Electronic Design,* Jul. 1984)
* Lisa Owner's Manual (Apple Computer, 1984)

Three books were written for the Lisa, but only Schmucker's book may be considered worth reading. Michael Posner's 123 page handbook is worthwhile for a decent overview of the Lisa's history and operational information. This handbook is also noteworthy for its recent publication date, which demonstrates the longevity of the Lisa. To join Posner's *Lisa Lives* user group write to him at 5170 Woodruff Lane, Palm Beach Gardens, Florida 33418.

REFERENCES: NEWSLETTERS AND PRODUCT SHEETS

Several Lisa-specific magazines were also around for a while.

* Semaphore Signal
* ICON
* The LisaTalk Report

Semaphore Signal was a very detailed Lisa newsletter which produced around 30 issues. ICON was also good. The LisaTalk Report was the newsletter of the Lisa NetWorkers, a group which tried to breathe some life into the Lisa after Apple discontinued it.

Many other general Lisa references exist, ranging from general magazine articles to press clippings. For information about the Lisa's first operating system, Lisa Office System or Lisa 7/7, see the following:

* Reviewing Lisa's Office System (*St. Mac* magazine, Mar. 1984)
* Venerable Lisa Software Improved (*Personal Computing* magazine, Mar. 1985)
* The Lisa Office System (Apple Computer, 1984)
* Lisa Product Data Sheets (Apple Computer, 1983-1984)
* LisaGuide screen prints (David Craig, 1984)

The Product Data Sheets are worth reading for their descriptions of the programs Apple created for the Lisa, including LisaWrite, LisaDraw, LisaCalc, LisaGraph, LisaProject, LisaList, and LisaTerminal, as well as the Lisa itself. The screen prints are a complete collec-

tion of the 126 screens shown by Apple's interactive tutor for new Lisa users, LisaGuide.

REFERENCES: HISTORICAL/ARCHITECTURAL

For historical information about the Lisa see the following.

* The Legacy of the Lisa (*MacWorld* magazine, Sep. 1985)
* The Apple 32 Line: Past, Present, and Future (*A+* magazine, Jul. 1984)
* Lisa Chronology (Orphan Support column, *MACazine,* 198?)
* *Fire in the Valley* (Freiburger and Swaine, Osborne-McGraw-Hill, 1984)
* *The Little Kingdom: The Private Story of Apple* (M. Moritz, 1984)

The Lisa Legacy article is especially worth reading, since it was written by one of the Lisa's main designers, who provides a concise narrative of how the Lisa changed personal computing.

Lisa development history and details are documented in the following references:

* The Past, Present, and Future of the Macintosh Desktop (*Semaphore Signal,* Mar. 1986)
* An Interview with Wayne Rosing, Bruce Daniels, and Larry Tesler (*BYTE,* Feb. 1983)
* The Birth of the Lisa (*Personal Computing* magazine, Feb. 1983)
* Lisa's Design (*Popular Computing,* Mar. 1983)
* Lisa: A Vision for the Couch at Apple (*Softalk* magazine, Jul. 1983)
* Racing to a Draw: How Apple Gets its Software out the Door (*St. Mac,* Jun. 1984)
* Apple's Second Try at UNIX (*UnixWorld* magazine, Mar. 1988)
* A Death in the Family (*ICON* magazine, Vol. 2, No. 3)

The BYTE article is an excellent interview with the main Lisa designers. "Racing to a Draw" is worth reading for its fairly detailed description of LisaDraw and MacDraw development. The "Couch" article is a good discussion of Mr. John Couch, the General Manager for Lisa, who may be considered Lisa's "father".

REFERENCES: TECHNICAL

Readers with technical aptitude can search out a smorgasbord of Lisa references that should satisfy the hungriest technophile:

* The Architecture of the Lisa Personal Computer (*Proceedings of the IEEE,* Mar. 1984)
* Lisa User Interface Guidelines (Apple Computer, Nov. 1983)
* Lisa's Alternative Operating System (*Computer Design,* Aug. 1983)
* Lisa: Up Close and Personal (*Softalk* magazine, Sep. 1983)
* Network Introduction Package (Apple Computer, 1983)
* The Lisa Applications ToolKit (Apple Computer, 1983)
* Lisa Workshop User's Guide (Apple Computer, 1984)
* Lisa Development System Internals Documentation (Feb. 1984)
* Lisa Desktop Libraries Interface Listings (David Craig)
* Lisa Hardware Manual (Apple Computer, May 1983)
* Guide to the OS (Apple Computer, Oct. 1982)

The Lisa Architecture paper is a tremendous resource of Lisa technical design and implementation facts, written by a primary Lisa designer, but it is extremely difficult to find. The Lisa User Interface Guidelines is a wonderful 100 page document that describes the design behind the Lisa's user interface. The Desktop Library interface listings describe the routines and data structures developed to implement Lisa Technology. The Lisa Hardware Manual is a lengthy tome describing Lisa's hardware in extreme detail; if you are an electronic-hard-

ware fanatic, this manual is for you. The author also has a 1981 preliminary version of the hardware manual which runs to only 80 pages, versus 200 pages for the 1983 version. "Guide to the OS" is an internal Apple manual describing the Lisa Monitor development environment, precursor to the public Lisa Workshop environment. This document should be of interest to those who yearn for information about the Lisa's early development years and the tools used for the programming effort.

REFERENCES: LISA TOOLKIT

Shortly after Apple introduced the Lisa in 1983, an enterprising computer engineer from Seattle started a programming group called the ToolKit User's Group (TUG). This group centered around the Lisa ToolKit, which was based on the Pascal language derivative Clascal, as developed by Apple for long-term Lisa development. Those with an interest in the ToolKit will find the following resources beneficial.

* Software Frameworks: The Lisa ToolKit (*BYTE* magazine, Dec. 1984)
* Professor Overrider's Almanac (David Redhed, TUG's newsletter, 4 issues)
* Save the ToolKit: A Call to Arms (Call A.P.P.L.E., Jun. 1984)
* An Introduction to Clascal (Apple Computer, Jul. 1984)
* The Lisa Applications ToolKit Reference Manual (Apple Computer, 1984)
* Object-Oriented Programming for the Macintosh (Kurt Schmucker, 1986)
* ToolKit source code (David Craig)

The Schmucker Macintosh book is recommended for its concise introduction to the Lisa ToolKit and the Clascal language. Though devoted to the Macintosh and MacApp, Apple's ToolKit son, this book does provide an excellent chapter on both the ToolKit and Clascal. The ToolKit source code is a wonderful collection of well-written modules which any programmer could profit from reading.

REFERENCES: MACWORKS

Those inquiring about MacWorks, which allows a Lisa to run (most) Macintosh software, should pursue the following:

* MacWorks XL User's Manual (Apple Computer, 1984)
* MacWorks Plus: Making a Lisa Speak Macintosh (*MacTech Quarterly*, Spring 1989)

Several articles and manuals describe how to transfer Lisa data to a Macintosh using the Macintosh XL Migration Kit; the most accessible is probably:

* Using the Macintosh XL Migration Kit (Apple Computer, 1985)

REFERENCES: PATENTS

Several U.S. patents filed by Apple cover key Lisa technologies:

* Lisa Twiggy disk drive front panel (Patent #Des. 266,426, Oct. 1982)
* ProFile hard disk case (Patent #Des. 273,295, Apr. 1984)
* Lisa case (Patent #Des. 277,673, Feb. 1985)
* Lisa mouse (Patent #4,464,652, Aug. 1984)
* Twiggy disk drive (Patent #4,466,033, Aug. 1984)
* Lisa QuickDraw "regions" (Patent #4,622,545, Nov. 1986)
* Lisa Memory Management Unit (Patent #4,926,316, May 1990)

REFERENCES: REPAIR

There are several good Lisa hardware repair books which current Lisa (or Macintosh XL) owners should seriously consider purchasing:

* Macintosh Repair & Upgrade Secrets (Larry Pina, 1990)
* Lisa/Macintosh XL Do-it-yourself Guide (Sun Remarketing, 1990)
* Apple Service Technical Procedures: Lisa/Macintosh XL (Apple Computer, 1988)

The Apple Service Technical Procedures manual is a very detailed document describing how

to fix errant Lisas or Mac XLs. The original Lisa systems came with a wonderful disk called LisaTest that allowed a novice Lisa owner to diagnose the Lisa's maladies.

REFERENCES: PRECURSORS

For an overview of prior art that Apple liberally "borrowed" for the Lisa design, see various papers from Xerox and others (the entries marked "*" are contained in the Xerox publication "Xerox Office Systems Technology: A Look into the World of the Xerox 8000 Series Products" [OSD-R8203A, Jan. 1984]).

* The Star User Interface: An Overview (*)
* Designing the (Xerox) Star User Interface (* [also in BYTE, Apr. 1982])
* Alto: A Personal Computer (Computer Structures, Principles, and Examples, 1982)
* The Smalltalk Graphics Kernel (*BYTE*, Aug. 1981)

REFERENCES: MISCELLANEOUS

Finally, this article's author has written several other, more specific Lisa papers:

* Apple Lisa Graphical Object-Oriented User Interface (Oct. 1987)
* A Review of Apple's Lisa Pascal (Oct. 1988)
* A Review of Apple's Lisa Workshop (Oct. 1988)
* Apple Lisa 7/7 Tool Deserialization (1988)

SUMMARY

The Lisa may be seen in retrospect as an experiment that both succeeded and failed. It succeeded by introducing several concepts to the computing industry which revolutionized the way (some) computers were built and the ways (some) users used them. It failed to convince its dual target market (both power users and normal users) that it had met its goals of being easy to use, powerful, and reliable. Lisa marketing was both imaginative and aggressive for its time but, even so, could not measure up to the accomplishments of the system itself.

Apple Computer is one of the few companies in the world with the gumption to attack Lisa-sized, Lisa-radical projects. Apple's successful demonstration that a desktop system could be both powerful and easy to use, and its attempt to migrate Lisa Technology features to its newer computers, should be considered a feather in the hats of all participants in the Lisa adventure. In a few short years, a relatively small group of talented and dedicated people developed a system meant to endow ordinary men, women and children with computing resources barely even dreamed of. Whatever provoked this conjunction of technical talent, it resulted in a brief, unparalleled flash of brilliance that is now a fading but alluring image.

We can only hope that this fading flash will somehow be rekindled in the future. Having the Lisa legacy without learning from it would be worse than not having it at all.

NOTES

[1] An earlier version of this article was published in LISA LIVES, the newsletter of the Lisa Lives Users' Group, for Spring 1993.

This paper will shortly be available in an updated version which will include considerably more Lisa operational and technical information. To request a copy, please send 2 or 3 Macintosh 3.5" disks and a SASE to:

David T. Craig
941 Calle Mejia, Apt. 509
Santa Fe NM 87501

[2] Interesting conjectures as to "Lisa's" identity can be found in Robert X. Cringely's *Accidental Empires* (Addison-Wesley, 1992) and in Owen Linzmayer's *The Mac Bathroom Reader* (forthcoming).

[3] Sun Remarketing
Box 4059
Logan, UT 84323-4059
+1 800-821-3221
FAX +1 801-755-3311

[4] This, too, was a philosophical inheritance from Xerox PARC. See Aaron Alpar, "LOGO and Smalltalk," ANALYTICAL ENGINE V1#2, page 8.

A CALIFORNIA COMPUTER ON THE MOON

[We just had to include a commemoration for the silver anniversary of the Apollo 11 landing. Spaceflight computer expert Dr. James Tomayko of Carnegie Mellon University offers this description of MARCO 4418, a California computer to the....er, core, built by TRW in Redondo Beach. — Ed.]

The computer in the Apollo Abort Guidance System (AGS) may be the most obscure computing machine in America's manned spaceflight program. The 330-page "Apollo Spacecraft News Reference" prepared for the Apollo 11 mission contains not a single reference to it, in contrast to several pages of description of the Primary Guidance, Navigation, and Control System (PGNCS) computer and its interfaces. The invisibility of the AGS is a tribute to PGNCS, since the AGS was never needed to abort a landing. It was. however, an interesting system in its own right.

NASA policy decreed an abort if one more system failure would potentially cause loss of crew. Hence the failure of either the PGNCS or the AGS would have aborted the landing. The AGS operated in parallel to the PGNCS in the LEM (Lunar Excursion Module,) and provided independent position, velocity, attitude, and steering information; it could verify navigation data while the LEM was behind the moon and blacked out from ground control, and first exercised this capability during the Apollo 9 and 10 circumlunar missions. The AGS pioneered "strapped-down" guidance system architecture, using sensors fixed to the LEM to determine motion, rather than a stable isolated platform as do conventional inertial guidance systems.

The AGS system occupied only three cubic feet and comprised three major components: an Abort Electronic Assembly (AEA) or computer, an Abort Sensor Assembly (ASA) or inertial sensor, and a Data Entry and Display Assembly (DEDA) for the AGS.

AEA and DEDA: The Computer Hardware

Like the PGNCS computer, the AGS computer evolved as its designers clarified its requirements and purpose. The first design included only a "programmer," not a true computer but a fairly straightforward sequencer, with about 2,000 words fixed memory and without navigation functions. Its job was simply to bring the LEM to a lunar orbit higher than any surface obstacles; the crew would then wait for rescue from the Command Module, with its more sophisticated navigational and maneuvering abilities.

In the fall of 1964, to bolster autonomy and safety, the AGS was respecified to provide rendezvous capability without relying on outside information. TRW then decided to include a computer, first considering an existing Univector accumulation machine, but finally choosing the custom-designed MARCO 4418 (for MAn Rated COmputer). It was an 18-bit machine, with 17 magnitude bits and a sign bit. It used 8-bit op codes and 13-bit addresses. Numbers were stored in the two's complement form, fixed point. Twenty-seven instructions were available, with per-instruction execution time varying from 10 to 70 microseconds. Unit size was 5 by 8 by 23.75 inches, weight 32.7 pounds, and power requirement 90 watts. The 4,000-word memory was bit serial access, divided into 2K fixed and 2K erasable cores. The cores were of the same construction throughout, unlike those in the primary computer, making the ratio of fixed memory to erasable memory in the MARCO 4418 re-definable; TRW was obviously building in compatibility with later applications.

The DEDA was smaller, at 5.5 by 6 by 5.2 inches, and less versatile than its counterpart in the primary computer. It was located at the right of the LEM control panel in front of the pilot. Sixteen pushbutton keys included CLEAR, READOUT, ENTER, HOLD, PLUS, MINUS, and the digits 0-9. Of the nine windows in its single readout display, three showed the address in octal, one the sign, and five, digits; this resembled the readout of the Gemini spacecraft computer.

SOFTWARE FOR THE AGS

AGS software repeatedly had to be "scrubbed" or reduced in size. By 1966, 2 full years before the first active mission of the LEM, only *20 words* remained of 4,000 in AGS memory. Memory management became a key concern of both TRW and NASA. Since the fixed portion was programmed early and remained set to save money, all changes had to be made in the erasable portion, which became very expensive and arduous; the developers fought to free up storage one location at a time. Some programming also had to be altered to forestall possible dangers. For example, early versions of AGS software followed the primary computer in calling for engine shutdown and an attitude hold upon restart; this sequence could be disastrous for a LEM close to the lunar surface. The installed version permitted the crew to fire the engines manually during a restart.

Software development followed a tight schedule and, despite obstacles, was completed in eleven months from receipt of mission profile and requirements to delivery of final program tape. One method of software verification was probably unique. To simulate motion and provide realistic inputs to the computer, technicians drove MARCO 4418 around Houston in a van, with the programs running.

USE OF THE AGS

The AGS was never used for an abort, but did contribute to rendezvous and docking with the CM on the Apollo 11 mission, and monitored PGNCS performance during all missions in which it flew. The only criticism of its performance was from astronaut John Young, who remarked that "one mistake in a rendezvous, and the whole thing quit;" restarts apparently occurred during recovery from some operator errors.

In the last analysis, AGS was like a parachute — mandatory, but presumably never needed. Its important legacy for NASA, however, was in improved ability to develop and manage spaceflight software.

[Adapted, by permission, from Volume 18, Chapter 2, *Encyclopedia of Computer Science and Technology* (Marcel Dekker, pub.)]

Book Review: HISTORY OF COMPUTING

An Encyclopedia of Computer History
(Version 2.0)
Antelope, CA: Lexikon Services, 1994
Hyperstack for MS-DOS or MS-Windows,
approximately 650 pages, US$19.95
ISBN 0-944601-405

Reviewed by Kip Crosby

When I began collecting tidbits of computer history, I stashed them in an MS-Windows string-search database, sorted by date. I badgered after details and worried that they'd escape before I had time to key them in. My paperbacks blossomed with post-it bookmarks. I puzzled over contradictions from multiple sources. (Is everybody saying "Been there, done that?") After many rampages through libraries, and thirty or forty hours of keying, I had....a pretty good reference stack. For some things.

Now along comes Mark Greenia and knocks my socks off. Watch out! Your socks are in peril too.

Lexikon Services' HISTORY OF COMPUTING bills itself as many references: an encyclopedia, a dictionary, a personal and corporate biography, and a series of chronologies. Anything that won't fit in one of those frameworks is relegated to a rich series of appendices, including things like "Personnel Changes in the 1990's," "Top 50 Software Sellers," and "Decimal-Hexadecimal-Binary." There are odd calls here; for example, I might have included "Programming Languages" under General Topics rather than making it Appendix A, and if "Digital Computer Survey of 1953" is a General Topic, why is "Computer Manufacturers of 1956" Appendix B? But some awkward categorization only underscores the problem that this hyperstack bravely addresses: Computer history is a *huge* topic from the standpoint of any single reference work.

Okay. Computer history isn't all here, either, and some of the gaps are frustrating; as an example, the biographical section ranges from Howard Aiken to Konrad Zuse and comprises only twenty-five individuals. But an hour spent with the HISTORY OF COMPUTING will

convince you that these gaps are less significant than they seem at first. This stack, in its voracious inclusiveness, has the same compelling fascination as the Guinness Book of World Records. Want to know about SHOOT (Superfluid Helium On-Orbit Transfer,) the first expert system used on the space shuttle? It's in here. Ever wonder what "Amstrad" is an abbreviation for? You'll just have to search and find out. What the heck was the "IRSIA-FHRS"? (Look in "Early Vacuum Tube Computers.") You can zip from entry to entry and menu to menu, mesmerized, until you stand up and discover that your knees are very stiff. Above and beyond the merit of the HISTORY OF COMPUTING as a reference work — which is considerable — its entertainment value as a computer history browser is a real clincher.

Labeled "Version 2.0," this stack is really the fourth update since the HISTORY first appeared, and every revision has brought significant enhancement. The most welcome news in 2.0 is a true automatic text search feature, both menu-by-menu and across the whole stack, which does a lot to smooth out the sometimes puzzling organization. 2.0 is also more comprehensive than any previous version and, with over 1,300 entries, is the equivalent of a *big fat book*. The bibliography alone, with over two hundred attentively chosen titles, is worth the price of the disk.

If this program has an Achilles' heel, it is the minor copyediting and spelling. A few minutes' browsing in the Q-Z section of the Computer Dictionary, for example, turns up "Argone" for Argonne, "Sherbius" for Scherbius, and "Bletchly" for Bletchley as in Park. These errors would be no more than annoying, except that the program is a string-search engine.... The search is marred, also, by being oblivious to a world of infixed capitalizations. When I search on "VisiOn" to find VisiCorp's windowing application suite, I'd rather not get hit with "vision," "envision" and "television," which give quite a few false matches. Presumably these quirks can be addressed in the next release, and if the stack's prior history is any guide, they will be. Greenia is conscientious about improvements.

Uneven, unabashed, and unrivaled, Lexikon's HISTORY is a must-have for any student of computers or their ancestors. I look at paying $19.95 and 2Mb disk space for this stack, and remember the hours of fluorescent library dust I invested to come....not even close. If you've read this far into the ANALYTICAL ENGINE and you have a computer that runs MS-DOS or MS-Windows, order the HISTORY OF COMPUTING before this day is out.

Lexikon Services
3241 Boulder Creek Way
Antelope, CA 95842

RESTORERS' SOURCE LIST, rev 0.9

[We've had several inquiries lately about sources for scarce and obsolete electronic parts. This list was scavenged from Internet traffic and checked by Frank McConnell and KC; total accuracy not guaranteed, but it should be fairly reliable. Please forward any necessary changes or verified additions.

ENGINE readers in other parts of the US: Please send name, address and phone listings for comparable stores in your areas. We intend to expand this considerably.]

Action Electronics
500 Lawrence Expressway
Unit G
Sunnyvale CA 94086
+1 408-734-3475

Al Lasher's Electronics
1734 University Avenue
Berkeley CA 94703
+1 510-843-5915

Arndt Electronics
1355 Shoreway Road
Belmont CA 94002
+1 415-592-6718

CSC/Disc Drive Depot
500 Lawrence Expressway
Unit H
Sunnyvale CA 94086
+1 408-734-3475

Curtis Trading Company
776 South Milpitas Blvd.
Milpitas CA 95035
+1 408-946-5455

Electronics Etc.
2738 Tenth Street
Berkeley CA 94710
+1 510-845-0169

Electronics Plus
823 Fourth Street
San Rafael CA 94901
+1 800-321-4524

Halted Specialties
3500 Ryder Street
Santa Clara CA 95051
+1 408-732-1573

Haltek Electronics
1062 Linda Vista Avenue
Mountain View CA 94043
+1 415-969-0510

HdB Electronics
2860 Spring Street
Redwood City CA 94063
+1 415-868-1388

Jameco
1355 Shoreway Road
Belmont CA 94002
+1 415-592-8097

Mike Quinn's
1080 Langley
Oakland CA 94621
+1 510-569-1539

SYNNEX Clearance Center
3789 Spinnaker Court
Fremont CA 94538
+1 510-440-3690

Weird Stuff Warehouse
1190 Kern Avenue
Sunnyvale CA 94086
+1 408-746-1100

Zack's Electronics
1380 Howard Street
San Francisco CA 94103
+1 415-626-1444

ACQUISITIONS

[We haven't accepted a lot of hardware this quarter, since there was no point to storing it in El Cerrito, hauling it down to Redwood City and storing it again. Machines waiting in the wings include an Osborne One, a Cromemco Z-2D, an IMSAI VDP-40, an HP Integral, some sort of Altos, probably a Morrow MD-3, and possibly a Kaypro 10 and a Compupro.]

HP 125

Dan Swaigen

"E. T. lives!" That's the traditional reaction to our April cover subject, the HP 125, with its futuristic "pod" looming from a pedestal base. This one was purchased from Dan Swaigen of Sunnyvale.

We had to store this computer before we had time to do a technical assessment, but in general: It's a member of the "100 Series" of micros (like the 110 laptop and the 150 touchscreen,) which flourished in the early Eighties. During this time, HP largely abandoned proprietary operating systems and applications for micros, so that (for example) the 125's operating system is CP/M, its BASIC/125 is modified MS-BASIC, and its WORD/125 is a custom version of Lexisoft's popular CP/M word processor, Spellbinder.

Like most early 125's, ours is paired with the 82901 dual 5.25" DSDD floppy disk drive, and a keyboard which unfortunately has a swath of plastic rot (see QUERIES). Another large box contains software for the 125 and 150, some of it still in the shrink-wrap, and a bunch of ring binders of program listings and possibly also HP newsletters. This is a treasure trove, and we impatiently await a second chance to look it over. Thanks, Dan!

KAYPRO II

Mel Shattuck

Think back to the days when computers were the size of a room....then the size of a refrigerator, or two....then the size of a desk. At the dawn of the Great Shrinking, it was so

easy to sit back and dream. *How about a computer with a handle on it?*

And before long, each in its own way, there they were: the breathtakingly expensive IBM 5100, militantly odd digital group Bytemaster or Conterm Hyperion, wildly popular Osborne, or the Compaq Portable, very suit-and-tie. Yet Non-Linear Systems' Kaypro II, with its sporty silver-and-blue color scheme, somehow epitomizes the luggable. The Z-80 CPU made it quick, or quick enough; the nine-inch CRT, a big improvement over the five-inch screen of the 5100 or Ozzie, would let you do a whole day's word processing with no threat of a headache at the end. CP/M as the operating system opened the doors to a galaxy of software. Some combination of form factor, convenience, reliability, and the accessible $1795 price put this firmly in the pantheon of memorable computers.

Mel Shattuck of Berkeley, a micro hand from the days of Cromemco and before, brought this pristine Kaypro over to CHAC's garage and donated it, along with appropriate distribution software, work disks, and manuals. Thanks a lot, Mel. Not having a Kaypro, in a computer museum in California, would be hard to imagine.

LETTERS

POSTAL COMMEMORATION OF COMPUTING

In a recent exchange of E-mail with David Greelish at HCS, I discovered that he had also thought about the possibility of getting the USPS to issue commemorative stamps for the 50th anniversary of the birth of the US computer industry.

My wife is a stamp collector, and she has a USPS booklet that has the rules for suggesting topics for postal commemorative stamps. What it says is that you have to submit the suggestion for a commemorative stamp or stamp series to the

USPS Citizen's Stamp Advisory Committee
Room 5800
475 L'Enfant Plaza West SW
Washington DC, 20260-6352

It says that helpful background information should be provided but that suggested artwork should not be provided. The committee receives hundreds of suggestions every month, and they can only use a few suggestions a year, so brief and to-the point suggestions with clear and concise supporting statements are important.

Suggestions approved by the committee and accepted by the USPS are then assigned to design committees which oversee the design of the stamp, so don't expect commemorative stamps to be issued without a few years lead time! Right now is the time to suggest commemoration of events that happened in 1947, and it may be too late to start the mill grinding to celebrate a 1946 event.

I went through your list of dates and found the following stuff that has 50th birthdays coming up soon, to which I added a few things for which I don't have the dates or appropriate details:

ENIAC — America's first electronic computer, built at the Moore School of Electrical Engineering at the University of Pennsylvania, it became operational in November 1945, and was demonstrated to the Army on February

15, 1946. ENIAC was apparently converted to a stored program computer in 1947; this latter date may actually be more important than is generally realized, since it is at that time that ENIAC apparently became a general purpose computer in the sense we now understand the term.

EDVAC →
ILLIAC →
SILLIAC →
MADVAC →
ORDVAC →

I don't have the dates for these machines! Some, but not all of these need to be commemorated, but I don't know which. These were the research computers that filled an important gap between ENIAC and the birth of the modern industry.

ERA 1101 — The first commercially built computer to be delivered in the United States, this was sold by Engineering Research Associates to the Georgia Institute of Technology in December 1950.

UNIVAC I — This was the first commercially sold computer; the contract to build it was between the Eckert-Mauchly Computer Company and the U S Bureau of the Census, signed on Sept 25, 1946. The machine was finally delivered by Remington Rand on March 31, 1951. Ultimately, 40 more machines of this model were sold. As a result, Remington was, for a few years, the world's leading computer manufacturer.

IBM 701 — The most important of the early computers, in retrospect. The prototype was unveiled on April 7, 1952; the first production model was shipped in December, 1952, and the first customer delivery, to Los Alamos, was made on April 1, 1953. This machine propelled IBM into a position of world leadership in the computer industry.

As an aside, I should note that the British should look into getting British commemorative stamps issued for the following important machines:

Manchester Mark I — This was the first fully operational computer that was designed from the start as a stored program machine. Runs first full length stored program, June 21, 1948.

EDSAC — Another event the British need to celebrate! Built by Maurice Wilkes at Cambridge, this ran its first program in May 1949.

LEO — The Lyons Tea Company's amazing venture, and a machine that not only marked the start of the British computer industry, but managed to beat the Americans to market!

Finally, I'll suggest a general introductory argument to be made in letters to the USPS advisory committee:

The computer industry was born in the wake of World War II, and over the next decade, we will be celebrating the 50th anniversaries of a number of important developments in this field. Given the important role that computers play in today's world economy, and given the important role our country has played in developing this industry, we feel that it would be very appropriate to mark these anniversaries on a series of commemorative postal stamps.

— from Doug Jones, jones@cs.uiowa.edu

[One of our favorite rationales for electronic transmission of the ENGINE is the warp-speed propagation of good ideas, and Doug has certainly contributed his share. Our Association's letter to the USPS Advisory Committee is in preparation. So far as the United Kingdom's GPO is concerned, we would certainly add COLOSSUS to the list of meritorious devices.]

MORE ON COMPUTERS AND MUSIC

I can't say if the system was ILLIAC I or II, but the following text might be of interest. It's taken from the liner which accompanied a 10" LP record published by Bell Labs in 1961 under the title "Music from Mathematics":

> In addition to "playing" music it is also possible for a computer to "compose" music. On Side Two of this record is presented an excerpt from a series of unusual experiments conducted at the University of Illinois by Lejaren A. Hiller, Jr. and Leonard M. Issacson. They successfully programmed the ILLIAC computer to compose music according to various rules of musical composition which were stored in the computer. The computer produced se-

> quences of letters and numbers which were then transcribed by hand into conventional musical notation suitable for playing by human musicians. This two-minute excerpt from the 20-minute *Illiac Suite for String Quartet* is played by the WQXR String Quartet (Harry Glickman and Hugo Fiorato, violins; Jack Braunstein, viola; and Harvey Shapiro, cello). A more detailed description of *The Illiac Suite* is presented in the album notes.

Excerpts from the enclosed notes, starting on page 7:

> THE COMPUTER AS COMPOSER
>
> [...] In order to investigate this idea [computer-composed music] L. M. Issacson and L. A. Hiller, Jr., in 1955, conducted a series of experiments of composing music with *Illiac*, the high-speed digital computer at the University of Illinois. They completed four groups of experiments and published samples of them in *The Illiac Suite for String Quartet.*
>
> THE ILLIAC SUITE FOR STRING QUARTET
>
> To set a digital computer to composing simple melodies, Hiller and Issacson assigned numbers in sequences to the notes of the music scale from low C upwards. At first only white notes were used, with sharps and flats omitted; but in later experiments a chromatic scale of about two and a half octaves was used. Then the computer was set to generating sequences of random numbers. These can be interpreted as equivalent to random music.

[a couple of pages of descriptions of the four movements and the sequence filters which were applied to produce the computer-written music]

> Musicians who have played computer compositions have complained that the score is often too difficult for human fingers and conventional musical instruments to perform well.
>
> That may well be. Perhaps in the future computers will compose "easier" scores; or, what is more likely, they may circumvent human musicians and conventional instruments entirely, and play the music themselves.
>
> In fact, several computers have been "practicing" for several months, and already they are becoming versatile musical instruments.

For context, the disk shows a copyright date of 1960 and the enclosed booklet (from which the above was taken) shows a 1961 copyright.

— from Joe Morris, MITRE.

[Liner notes and booklet text reprinted by permission of AT&T.]

HISTORY QUERIES

I have a series of questions concerning the use of certain techniques in computer design. They are:

1.) Which were the first computers to use microprogrammed architectures as opposed to hardwired architectures?

2.) Which were the first computers to use interrupts? Was the interrupt state stored in RAM or internal registers on the processor?

3.) Which were the first computers to use paging of RAM or ROM memory?

If someone could point me at someone whom might know the answer to these questions or could suggest some publication, library, etc. that might be of help, I would be very much obliged.

Andrew Robertson
Department of the History of Science
Harvard University

CP/M COMPUTERS: REPLIES TO BESEHANIC, LACEY, GALLES, WEST

Kip, got the ENGINE yesterday. Some random comments and responses to things in it:

— Cover, the picture of an HP 125 is not accurate. It has the pedestal base WAY too big. Have you considered taking photos and scanning them?

— Pg. 22, the Morrow doesn't *have* a monitor or a keyboard. Let's not apply PC terms to pre-PC computers, please. The Morrow series hooks up to a serial *terminal*, which provides the system console. Morrow sold several terminals under their label, including relabeled ADM-3A's and Freedom Liberty terminals.

— Pg. 25, note that the HP 86 will run CP/M with the insertion of a CP/M cartridge.

— Pg. 35 (1) The Husky Hunter is a CP/M machine which was part of the standard equipment of NATO forces. If Jan Besehanic wishes, I will copy the Husky brochures for him. If he wants to sell or trade the Hunter for another computer, I'd like to have it for my collection. (2) Tell Dave Lacey to talk to Sydex. They will add the Microlog format to 22DISK if it isn't already in there, and then anyone with a PC with an 8" drive attached can copy the files to other formats. Microsolutions will sell him a Compaticard and cable to attach an 8" drive to a PC, or I will copy the files for him for $10 a disk. I don't know what he can do about NBI word processor disks, but Sydex might have some ideas. (3) I have the NorthStar Advantage manuals, and will sell Bob Galles copies, if he wants. ED and ASM, of course, are standard CP/M utilities which any book on CP/M describes; he can look in his local library, or I will sell him a CP/M book. If F80 is a FORTRAN compiler, he will have to identify which one it is, by running it, before I can help him.

— Pg. 37, Tell John Todd West that Avocet sells a whole line of PC cross compilers, including Z80. They advertise in *Circuit Cellar Ink*, among other places.

— from David A. J. McGlone, via GENIE

[David, thanks for the useful information! We'll take this occasion to remind our readers that, as a resource for the worldwide community of CP/M computers and their users, nothing surpasses Lambda Software Publishing and *The Z-Letter*.

As for our covers — well, we certainly will run photos as this issue demonstrates, but we'll run art, too. April's cover was no engineering drawing, obviously; it was meant to *feel* like an HP 125 and convey some of the design's ingratiating weirdness. — KC]

MICROS: LAST-MINUTE SAVE

Just going through your on-line magazine. Really want to commend you on this publication. I was wondering if something like this existed and I am glad it does. There is a wealth of information as well as hardware and software that should be preserved before it becomes too difficult to find. The time is ripe for the collection and organization of this material and devices.

Lots of early microcomputer stuff is still out there to be acquired before someone tosses it out (unknowingly). For example, I often tour thrift shops for antique calculators, books, etc. Recently, I stopped into the local thrift shop and found that someone had anonymously donated the following:

- Osborne 1 portable
- Commodore PET
- Adam
- Atari 800
- original IBM PC
- Commodore 64
- VIC-20

They weren't there the day before. (Since it was 1/2 off day, I bought them all, except the Adam and the PC.) These machines came close to being tossed in the dumpster by someone. Even the thrift shop was not sure what they were. I am glad to see that publications such as yours are bringing together individuals who are interested and knowledgeable about computing and the value of preserving its historical roots. Thanks to all your staff (& readers)!

— from Mark Greenia, Lexikon Services Publications, via AOL

ORIGIN OF "MINICOMPUTER": REPLY TO JONES

Hello from sunny Nottingham, in the UK.

I have just read vol. 1 #2 of your interesting publication. You asked about the origin of "Minicomputer".

The answer is in *The Ultimate Entrepreneur*, by Glenn Rifkin and George Harrar of *ComputerWorld*:

"John Leng, who started and ran DEC's Canadian operation until 1964, flew to London to establish DEC's presence in the United Kingdom. In the mid-sixties, mini-skirt fever raged on London's Carnaby Street. Leng zigzagged through British traffic in an Austin Mini. He sent back sales reports: "Here is the latest minicomputer activity in the land of miniskirts as I drive around in my Mini Minor." The phrase caught on in DEC, and then the industry trade publications grabbed onto it. The age of the minicomputer was born."

This book has many interesting anecdotes for anyone with an interest in computer history.

Keep it up,

— from Nigel Lowey, DEC UK

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]

ANALOG COMPUTER, NON-ELECTRIC, URGENTLY WANTED

I would like to procure a high-quality analog computer, known as slide rule, preferably one with four digits of precision. The usual supply stores don't carry them any more. Does anyone know where slide rules can be found these days?

— from Peter van Roy, DEC Paris

[This seems to be a question of general interest and we already have two answers. Try:

Bob Otnes
Oughtred Society
2160 Middlefield Road
Palo Alto CA 94301 USA

or

Suzanne Wyatt
Box 83
Dearborn MO 64439 USA

both of whom have slipsticks for sale, so far as we know. — Eds.]

DEC VT-180: CURIOSITY AT CORNELL

I'm ashamed to confess, I had never heard of a VT-180 before... well, at least not until one was donated to our Classic Computer Club. I've given it a full check-out, and discovered that this unit contains a Z-80 CPU, has 64K RAM, and runs CP/M 2.0 from an RX-180 floppy system.

My question is: What the heck?

As I said, I've never seen a reference to the VT-180 or RX-180 floppies anywhere, and I'm dying to know a little bit more about them. What were they developed for? When were they in production? What format is the RX-180? How close on the heels of this machine was the Rainbow released? Thanks very much for any and all information!

- from Seth J. Morabito, Cornell University Classic Computer Club, sjm1@cornell.edu, sethm@pnet.com

EDUCOMP: THE GOOD OLD DAYS

When I was in junior high back in 1977, we had a computer that I believe was manufactured by DEC, but it went by the name "EDUCOMP". The computer's distinguishing features were as follows:

- Had a Teletype with a punch-tape read/write unit as the I/O device.

- Had a drive for those 5-inch DECtape thingy's.

- Had an OS built around BASIC. This OS was loaded in from the tape when the system was booted.

- Booting the system consisted of inserting one of those circular key-things into the system unit (which was about the size of a large modern microwave oven, as was the tape drive), turning the key, and depressing four toggle switches in the proper sequence.

- If everything was working, the teletype would respond with a "." prompt, at which point you typed "R BASIC" (there was no lower case). The tape would whir back and forth for a minute or so, and then come back with the word "READY".

- There was a variety of software available. The most popular was a horserace simulation where the greatest horses of all time (Man-O-War, Citation, Whirlaway, Coaltown, etc.) competed against each other with the help of an odds table and a random-number generator. The user could place bets and win or lose money.

- Other software included a lunar lander, 3D tic-tac-toe, a simulation of Mendelian inheritance in a population of moths, a rather interesting diplomacy simulation, and several others. All programs used either pure text or primitive TTY character graphics. All were written in BASIC. Does anyone else remember this system? Did DEC make it? Any info and other reminiscences will be much appreciated!!

— from Richard S. Smith, rsmith@netcom.com

FORTUNE 32:16: JUST ABOUT ANYTHING

I've been given a Fortune 32:16 system that is about 12 years old and has been in daily use all that time running the inventory & sales ledgers for a small business with 5 terminals and two printers. The configuration is:

68000 processor, 1 Mb RAM, 20 Mb Shugart hard disk, 5 1/4" floppy (800K maybe?), at least 8 serial ports.

The software I have is: For:Pro 1.8f & 1.7, Fortune Word Processor, Fortune Business Basic, Fortune Account system in Business Basic. Just about all the Docs are also here.

What I need is the C development package, more up to date OS; I know there was a For:Pro 2.1 as the C-Kermit makefile supports it. Also hardware info would be good as I'd like to try to upgrade the RAM and HD.

So please, if anyone has anything on this let me know. I used one of these for a short time when they first came into the UK and they were pretty impressive in their day.

Thanks for anything you have!

— from Jonathan Stockley, via Internet

MATTEL INTELLIVISION: TECHSTUFF

I'm looking for information on the old Mattel Intellivision video game console.

1) The Intellivision I (brown case, internal power supply) requires (according to the box of the Computer Module) "factory modification" to allow it to be used with the Atari 2600 adapter (or as Mattel called it, the "System Changer"). Does anyone know what this modification was and how to do it?

2) The Intellivision II has some compatibility problems with some 3rd party software. I hear there is a modification to fix this. Anyone have this information?

If anyone knows of sources for game cartridges or consoles or especially stuff for the Intellivision Computer Module or the Aquarius, please let me know.

— from David Tipton,
6500dtpt@ucsbuxa.ucsb.edu

MITS ALTAIR FLOPPY DRIVE WANTED

I am looking for a MITS Altair floppy drive including controller cards.

— from Rick "richard66" Shane, +1 614 444-0213, via AOL

[Rick,

You and half the rest of the world — lately. The good news is that Haddock catalogs this drive at US$200 to 300, so it's not stratospheric, but it will still take some digging at any price. If we hear of one for sale we'll let you know. — Ed.]

NCR DECISIONMATE V: BOOTLESS

Does anyone have a CP/M disk for the NCR Decisionmate V? I have the original system with all manuals, and it has a hard drive but I can't boot it since the system files got messed up. Any CP/M boot disk should work...

Thanks!

— from John Wink,
jgwink@cayley.uwaterloo.ca, via Internet

[John,

You're being too optimistic when you surmise that "Any CP/M boot disk should work," but if David McGlone has a bootable disk in the proper format, he can help you out. See the address for Lambda Software Publishing on page 45.]

NORTHSTAR HORIZON: BOOTLESS TOO

I just picked up a NorthStar Horizon computer. (It will go nicely with my SOL-2.) On turn-on, it tries to access the floppy, but I don't have the boot disk. Does anyone have a copy of the boot floppy that they could duplicate/email? I would also like to know if there is any documentation available (SAM's, TAB, etc.) Thanks,

— from Charlie Brett, cfb@fc.hp.com

[Charlie,

Again, David McGlone at Lambda Software Publishing is your source. Refer to his letter on page 39.]

RACAL-MILGO OMNIMODE 48 SAYS "HELLO"

I picked up a couple of these Racal-Milgo things for US$2 ea. I really would like to figure a way to use them, as every time I power them up they say "HELLO," and I like that. I wish all the rest of my stuff was so polite as to greet me before it started causing problems! Anyone want to tell me what use I could put these to? — as just turning them on and off again is getting boring....

— from David Case, via Internet

RESEARCH MACHINES LINK 480Z: "A WORTHY INTELLECTUAL CHALLENGE"

A friend has....decided to go back to the basics of computing and teach himself some machine code. He obtained a Research Machines link 480Z machine — Z80 processor.

Does anyone have, or does anyone know where I might find, a listing of the call addresses into the ROM?

(Until he started asking me about this, I'd forgotten that I'd ever written machine code... I think it's a worthy intellectual challenge for a musician who's become fed up with using Amiga programs without knowing what happens under the hood...)

— from Mike Holderness, via Internet

SEMICONDUCTOR LASERS: AUTHOR'S QUERY

....I'm working on a history of, amongst other things, the semiconductor laser, and I'm trying to track down its first application to data storage. I have the Philips/compact disc side of the story fairly well tied down, but there are two other things I need to know, viz.:

- How on earth and why did IBM get involved with MCA (in Discovision, the company that holds the basic patents on laser audio-video analog disk technology)?

- Who first proposed adapting the compact disk player for use as a CD-ROM drive?

— from Bob Johnstone,
bobjohnstone@twics.com

SHARP MZ-800: ANY INFO WANTED

Today I bought at a second-hand shop a Sharp MZ-800 computer (built-in cassette drive, plugs into TV set). At boot-up you can either load something from tape or enter a monitor. The only functions of the monitor that I have as yet discovered are loading from and saving to tape, and turning the beeper on/off.

Does anyone know about this thing? Manuals? Software? Useful hints? All info appreciated! Cheers,

— from Sander van Malssen, via Internet

TEAC CT-600H TAPE DRIVE: REPLACEMENT NEEDED

A friend....just had his tape drive blow out on him. It is a TEAC CT-600H according to the number on the cassette, and the size is 60Mb per tape. The thing about this drive, though, is that it appears to take standard tape cassettes! I've never seen a drive like this before. Does anyone know where we could find a replacement?

Regards,

— from Peter L. Buschman,
97buschmanp@matt.alma.edu

[Peter,

By "standard tape cassettes" do you mean quarter-inch audio cassettes, or is this one of those drives from the mid-eighties that backed up to video tapes? Just curious. — Ed.]

UNIX BOOKS: REPLY TO BOOTH

Russell Schulz of Edmonton, AB, Canada notes that reprints of the "UNIX System Software Readings" are available from UMI, 300 North Zeeb Road, Ann Arbor, MI, USA; +1 313-761-4700, business hours US Eastern time. UMI quotes bound reprints of the AT&T/Bell System Technical Journal (which is what these were) at US$50 per issue, with four to six weeks' delivery.

VICTOR 9000: BOOT DISK SOUGHT

Does anyone know where I can get a boot disk for a VICTOR 9000 system? It is a CP/M-86 machine. I bought it at a garage sale (actually I wanted the printer, an Epson MX-100, and they would not sell me just the printer). I received some of the manuals and some program disks including a SYSGEN disk but not the boot disk. Any other info on this machine is appreciated i. e.: upgrading, possible uses other than a big paperweight or a boat anchor.

— from stan.salter@ablelink.org, via Internet

VISION: WHAT WAS IT?

I seem to remember that in 1983, before the Mac hit the scene....the VisiCalc people came out with a GUI for the PC (XT-class, AT's hadn't come out yet) called VisiOn, which included the first mouse available for PC's. It came with a word processor and some other software. Does anyone remember this? I just remember the ads (I owned an Apple][at the time). What was it like?

— from Jonathan Badger, via Internet

[Jon — Our on-line references say that VisiCorp introduced VisiOn, a suite of integrated software with windowing capabilities, at Fall COMDEX in November 1982. A projected list price of US$1500, daunting hardware requirements (512K RAM) and rampant bugginess doomed it almost immediately; but Bill Gates perceived it as enough of a threat that he accelerated the development of the Interface Manager, which became MS-Windows. You'll find some more details in *PC/Computing* magazine (US), March 1993, on page 158. — Ed.]

WORD MANAGEMENT SYSTEM: GETTING BACK ON TRACK

I know someone who needs to read a 5.25-inch floppy, 16 hard sector, using an old Word Management System. If I could find a machine that would read the old Micropolis drive diskettes, I've got the old program. Anyone got a way?

— from "hshubs" via BIX

ONE FROM THE EDITORS: HELP FIGHT PLASTIC ROT

Small computers and terminals of the 1970s and early 1980s typically have hard plastic cases, gray to gray-beige in color. Over a period of years this plastic has often turned a garish yellow-brown and become very brittle. This has happened to a lot of Hewlett-Packard computers — including our own HP 86 and HP 125 — but Karen Lewis at HP Archives says it also appears on many Apple II's and III's.

Protecting the computer case from UV light will arrest this degradation, but we're interested in reversing it! We've asked several authorities and, so far, only learned that xylene-based copier cleaner will restore the original appearance of the plastic surface. But xylene is nasty to electronic components and painted finishes, it's quite toxic, and something tells us this isn't a permanent repair anyway.

To the best of our knowledge, this is a minor epidemic and will have much worse effects in ten to twenty years if not explored now. If any ENGINE reader has pertinent background in the chemistry of plastics, we — and quite a few others in the curators' and restorers' community — will be grateful for advice.

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Kip Crosby, Managing Editor
Jude Thilman, Telecomm Editor

PUBLICATIONS RECEIVED

The Computer Museum NEWS, Summer 1994. Networked Planet; Computer Bowl All-Star Game; Internet Auction; Contemporary Art and Computers; Special programs. 8 pp.; available with US$25.00-50.00 annual membership. From Brian Wallace.

International Calculator Collector, Volume 2 Number 2, Summer 1994. Collecting trends; New members; "Calculated Boom" (October 1972 *Newsweek* reprint); Ten-key adding-listing machines; Classifieds; more. 16 pp.; US$12 per year with membership. From Guy Ball.

Historically Brewed, newsletter of the Historical Computer Society. Issue #6, Jul/Aug 1994. Kaypro Korner; Canon Cat; PCjr; Unisys; The MITS Story. 24 pp. US$15.00 per year; Can$20.00; International, US$24.00. From David Greelish.

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

Number 30, March/April 1994. Bondwell 2 laptop; Evolution of ZDB Z-System database; correspondence, resources and technical discussion. 20 pp. [We printed this in the April issue as the contents listing for *Z-Letter* #28. We regret the misprint.]

Number 31, May/June 1994. Customer and subscription database programming; Bench debugging; Speeding up Eagle disk drives; correspondence, resources and technical discussion. 24 pp.

US$18 for 12 issues (2 years); Canada/Mexico, US$22; International, US$36. 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.

International Association of Calculator Collectors, 10445 Victoria Avenue, Riverside CA 92503. Guy Ball, Bruce L. Flamm, directors.

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

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

Unusual Systems, 220 Samuel Street, Kitchener, Ontario N2H 1R6, Canada. Kevin Stumpf, president.

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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. Previously published material will be republished only in clearly attributed quotations or citations; or when its publication in the ANALYTICAL ENGINE will bring it to the attention of a significantly broader audience; or when the original publication is materially obsolete or inaccessible.

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 3.5", or Mac HD (1.4) diskettes. Alternatively, please send your article as ASCII or ISO Internet mail. Please avoid submitting on paper unless absolutely necessary.

SUBSCRIBE!

In the first months of 1952, Rey Johnson leased the building that became the IBM San Jose Labs. On April 24, 1953, an IBM 701 was delivered to Lockheed Aircraft Company in Glendale. California's computer industry was off to a flying start — more than forty years ago. Today it continues to set standards for the world.

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THANKS TO....

Tom Haddock and Dan Alexander for the book tie-in.

Nancy Mulvany and Robert Praetorius for donations.

Roger Sinasohn and his rough-but-ready Land Rover for help with the (re)move to Redwood City.

Wesley Hohfeld for lending us his pickup truck; and Hilary Crosby for driving it.

ETERNAL VIGILANCE....

Always remember that, if you're expecting an ANALYTICAL ENGINE and you don't get one, we want to know about it. Pronto.

We're not saying that this is likely and, frankly, it isn't. But: Maintaining the list of addresses to send the ENGINE via Internet mail requires the (fallible or fatigued) human brain as a bridge between two pieces of software. As for paper copies, it seems that the Postal Service occasionally sends one to \dev\null. In early July we know that one electronic copy, and two paper copies, of the April ENGINE were definitely mailed and never arrived.

If you're supposed to get an ENGINE and you don't, *complain*. We'll send you another one.

NEXT ISSUE

IBM and RAMAC, Part Two; and lots, lots more....

COVER ART

The Association's Processor Technology SOL-20, NorthStar 5.25" floppy drive, and Micro Computer Devices modem. Photo by Joseph Schopplein.

NINES-CARD

Hey, That Moose Is Eating My Tape!

The UCLA computer club ("UCLA CC" or just "CC") was formed in the sixties, and was already a thriving institution by 1969. "The machine" that we got to use was an IBM 360/91, a mainframe running IBM's OS/MVT. We would submit card decks in the evening, and we'd get our printouts back the next morning. Each club-member's job was allotted 18 seconds of CPU time per night. These charges were accounted for in terms of the "Machine-Unit-Second", or "MUS". So, eventually, the UCLA CC had their own punched cards made up with a large picture of a moose on them, chewing on a magtape, with a stack of printout paper and the "club log" in the background.

The '91 was roughly a ten million dollar machine; I heard that there were only about 10 of them ever made. "Ours" had 16 Megabytes of core memory in it — half the memory of the $10,000 workstation I'm typing this onto (but of course it isn't real magnetic doughnuts any more).

Originally, the "club log" was simply a logbook (an engineering-style lab book) to keep track of when and by whom the club's office in the engineering building was opened and closed each day. Each log entry had a time and a small area for comments. Gradually, the comments section took over, and the log evolved into something like a 50-person shared diary, in the form of more than a dozen lab books. Clubbies would write stories, poems, songs, parodies, philosophy, draw cartoons and psychedelic art — in some ways it was like an unmoderated, very local, multimedia-based newsgroup. Unfortunately, the log(s) were stolen during the 1970's, and they never reappeared....

— from Doug Landauer, Ben Lomond, CA.

[Can you *imagine* having a 360/91 for your computer club? I wonder if that machine is still around! — KC]

CONTENTS

ARTICLES

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