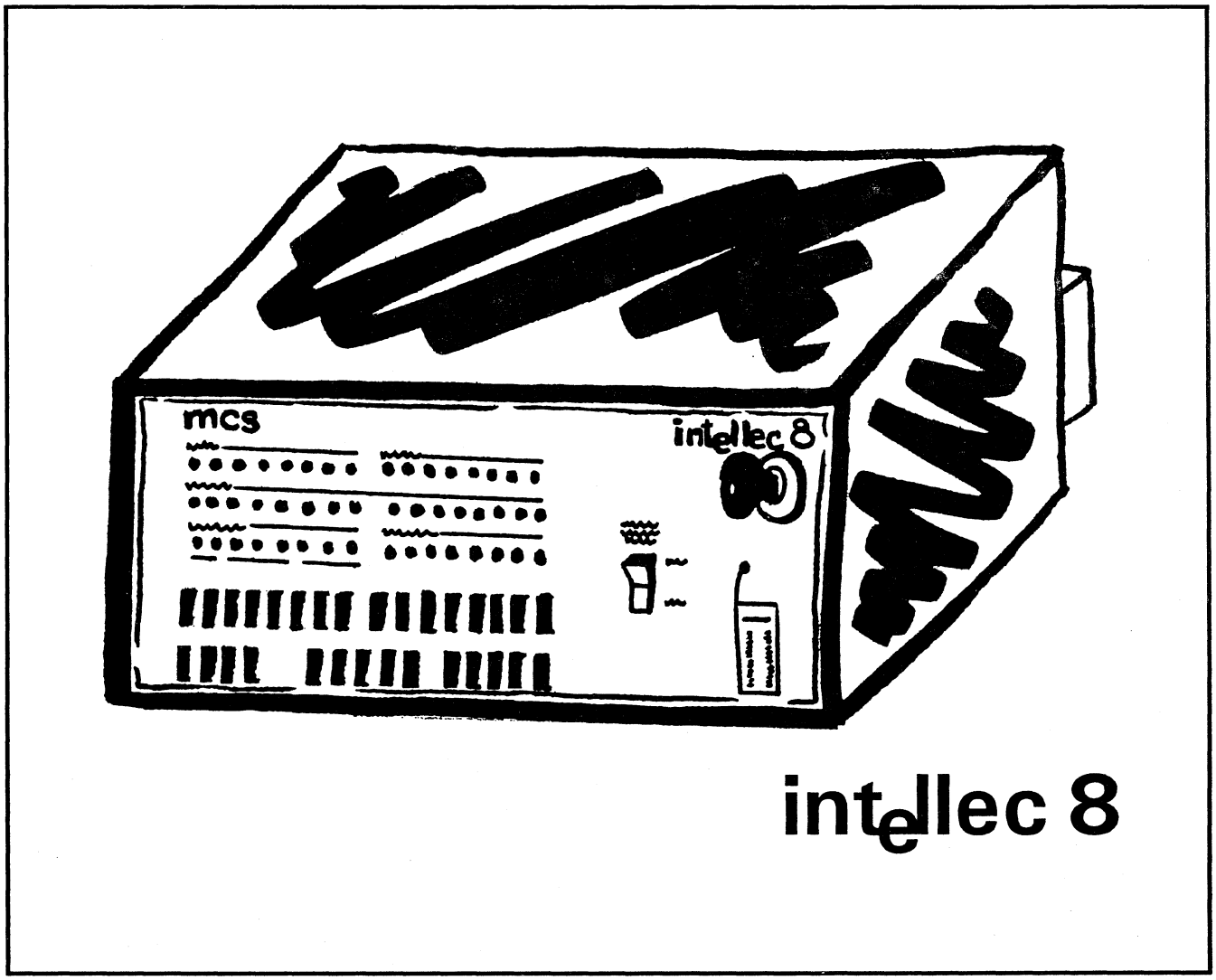
*The* Analytical Engine

JOURNAL OF THE COMPUTER HISTORY ASSOCIATION OF CALIFORNIA




***Intel MCS***

*Hal Layer / Jil Weil*

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# The Analytical Engine

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## Editorial: THE X-PROJECT

> My drawing was not a picture of a hat. It was a picture of a boa constrictor digesting an elephant. But since the grown-ups were not able to understand it, I made another drawing: I drew the inside of the boa constrictor, so that the grown-ups could see it clearly.
>
> — Saint-Exupéry, *The Little Prince*

In eighteen months we've learned a lot about pushing the envelope. First the micros began to arrive, and, well, micros are easy. (Up to a point!) Then we retrieved the PDS 1020 and the HP 3000 on the very same day, and with some stretching (oof, grunt) we had space for the minis too.

Okay. Playtime is over. Are we ready for a mainframe?

A major Federal agency in the Rockies would like to clear out a bootable and working XDS 930. This once-potent mainframe from Xerox Data Systems (which began life as Max Palevsky's Scientific Data Systems) was built in Southern California in the early Seventies. Certainly there are many classic California mainframes, but this one indisputably has a lot of soul. And while it's not small, it's not gargantuan, either. Just the size to make rookie CS students stand there with their mouths open.

If we can find a place to put it.

Because what we mean by "not gargantuan" is....ten or twelve racks. Say fifteen feet long, five tall and four deep. About the size of a small five-passenger sedan. On its side.

It could be the kingpin of a real, museum-quality computer collection. If we can find a place to put it.

We could even have it running, for special occasions. Receptions. Conferences. Anniversaries. Fundraisers. If we can find a place to put it.

When visiting scholars ask to see our California hardware we could say "Right this way." If we can find a place to put it.

Look, friends. We conquer space or it conquers us. When CHAC started eighteen months ago, it needed money, organization, contacts, and credibility. Now it needs money, organization, contacts, credibility, and space, *mostly space.*

The opportunity to secure this XDS 930 is not unlimited; nor is the patience of its current owners. If we can't find a place to put this within reasonable time — probably defined as a couple of months — this agency will write us off as Not Serious, and scrap the computer.

*You* can help us save this California classic by pointing the way to donated storage for a computer about the size of a small car. The space has to be long-term, because we don't want to move this again for trivial reasons. A Silicon Valley location would be nice, but anywhere in Northern California will do. Your company's tax deduction will be signed, sealed and delivered. And, naturally, undying gratitude and recognition is part of the package.

1999 is here. Please help!

## IN IT FOR YOU, Part Two

To our enthusiastically received offer of a discount on Doctor Haddock's *Collector's Guide to Personal Computers,* we now add a second spiff — this one exclusively for subscribers.

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- Numerous revisions and clarifications in the Dictionary.

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## NEW ADDRESSES

We're firmly established in Palo Alto and eager to receive whatever you might want to send. (Note: Please *don't* ship a computer or other heavy hardware without querying first, by e-mail or snail-mail.)

Subs, articles, donations and general correspondence are welcome at:

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We were hoping to have a new e-mail address by the time this issue of the ENGINE appeared, but InterNIC is drowning in requests for domain names and couldn't get back to us by October 15th. Look for the updated address on the net and in the January ENGINE.

## A BALLOT

[Ordinarily, ballots for the National Computing Science Day survey are confidential. But we asked Tim Patterson, career database hacker and humorist from Berkeley, for permission to print his.]

"Free propeller beanies for every man, woman and child in the United States and all its colonies, formal and informal.

Requirement that on National Computing Science Day, all members of Congress speak only in machine language.

Mandatory 10% raise every year for all clerical and manufacturing employees in Silicon Valley."

[Gee, *that* should be popular. — Ed.]

# "THE SAME TECHNOLOGY STILL HOLDS:"

## Rey Johnson and Jack Harker talk about RAMAC, the Low Cost File System and the dawn of the floppy (Part 2)

**Interview by Kip Crosby and Max Elbaum**

*KC: This does lead into something else that we should consider before we get too far along in the hardware technology. There always was the question of how you defined the data on the disk — once you put it on there, and can we briefly treat questions of encoding and data location before we go further?*

RJ: Packing random numbers efficiently and getting to them. Punch cards all stack one on top of the other, and the space required is determined by the number of numbers you have. But here, if the numbers are a thousand units apart, stacking them becomes the problem. I'm not enough of a systems engineer to answer that, but at the time we had Pete Luhn, a very prolific inventor in IBM, who was responsible for the mathematical system whereby doing arithmetic on an account number, you generated random numbers, so all account numbers took on the characteristic of random numbering and could then be sorted and stacked very efficiently. And then when you got back, you'd re-convert that random number by the encoding technique to the original account number.

*KC: Did this amount to on-the-fly data compression?*

JH: No. That was to randomize the records so that you could get a uniform distribution of records, because it didn't have index tracks on the first RAMAC.

*KC: So all the indexing had to be performed on the data itself?*

JH: In order to get a uniform distribution of records across the space, you wanted to randomize it. It was a pseudo-random algorithm that would allow you to reproduce the process and locate the record.

RJ: The records were in fixed-size pockets, and when the pocket ran over, there was an address of where the next pocket would fall.

JH: So if you did get duplication then you'd write trailer records. The original recording, as I recall, was a straight conversion. But in later times you got a little more sophisticated than that, in terms of using frequency versus code length. And you really didn't do much data compression, in the classic sense, for a long, long time.

*KC: Because even without any kind of compression, you still had data densities on the disk files that were more than competitive?*

JH: Yes. We were always very conservative on the electronics side of re-writing, because you really had a problem of reliability as you were updating things in real time, and you didn't have good backups.

RJ: It's a classic problem — how do you stack random numbers in space that tend to be sequential?

JH: When ASD was broken off from the development laboratory [in May 1959] there were people in Rey's lab who were trying to convince us that they could record at ten times prevailing density just by using some data compression and some signal processing technology, filtering, pre-comp, post-comp — things that are all standard now, but they took a long time.

RJ: The thing that has surprised us is that, over these forty years, the same technology still holds. The moving heads over the rotating disks and surface; and to this day — Emil Hoffner, who has been the most active in signal processing, claims that he can get at least ten times the density of any system now in use through new signal processing. And the latest, very important change that has taken place in the reading head is that no longer does a signal get its energy out of the speed. The signal is subject to variation by the presence of the magnetic bit — it's magnetostrictive — so that you can really go very slowly if necessary and you don't have the same servo problems. And it gives some increased density in the bargain.

JH: It's been a very extendable technology — far more than we ever envisioned.

*KC: We were talking about that on the way over, how throughout the rest of computer technology you have succeeding generations of hardware every 18 months to three years, and yet here at the core of storage is that same old hard disk, 40 years later, spinning the way it always did.*

## PRODUCTION ISSUES

*After you moved the lab from Notre Dame Avenue to Julian Street — in February of '56 at the Western Joint Computer Conference — you gave a demo of a device with 50 24-inch disks on a common spindle, and on those 24-inch disks only the outer five-inch band was used for data recording. Now why did you use such a small proportion of the area for data?*

JH: Try to get a disk that big flat!

RJ: Wasn't the disk smaller?

JH: No, it was 24. I don't think we ever built a file less in those days. The 24-inch criterion came about — the first file that we made that worked, had disks made of an almag alloy, a printer's masterplate for photolithography, dead soft and very flat. These plates were two feet square, and that became the constraint of the first disk that we built. We'd set those plates on a piece of plywood, and use a plywood radial arm with a centering pin on it and a router. And you'd set the router to cut the O.D., and then you'd move it to an inner position and cut the I.D. And that's how we made the first successful disk. We'd made mockups before, as Rey had described, but this was the first one you could really read and write on.

RJ: This [*in picture from PG&E Progress*] is Wes Dickinson. He was a test engineer.

JH: Wes was one of the servo engineers.

RJ: He was sitting at this early model RAMAC disk file, testing it. One day, the spacers between the drums exploded and flew in all directions. It cut him on the nose and at a tendon in his arm, plus a bystander. They had called it a bologna slicer even before, and with that kind of explosion, we were afraid of the whole project going down. What we had done is — because these spacers had to be fairly thick — it was very difficult to put them on and off the spindle. So we cut the disk so that it was slightly expandable, and thus went on and off easily. We depended upon the compression upon assembly to hold them.

JH: The way the disk was designed, you had spacers that went down over a shaft, and spacers were cast iron rings and you could grind them very accurately for spacing the disks. The disk rested on a step on the spacer — I think we used a rubber ring to compress it against the flat side of the adjacent spacer. So we were having trouble, because with the tight fit between the shaft and the spacer, there was a cocking problem sliding the spacers down the shaft. A suggestion was made and it seemed reasonable: you could cut the spacer, because once the disk was on it, the spacer was contained and couldn't expand. So it was safe as long as there was a disk on it. What happened — and a lot of us wonder why we ever let it happen, but we did: disks were a hard commodity to come by in those days for test purposes.... So in order to test the servo you would load up a spindle with four or five disks on the bottom, and four or five on the top, and then nothing in between but spacers. And the compression was the only thing that held them.

*KC: Right, and the spacer came apart.*

JH: And once one spacer came apart the rest of them exploded. And I feel badly about that, because I was one of the design engineers and should have seen that!

*KC: Let me ask you a question that hadn't occurred to me before: If these disks were made out of lithography plates, they aren't the hardest thing in the world. And when you stack those disks on a vertical spindle, how do you keep them from drooping?*

JH: The hardness does not relate. You're mixing up two physical qualities: stiffness and hardness. A stiff material isn't necessarily hard or soft. You don't make something stiffer by hardening it. So, yes, it was a soft plate but relatively thick — a tenth of an inch thick.

The one that Rey showed you here was one of the production disks, because those lithography plates were expensive. [For production] We laminated two fifty-thousandths sheet aluminum disks, and then relied on the lamination process to get the flatness we needed.

RJ: Basically the disk is held at the center here — there's no tendency to droop.

JH: There is a measurable droop from I.D. to O.D.

RJ: Oh yes, very slight, but it's uniform.

JH: Yes, it's uniform. Again, we were in a thousandths-of-an-inch spacing and that's relatively forgiving. The disks had a total run-out, probably in those days, of five ten-thousandths.

*KC: Measuring from I.D. to O.D.?*

JH: No, just the ripple. If you spun the disk....

RJ: I thought it was more than that. But in any case the head was always positioned against the surface, and to this day is positioned against the surface, not to a dimension.

*KC: So that in fact, the total run-out of the disk was a relatively large multiplier to head gap?*

JH: Always has been, always will be. Even today, although the disks are very flat, the spacings are very small. And that was the key problem on the 1301: that the run-out of the disk — not the gross run-out, but local run-out of the disk — was significant relative to the spacing, which came out; if you've been into disk technology at all, there is a thing called an "X"; a measurement of the disk, which is acceleration. We got so the way we cured the problem was by testing disks looking at the second derivative of the geometry, and you had to specify that that second derivative could not be too great.

*KC: Could not be larger than a value which would prove out to a flat enough disk ...*

JH: The airhead was more forgiving, for various reasons, than the gliding head.

## MAKING THE HEAD FLY

*KC: The airhead was a guaranteed terrain-following head, in a way.*

RJ: So was the gliding head.

JH: The trouble was, the geometry of the head, compared to the local flatness of the disk, is relatively the same dimension. And so the shape of the disk is the same, as if you've misshaped the head locally. That's a problem that would not be a problem with an air-fed head, because the air cushion is more stable.

*KC: Right. But when you have a flying head, or what was called a gliding or sliding head — the ADF, which became the 1301, was a slider head, right? And what were some of the problems associated with that?*

RJ: Resolving the philosophy of whether you needed a curved edge or a straight edge, how the air got under and stayed there.

JH: To go back in history a ways, if you read classic bearing theory, Lord Raleigh sometime in the 1800s, 1700s, whatever, demonstrated that you could polish a penny and then if you held it against a spinning disk, it would act as a bearing. And so the fact of the air bearing is old. In fact, Rey commented there was a company called Sunn Hone that made hones to get very accurate poles and shafts, and they had a demonstration with a shaft and a donut, where you could sit and spin the donut, and it would spin forever on the film of air. They had smooth enough surfaces.

*KC: Because the donut and the shaft were matched that closely?*

JH: It's the same thing as a journal bearing in an automobile, except you're using air as the lubricant, air as the media between. And there was a classic lubrication theory for such bearings. The problem is that air is a compressible fluid, and no one had ever done either systematic experiment or analysis of bearings with a compressible fluid, strange as it may sound. That was really the new art.

*KC: It's not so strange as all that, because most bearings had been lubricated with fluids that were not gasses, and all fluids that weren't gasses are by definition, incompressible.*

JH: Early, the idea of an air bearing had been proposed and it sounded like it would be a good way of a self-acting bearing, of building a multiple-head file, which is what we wanted for the ADF. And we were building them and trying to make them work, and we just kept having repeated, unexplainable failures. So that's when we started looking for the shape of the bearing to make a big difference. It was my first management job and so I said, "We don't know how flat they are — let's make them all flat." That's when we started buying optical flats, and we would polish them until they were flat, and then they all failed.

*KC: Optically flat heads?*

JH: And they all failed at a given spacing. They would all work stably until you got to about two hundred micro-inches, and then they failed. And that was when a very good bearing theorist, Bill Gross in research, and a programmer, Bill Michaels, programmed the 650 to do a mesh analysis with a compressible fluid. Ken Haughton and Russ Bruener were the two individuals who did the experimental work, and we found that as you curved [the head] you would achieve a stable bearing. You have to shape the bearing, you have to have an entry wedge. If you look at heads today they're flat, but they've got a slope in the front.

*KC: Because if you're going to have air under that two hundred micro-inches, you've got to provide some way for the air to get in?*

JH: No, it has to do with — I don't know an easy way to take you through it. It's the fact that you have a wedge. The force generated up is because there is a decreasing spacing, and to do that you have to have the bearing at an angle. Once you generate the pressure at the leading edge, there will be the slope that is necessary to generate the pressure.

*KC: It's literally a hydrodynamic ...*

RJ: From a practical engineer's point of view, if you're going this way against the surface, this very last air, here, the last row of molecules of air, has to move at infinity — sideways — to not move under.

JH: This is not a Bernoulli effect. It is not because you have a flow under. It is because you're really getting a circulatory component of the motion. You're in the boundary layer, so the air against the slider is stationary. On the whole surface of the head the air is stationary; at the disk it's moving. And you have a velocity gradient, therefore, in that area. It is the changing of velocity gradient that produces a normal force.

*KC: And when you had a perfectly flat head ...*

JH: If you have the two of them flat, you will not generate the kind of a gradient that will give you an upward force.

*KC: So that when you got the perfectly flat head, the optically flat head close enough to the disk, it just sort of clamped down onto the disk because there was not proper flow?*

JH: With the non-compressible fluid, you can think of it as a lever coming back to an imaginary pivot point. As you press down you will always have an angle until you come into contact. A simple analogy is if you raised the pivot point a little bit above the disk, above the flat surface; as you come down you reach a point at which they become parallel and it collapses. That's not technically an accurate description, but it's a visualization.

*KC: It's a good visualization, because I certainly never understood it before as well as I do now — calculus or no calculus.*

## THE LOW COST FILE SYSTEM

*Let's go on to talk about the 1311 a little bit, the Low Cost File, which was the attempt to bring the disk or the disk pack technology into a format more appealing to IBM's traditional business customer — is that accurate?*

JH: The program started after the RAMAC was well underway. There was a proposal to build a smaller RAMAC — a half RAMAC, to go to a lower cost base, and therefore smaller businesses and larger market. And three of us were assigned as a study by Lou Stevens to do it. We had to have a disk that was about half the size and capacity. We actually designed a machine that never, of itself, came to fruition, but I designed the file. And at that time there

was also an effort in Rey's lab, under Al Hoagland, to build a single-disk file. And they designed and built a prototype of an advanced file that had a removable disk. At the same time someone did a study — and I've forgotten, was it [John] Knowland? — a study of a utility billing application. (By the way, there's a lot of emphasis today on understanding customer problems. In those early days in the lab we spent more time — all the engineers — going out and talking to customers, not trying to have them tell us what we should build, but to try and understand how they were running their business.) The planner said, "If I could have disks that were removable like tape, I could use them in a mode like tapes, a skip-sequential processing." Because, although the disk was slower than the tape in terms of data because it was a serial device and not a parallel read, you could be competitive — in fact you could do the job faster, because you'd skip over the records that you weren't using, which was the great shortcoming that tape always had. So this was the application, and in evaluating this program, I decided that if I was going to build it cheap I had to cut the capacity down and the disk size — it started out by being a half-size RAMAC file, so the disk was going to be 12 inches instead of 24.

*KC: But somehow it ended up 14, didn't it?*

JH: That's because the first time I laid the format of the disk out, I laid it out with an outer track at 12 inches, and I said, "Well, it's got to be 13 inches." I went off the program at that time, but during the later development they were having trouble with the density at the I.D., and Vic Witt said, "Make the disk an inch bigger," and that solved the problem. The challenge was cost; in those days it cost just about twenty-five thousand dollars to build a RAMAC, and to build the ADF was going to cost fifty thousand dollars, and I had to build this whole drive for two thousand dollars, that was the objective I'd been given.

*KC: Two thousand dollars?*

JH: Yes, which was less than the cost of the heads on the ADF. And so we had to come up with clever, cheap techniques.

RJ: How many did you build?

JH: Probably about twenty thousand. See, in those days, if the market that we projected was for five thousand of something, that was a mass market. And there was a very foresighted planner we worked with on the low-cost file — Chuck Hester. He wrote a planning proposal which said we could sell fifty thousand of these, and everybody thought he was out of his head. Obviously we didn't — we didn't sell that many 1311s, but that was because it was superseded by the 2311.

*KC: But by now, when you talk about much larger sales projections, I would think we're getting into the period of the 1401 when you could put a small computer, so-to-speak, in an office without its own air conditioning, without a lot of the expensive support that large computers had traditionally required.*

JH: The 1311 was introduced with the 1440, which was a scaled-down 1401. And it was not a very successful product in and of itself, which is probably why the 1311 didn't sell more than it did.

*KC: You mean the 1440 wasn't?*

JH: The 1440 wasn't. But then they started putting the 1311s on successive machines, then the [System/]360 came along. The 2311 was the disk file for the 360.

*KC: Right. Just one detail for my personal curiosity: If a 1440 was basically a 1401 with a hard disk, what was a 1410?*

JH: It was scaled up from that. These things — you're getting into territorial more than technical.

*KC: In what sense?*

JH: Endicott was the 1400 series; Poughkeepsie was the 700, 7000 series. San Jose had the 305. There was to be a 310 that never saw the light of day, because Endicott showed that if they took a 1401 base and added this, and this, and this, it was judged to be better. And you were leveraging off prior development, and the 310 would have been a totally new development — it was not really an upgrade of the 305.

## DRUM MEMORIES

*KC: Speaking of project-based territoriality, was some of that responsible for the last super-fast drum memory, the 7320?*

JH: Drums were never a happy product in IBM manufacturing. Manufacturing drums was never a satisfactory thing.

*KC: Well, you've got a great piece of metal here with a ten-thousandths run-out ...*

JH: And plating is a dirty art. They were continued primarily for the military applications. We had many attempts and then finally we came out with the fixed-head file. Essentially these were all driven by the high end of the computer — it wanted fast access.

*KC: They wanted access that was in proportion to CPU speed basically, because when you got to the high end, you were paying a lot for CPU speed.*

JH: This was, again, a territorial argument. And you'll notice that there aren't such things these days.

## "THE MOST SUCCESSFUL OF PLANTS"

RJ: Since this is a California computer history, I think the San Jose site is really history in California, because it was hailed as the most successful of plants at IBM, and it actually called for more manpower than any other business in Silicon Valley....

*KC: It was financially the most successful of all of IBM's labs?*

JH: It depends on how you measure. I'm just looking at innovation, of the things that started out here. We had more projects than we could ever implement, but if you look at the ones that came — the whole cash issuing business, mag-stripe credit cards. There's a whole litany. Talk about compression, some of the early successful data compression work was done in Rey's lab.

*KC: According to my notes here, the San Jose lab was operated as a separate facility until 1968. It was an independent thing; it may at some point have come under the jurisdiction of Advanced Systems.*

RJ: It was always part of the corporate family. It never had the kind of independence that it has now as an independent subsidiary.

JH: When IBM decided to produce the RAMAC through development as a product, as Rey said, he didn't think he wanted to be a product developer. At that time the lab was split, almost exactly when IBM formed the research division, and Rey's lab became the West Coast Research Lab. There was a development lab, which remained at 99 Notre Dame, and Rey moved to Julian Street. The development lab under Lou Stevens developed the RAMAC. I floated back and forth between the two organizations. And then later, IBM formed the Advanced Systems Development Division, and again Rey's lab split into two pieces — one of which was Advanced Development, which he took, and then a research lab.

RJ: The lab was called Research and Engineering Laboratory in the beginning, and my approach to research in the industrial laboratory was that basic research is almost always necessary, in order to understand what you're trying to do, so you can do it better. That was why we hired Al Hoagland very early in the program, to understand what magnetic surfaces are and how magnetic heads work. Many of us didn't know that. We hired Dr. Bill Gross to understand bearings, and we had chemists and people who understood what we were doing, so we could make a better disk coating. My own role has always been essentially invention and design. When the corporation expanded in the R&D direction, they hired Dr. [Emanuel] Piore as research director. He was in favor of having advanced development, and exploratory development as part of research; but he lost the battle somewhere, and so a research division was founded with a major laboratory in Westchester County, New York. My laboratory was split — my physics and chemistry departments went to research, and I moved my laboratory up to Los Gatos. In that laboratory we developed a lot of things that nucleated into products, but they didn't all have the direct line of product that RAMAC had.

## BASIC RESEARCH

JH: It was a kind of basic research.

RJ: It was new development. We developed the first cassette for a video recorder, actually.

*KC: When was that?*

RJ: In the late '60s. Tom Watson looked at this and he said, "You know, this is a very interesting machine, but we're not in that business." IBM was working with Sony in Japan. Sony came over and looked at what we were doing, and they changed their approach to the one used at Los Gatos — from a wide spool-to-spool system. Our contribution was pulling the tape around a spinning head, then returning it to the cassette. But IBM did not exploit the Los Gatos laboratory's breakthrough.

The same thing happened in a voice-assisted typewriter project that Wes Dickinson was working on. We had a thousand-word typewriter in which you could say, "Dear sir," and the words would flash up, including all the homonyms. If you said "two," it would flash *two, to, two, Sioux, chew,* and any other "homonym." It was a pattern matching system — it matched the pattern of the person's previously recorded voice, an analog machine. As happened a number of times, it didn't work very well when we showed it to Tom Watson. He went back to New York and inquired of the research staff, which had worked on voice recognition, and they agreed — as we did ourselves — that it would be years and years before reliable voice recognition became practical. But that was the premise I'd started from: no way would you ever be able to build a universal voice recognition machine with any kind of vocabulary. I intended to work within a personalized, limited vocabulary to create a useful typing machine, but I got squelched and it folded.

*KC: And of course that became the core of the great debate over voice recognition. Is there a market for a machine that has to be trained to single voices, or do you have to wait until you have enough computational power to do the whole shot? — which is a debate that's going on many more times today.*

RJ: Correlated voice patterns work with human assistance. And the same thing goes for handwriting. There's just no way that you'll get a universal, reliable handwriting machine — there's too much variation in humans as to how they do writing; but you can make a useful machine that's *not* universal. We built a model in which the voice recognition was connected to an adding machine. It worked with all the decimals and control words; IBM demonstrated it at the World's Fair in Seattle. We did a lot of interesting things. I was appointed an IBM Fellow in 1965, I've developed a lot of learning machines since then.

*KC: But this was a tremendous amount of development. May I point out, we've taken two hours to go through a fairly summary description of San Jose's contributions to IBM and to the world at large, and I'm sure there are more we haven't even touched on.*

JH: The floppy disk.

## DAWN OF THE FLOPPY

*KC: I'm not letting that one go by. IBM made the first floppy disk?*

JH: It was when the Model 4360 went from core memory to semiconductor. They needed an IPL — initial program load — device, and we were given the task of an IPL device in San Jose. And [Alan] Shugart had Dave Noble look around and figure out how we could make an inexpensive form of IPL — something you'd publish or initialize, and then distribute. And he looked at a number of possible predecessors — one of which had been developed in Rey's lab by a guy named Bob Tresieder, which was a stretch membrane disk. I don't know if you've ever heard of that technology; 3M has pursued it off and on for a fair time. If you take a disk in a flexible medium, and stretch it uniformly on a circular periphery, you can then cut a hole out of it, and what you have is a stretched membrane. And with the circular cut there's no distortion, because all the forces are radial.

*KC: Everything was released by the circular cut?*

JH: No, it didn't release anything, because there were no radial forces on the inner edge, but you'd have a stiff thing. David looked at that and decided to do something simpler, which was: you just have a flexible disk against a padded surface and press a head against it, and he showed it would work. The first one, called

MINNOW, was an IPL device for the semiconductor memory systems, and then as a successor product was developed, we looked at the application of a read-write device.

*KC: So the first ones, being IPLs, would be read-only?*

JH: They would be read-only in the field; there was a recorder we built for it in the factory.

*KC: It was like CDs now, because it was recordable in the factory but read-only in the field? What year was this?*

JH: That was in the early '70s, probably close to 1970. Dave developed such a thing — Figaro was the name of the project initially — and we couldn't find anybody who was interested in it. Dave went back and sharpened his pencil, and it became Igar, which sliced the "F" and the "O" off Figaro. He had a talented, small group of engineers, and they came out — essentially — with the eight-inch disk product. We were then just starting to see the keyboard-to-tape Mohawk recorders, and our Rochester lab got the job of building a direct input device. They were looking at a tape drive being developed from Boulder, but the guy who ran the Rochester lab came originally from San Jose — I had worked with him for years. He came out and I showed him this, and we convinced him that the floppy disk was better for a direct-key input machine.

*KC: So that was the beginning of key-to-disk?*

JH: Yes, and it was obviously tremendously successful. And we moved the project from San Jose, first to Boulder and then to Rochester where it was manufactured. But it was developed in San Jose....

## MORE ON PLASTIC ROT

Our piece in July's ENGINE on plastic rot — degradation and embrittlement of molded plastic parts through exposure to ultraviolet light and other environmental influences — produced a flurry of discussion from California to the UK. The consensus is that much more research must be done, but that existing knowledge is of some use. Edward Then of Imperial College, London, posted to us that

"You are right to say that [application of] xylene is not the best solution to the problem of yellowing in plastics. If my guess is right, the case of the 'Apple' is made using ABS plastic, which would be damaged by a xylene-based solvent...."

He promises a short article on contemporary methods of conserving plastics, to appear in the ENGINE soon.

## ASSURANCE FROM AMERICA ONLINE

[Several ENGINE subscribers, who received electronic copies using America Online as a gateway, complained that the issue arrived in chunks with text missing from the end of one or more sections. We queried the service and received this reply.]

I am writing on behalf of America Online to answer your recent questions about the ANALYTICAL ENGINE being truncated when split.

I sincerely apologize for any inconvenience this has caused you. We are aware of this bug, and are feverishly working to nail it to the wall. The bug resides in our mail splitting routines. It is somewhat more destructive to documents than the line-eater bug of lore. We currently have 5 of our top people working on it. I assure you it does not target your publication alone.

Should you have any further questions or comments, please feel free to write again.

Dave Koster, Technical Support Representative

# BLETCHLEY PARK MOVES FORWARD

by Chris P. Burton,
The Computer Conservation Society

Readers of the ENGINE will be aware that during World War 2, up to 12,000 people worked at Bletchley Park, fifty miles north of London, on ultra-secret code-breaking work. Enemy radio messages were intercepted, the sophisticated encipherments were broken, and the resulting information used to the Allies' advantage. The clever work was done by mathematicians, including Alan Turing, and linguists, while the bulk of the dreary routine work was done mostly by servicewomen. A large special-purpose electronic machine, COLOSSUS, was installed there in 1943, followed later by eleven more. With hindsight, we would probably say that Colossus was a fixed-program electronic computer, in the same sense that ENIAC was. Despite the large number of people working there, a comprehensively observed oath of secrecy prevented any information about what went on at Bletchley Park (known affectionately as "BP") leaking out — until the mid-1970s, when the existence of Colossus was revealed, but with little information about the design or use of the machine. In subsequent years, a few fascinating books about BP have appeared, sometimes contradictory, and usually tantalizingly short of key details. There has been no memorial to all those people who worked tirelessly, in Spartan conditions, most of them knowing neither what their fellows were doing, nor what results their own work might have contributed to.

About three years ago the 57-acre park, with its Mansion and many surviving wartime buildings, appeared at risk of being sold off for housing development by its owners, British Telecom and Property Holdings, the agency which looks after real estate for the government. Some wise people in the neighborhood recognized the threat to a potentially important heritage site, and formed the Bletchley Park Trust, which at once appealed for funds to preserve the estate and to prevent demolition of key historic buildings. To pay for the property, the Trust plans to set up a number of museums as a "Museums Campus" for the public, and to lease out some post-war buildings as office and workshop space to paying tenants. Since the formation of the Trust, negotiations have continued with the owners for acquisition, but these have not yet reached their conclusion. Recently, however, a two-year lease on one building was agreed, and permission granted to allow the public into the Park. These arrangements allowed the Trust to hold Open Weekends for the public, to have guided tours of the buildings, and to present various exhibitions relevant to the wartime effort. At this stage, all work is being done by volunteers.

All this is highly relevant to the Computer Conservation Society and to its Secretary, Tony Sale, a founder of the Trust and its Museums Director. The plan is to establish separate museums of post-1930s technology, particularly for Cryptography, for Computing, for Radar and Electronics, and possibly for Telecommunications and for Air Traffic Control. The museums will be housed in the numerous and spacious buildings. The whole park will have a 1940s theme against the background of the code-breaking work. The Museum of Computing will have adequate space for workshops and storage, and it is likely that much restoration done by the CCS will take place there, supplementing current activities in the science museums at London and Manchester. While these museums and workshops are established — a process which will take years — various exhibitions have been mounted for the Open Weekends which will sustain public interest in the project.

Most exciting for computer historians is the ongoing construction of a working replica of Colossus. This is being done against great odds, since at the end of the war, Churchill ordered that the twelve Colossi must be "broken into pieces no larger than a man's fist", and no significant fragments are known to remain. If the machine is to be re-created, it must be done soon and urgently, while memories and experience of the surviving designers and users can still be tapped.

The Colossus Rebuild Project was launched, and the Bletchley Park Exhibitions officially declared open, on 18th July by His Royal Highness the Duke of Kent, patron of the British Computer Society. This Royal Opening, which I was privileged to attend, brought welcome public attention to the Trust and its efforts.

For someone who has read about and is fascinated by the wizardry at BP during the war, but has never visited the place, driving past its stern warning notices, its security personnel (civilian, not military!) and its long, low, bomb-proof buildings brings a lump of nostalgia to the throat. Many of the buildings, empty since the end of the war, have their windows boarded over for protection from vandals. You pass the Mansion, looking exactly as it does in the photos in the books, with the lawns and trees and the lake below. To actually walk up to the faded, decrepit wooden Hut 6, where the first decipherings of the Enigma machine's traffic were made in 1939 and 1940, and to place one's hand on the warm wall, almost brings a tear to the eye. But the winter of 1940 was particularly severe, and one of the huts was heated by a greenhouse heater! Such uncomfortable conditions, and such magical, exciting, never-to-be-repeated work was done in there! Across the way is Hut 11, where the first Bombes were housed, and over there beyond the green grass is the utilitarian-looking H-Block, where the first Colossi worked. In that building are most of the present-day exhibitions and the rooms where Colossus will be rebuilt.

The Royal Visit day was one of the many very sunny, hot, summer days that Britain has been blessed with this year. Security was tight; we had to have our passes applied for and received a week beforehand. I believe about 800 guests were invited, and I guess that 600 turned up. Very many of them were elderly former workers at BP, who had been given dispensation by GCHQ to admit to the work they did. Last admissions were at 10:30, then the barriers were closed until about 11:00, when His Royal Highness arrived and was welcomed by the Lord Lieutenant. The crowds of guests were unfortunately not allowed to go into any of the buildings until after the tour by HRH, so they had to wander round among the trees, and look at the buildings from the outside for most of the morning. Somewhat tiring in the hot weather!

The welcoming ceremony was at the Mansion, the focus of the park, and the party was then driven to the exhibition tour in a series of beautifully restored WW2 jeeps, with pennants flying from antennas, driven by uniformed "military police". The Duke's party was then escorted round the exhibitions by Tony and Margaret Sale.

In the confines of this article I can only mention a few of the exhibitions. The first room contained the collections of The Buckinghamshire Aircraft Recovery Group; sad reminders of the Battle of Britain and after, wreckage of Spitfires and Messerschmitts, Junkers and Heinkels, dug from their inadvertent resting-places in the English countryside. The names of crews have been traced, and inscribed near what is left of their machines. A complete but damaged Rolls-Royce Merlin engine, the type which powered the Spitfire, shows the awful force with which it hit the ground.

Further along in H-Block, the US Forces Re-Enactment Group have converted several rooms into part of a US Infantry base. One room is the GIs' bunkroom, beds made up and lockers tidy, pin-ups on the wall, and an old radio playing Glenn Miller. Another is an officer's room, with desk and maps of Europe. There is a quartermaster's store, and a couple of rooms of memorabilia pertaining to the US activities leading up to and including the D-Day invasion. Uniformed "GI"s were on hand to explain things - I noticed a present-day US senior officer engrossed in conversation with one of the guides.

Leaving the Infantry, the visitor next finds himself at the start of the Cryptology Trail. It is very interesting to move along the corridors, from room to room, viewing the sequence of activities starting with the enemy enciphering and transmitting a message. The intercept room has operational HRO receivers, where the operators write down the Morse messages, then send the encoded intercepts through the telegraph exchange and motor-cycle dispatch

riders to "Station X," as Bletchley Park was known. A mock-up of the registration room leads to the various stages of decoding and assessment prior to distribution of intelligence to field-commanders. Visitors can see a real Enigma machine, with one of the code wheels opened up to display the random cross-connections, a rare sight. There are also Lorenz and Siemens telegraph ciphering machines, for which Colossus was built to crack the wheel settings. The role of the pre-war Polish code-breakers is not forgotten, but more artifacts will be needed there, as perhaps also in the decoding stages after intercepts were registered. It is an interesting exhibition now, and potentially stunning when work is completed.

Following on after the Cryptology Trail, the visitor enters the Computer Exhibition, staged by the Computer Conservation Society. It includes an almost-working Elliott 803, rescued from a barn, and dating from the mid-1960s. There is an IBM 1130, a Burroughs Visible Record accounting machine, some Digital equipment, and an early Sperry drum — very heavy and parked in the middle of the room. One member has put on a very good display of equipment showing the evolution of personal computers from the Altair, through Northstars and other S-100 bus machines, to early odd-balls like the Sinclair QL. Appropriate peripherals and software are on display. The line ends with a modern 486 PC on loan from Olivetti, which is running my graphical simulator of the Ferranti Pegasus, thus nicely closing the loop back to the earliest vacuum tube machines. I had also provided a working nickel acoustic delay line store, dating from 1956, storing and counting 42 bits, and requiring +300v, +200v, +13v, -10v, -20v, and -150v, as well as heaters and standard clock signals. Don't let the children get their fingers too close to that exhibit! For fun we also had a relay machine, which I had built in 1952, playing Noughts and Crosses. The Duke of Kent spent five or ten minutes in the Computer Exhibition, took a great interest and asked extremely relevant questions. It was a great pleasure for us manning the exhibition to see that we had influential support for what we were doing.

Next to the Computer Exhibition is the Electronics and Radar room. A very large collection of equipment here is primarily familiar from the World War, and includes BC221 wave meters, Bendix radio compasses, and masses of British radio equipment and radar sets of various kinds. A Baird Televisor from about 1933, with its rotating perforated aluminum disc and neon lamp behind, gives 30 lines resolution, on a picture about the size of a large postage stamp. It is most interesting to compare the manufacturing quality of the wartime military equipment made in various countries — German solid and precise, US efficiently made and neat, Canadian a cross between US and British, and British, thrown together in a hurry but working in desperate times. It is rumored that one of the people who have staged that exhibition has access to 300 tons of wartime electronic equipment. [Ouch! — Ed.]

The Duke next moved to the Colossus Rebuild Room, where he met some of the designers, including the team leader, Dr. Tommy Flowers, now in his eighties and very alert and knowledgeable. Stacks of accumulated equipment lie on the floor. A PC running a CAD system is used for re-creating drawings which would have been hand-drawn in 1943. A prominent pile of steel channel sections and angle iron is ready to be cut up, drilled, painted and assembled for the racks of the machine. Link sockets mounted on beechwood strips, identical with those used in Colossus, have been rescued from old Strowger rural telephone exchanges. (The last of those exchanges will be replaced with digital electronic equipment and scrapped next year, which shows that the rebuild project is perilously near to too late even now.)

The Royal Party then embarked on the jeeps, and other VIPs traveled in a 1940 bus, to see the Motor Pool, with numerous wartime vehicles preserved and operated by another enthusiasts group. He then arrived back at the Mansion, where he unveiled a stone tablet marking the occasion, before entering the Mansion to see the Winston Churchill exhibition. At last the crowds of guests could go round the exhibitions themselves, and into the welcome coolness. Those of us on the stands

were now busy for the rest of the day meeting old friends, explaining what was on show, and snatching a quick look at the other exhibitions as well.

What a day! It was a milestone on the long road to the Museums Campus, and very satisfying to all the volunteers, who had converged from many parts of the country to make everything presentable in a very short time. Particularly, the active members of the Trust are to be congratulated on their vision and hard work to get so far on almost no funds.



## SEX ON CAMPUS, 1969; California's First ARPANet Host

by Doug Landauer, Sun Microsystems

Aside from my brief tenure as a teenager with a newspaper route, every job I've ever had involved writing software. The first one was at UCLA, in 1969. At that time, Steve Crocker, Jon Postel, Vint Cerf, Charlie Kline and others were participating in the beginning of an experiment in the interconnection of computers — the SDS Sigma 7 at UCLA was going to be connected as the first non-BBN host on the ARPA network. BBN was (and is) Bolt, Beranek, and Newman, the Cambridge, Massachusetts based company which had the contract to provide the hardware, physical connections, and basic system software that formed the basis of the ARPA network. They built the "IMPs" (Interface Message Processors) which formed the homogenous substrate which was the key simplification that made communication possible among the variety of systems that were to be connected to this new network. (Today, BBN continues to be a flourishing business, with a definite presence on the Internet; they are on the World Wide Web as http://www.bbn.com.)

My older brother had gone through UCLA four years before I did, so I had already gotten to play around with some of the other computer systems on campus. I was a sixteen year old freshman, hanging out at the UCLA Computer Club, where everyone was known by their initials — my brother was CAL, I was DAL. My brother's friends were JAB, TG&, REG, et al. The Computer Club served as a combination fraternity house and office, and a home for socially-challenged, intellectually-gifted, literal-minded nerds. The club's office was in the Engineering building at UCLA, which has some of its entrances on the east side, where the fifth floor is the ground floor, and some of its entrances on the west side where the ground floor is where you'd expect it to be.

An aside: One kid that even the clubbies treated as a geek (as most of them had always been treated) was this high school kid on some kind of high-school parole — uh, I mean "honors" — program that let him spend the summer at UCLA. He was real into hardware, to the disdain of many of the rest of the clubbies, most of whom were software types. Anyway, Steve went on to make probably more impact on the computer industry than any other person in the history of the Computer Club: he invented the optical mouse that sits next to nearly every Sun; he founded Mouse Systems, Frame Technology, and (currently) Infoseek. Sometimes it's amazing how poor our vision can be, outside of our own little cliques.

So I was loitering at the club office, along with JAB and TG&, when Steve Crocker and Jon Postel came in and wanted to find some hackers to help write some "network software". It's hard to convey how new and exclusive both of those words were then, and how novel it was to combine them! They hired the three of us, to share an office and write programs.

My job was to write some initial tests just to make sure that the hardware worked, in the hard-wired link from the host to the IMP. The network was designed as a network of IMPs, so that the low level, long-distance communications protocols (hardware and software) would only need to be implemented once, on the IMPs, so that they would form an IMP-to-IMP network. Each kind of host would only need to have one kind of network driver and network communications software written for them — host-to-IMP.

Our host was a Sigma 7, a computer made by Scientific Data Systems. Architecturally, it was a rather ordinary 32-bit machine. The one most interesting feature that I still recall about its instruction set architecture was that the general purpose registers lived in the first 8 or 16 words of memory.

There were no really dominant operating systems at the time (and there were *no* portable operating systems). The people in charge of this project decided to use a research OS from one of the Lawrence Labs (LLL or LBL), called "GORDO". As we added to this OS, we gave it a new name — the "Sigma EXecutive" (a.k.a., "SEX").

The disk storage on the Sigma 7 was a big silver-colored platter disk, mounted like a clock, with the axis horizontal. Its diameter was nearly a meter. We never had a serious mishap with it, but I always had this fear that if it somehow came off the end of its spindle, its edge would hit the floor, it would gain some traction, and would shoot off sideways, through the wall of the room.

Around that time, the industry's custom was for each instruction set architecture to have a name for its assembly language. (My first program was written in IBM 1401 Autocoder, a simple assembly language.) The Sigma 7's assembly language was called "Symbol". A later upgrade brought us "Metasymbol", which I believe added macros (wow!).

The Sigma had a card reader, and could boot-load from it. Someone (I recall it being Vint Cerf, but I could be wrong) had written a small boot program, which fit on one card, which could make the machine chirp like a bird. There was no speaker — the program worked by tweaking the RF interference that leaked from the machine, and a small AM radio had to be placed near the CPU in order to hear the chirping. The program contained a triply-nested loop, with relatively prime loop counts. It could go on for days without repeating itself.

GORDO/SEX had some very interesting ideas, for the time. With the notable exception of Multics, most operating systems to date had only one- or two-level directory systems, or directories that only privileged users could create, or even worse — fixed partitions. SEX was like Multics (and therefore UNIX, MS-DOS, MacOS, and nearly all currently popular operating systems) in that directories could contain files or other sub-directories in a fairly general way. Because this was a moderately new and relatively less popular idea than it is today, it felt like quite a privilege to have this kind of power available.

SEX was unlike UNIX in that there was no such thing as an absolute pathname — for the normal user. Each user could only get access to files that appeared to be in sub-directories under their home directory. So it appeared as if each user had their own tree-like filesystem. Except that each person had a "Post-Office" sub-directory, which was shared among all the users, and it had a "General-Delivery" sub-directory — these two were used for e-mail and general file sharing. There was some kind of super-privileged user, or privileges that could be bestowed on particular users (I forget which way that worked). The privileged or super user could see all of the other users' directories, making the system look a little more like UNIX systems did, a few years later.

At some point during my time there, Xerox bought SDS, turned them into XDS, and drove them gradually out of business. Later, the Sigma 7 was finally replaced with a PDP-11, on which we (well, they did — I was no longer working at that job) ran an operating system called ELF (German for "eleven"). It didn't take them very long before they decided to replace that OS with the new, not very well-known OS called UNIX.

So at that point, it could truthfully be said that management took away our SEX and made us UNIX.

## Book Review: COMPUTERS IN SPACE: Journeys with NASA

**Dr. James E. Tomayko**
**Indianapolis, IN: Alpha Books, 1994**
**197 pages, US$20.00 (paper)**
**ISBN 1-56761-463-9**

**Reviewed by Kip Crosby**

Only a few people have flown in space, and many of them are legendary. Only a few computers have flown in space, and most of them are completely obscure. Is this fair? To redress the balance, we need a big, breezy, copiously illustrated book written by someone with a reporter's persistence and a *Jeopardy* contestant's appetite for odd facts. Luckily, this is it.

Spaceflight computing forces the unlikely to do the improbable with the insufficient. Ounces count, cubic inches vanish, and working conditions are dismal. (The Honeywell control computers for the Shuttle's main engine are bolted to the combustion chamber.) Parts take so long to certify that they're obsolete when they reach space. (The microprocessors on Galileo were RCA 1802's — early-seventies chips for a 1989 launch.) One bug in the software can result in catastrophic malfunction. (So long, Soviet Phobos probe.) Yet these computers routinely must be far more reliable than their pampered earthbound cousins. This thread of contradiction, of raw technical brilliance outplaying bizarre poverty of resources, keeps a fascinating tension in Tomayko's story.

Psychological tension plays a part as well. In early suborbital and orbital missions — Mercury, Gemini and Vostok — astronauts and cosmonauts apparently had very little to do, except during takeoff and landing. Since most spacefarers are pilots foremost, this gave rise to a natural resentment of being "Spam in a can," human supercargo included for the sake of prestige; and this resentment often was transferred to the computers, which were perceived as stealing the pilot's thunder.

Yet, on a steady diet of abuse and ingratitude, computers flourished and finally became indispensable to spaceflight. Whether in simulation, command, navigation or information retrieval, these toughened boxes have become hand-in-glove partners of the pilots and controllers who rely on them. Jim Tomayko, who knows his stuff, takes his reader on a grand tour of the subject, starting with computer simulators, preflight testing, launch and mission control, then plunging into the history of Mercury and Gemini, Apollo, the Shuttle, and the unmanned probes including Viking, Ranger, Mariner, Phobos and Galileo.

This is a big job and the author brings two big advantages to it. The first is an easy, colloquial style, so that although the story has to be salted with acronyms, it always avoids the blockishness of manual-ese. The second is dozens on dozens of photos from NASA itself, IBM, JPL, Draper Labs, Lockheed, and many other sources, supplemented by schematics, panel drawings, and an occasional graph. Whenever the text even *threatens* to become opaque — bam! — there's an illustration or a sidebar. Together these lift the story out of "NASA as a second language" into the realm of vivid, compelling technical history. *Computers in Space* will be accessible to high-school students, yet consistently rewarding to seasoned space freaks, who will repeatedly mutter "[expletive,] I never knew that."

In fact, though, this book's breadth of appeal gives rise to my only reservation about it. More than a textbook, not quite a coffee-table book, it zigzags uneasily between the two ideals. Occasional clinkers of stodgy phrasing are transparent attempts at simplicity. Italicized words and phrases are scattered through the text, but the typographical convention doesn't seem related to anything; sometimes these terms are defined as they occur, sometimes not. (Such definitions as are needed might have been better off segregated in a glossary at the back.) I suspect that this quirky emphasis was forced on the book by an editor, and it doesn't do any real harm.

This is a good book at the right time. Read it and you'll understand, not only the trials and tribulations of computing in space, but its detective work, its leaps of faith and brilliance, and its civilian spinoffs, like programmed re-

dundancy and fly-by-wire control. The lavish beauty and unrelenting detail of *Computers in Space* make it a book you'll want to read avidly, then keep in your permanent library.

## IC Corner: EARLY IC ALU'S IN THE XEROX ALTO

by Tom Del Rosso

With reference to constructing a 16-bit CPU for the [Xerox] Alto by "stacking" four 4-bit ALU's [see July ENGINE page 11,] the 74181 is a standard TTL part from the late 60's. It's not a CPU, as the 4-bit 4004 was, but only an adder, subtracter, 1's or 2's complementer, shift right or left mux, and logical AND, OR, XOR circuit. It contains no registers, and no control logic, so cascading it is as simple as going from Carry Out of one, to Carry In on the next. Multiple 74181's share a common control unit with no complications.

Since it needs external control, I would have liked to hear about the control method — hard wired, state machine, or microcode; I also wonder, how many boards, and how much area. Great interview though. There was a lot more in there than what I missed.

The 74181 is barely MSI, not LSI at all. It has around 50 gates, and it's not much more exciting than an octal latch. So, the Alto apparently was a real scratch-built machine. Yet the 74xx181 is still in production, just like other members of the standard TTL family. All the usual speed/power variants, up to Advanced Low-power Schottky (74ALS181) are still made, with a relatively new functional variant, the '881.

There are other examples of seemingly obsolete TTL parts still produced, like the Gray Code and Excess-3 Code converters. But with the increased availability of modern ASIC's, almost all of the TTL family must be in very small demand today.

It is somewhat interesting, however, that the 74181 uses a simple circuit for each bit to compute 16 logical and 16 math functions, including addition and subtraction. The function is selected with 4 control inputs, and one logic/math mode input. The logical functions have the carries disabled for all bits, and the math functions enable carry.

That core circuit dates 'way back; as "The Art of Digital Design" (by Winkel and Prosser, Prentice Hall) says, "The circuit [for a universal logic function generator] has long been known", but it isn't clear when this development was made. The book gives the basic one-bit circuit, and you can see the full-featured version, with the carries that add math functions, in any modern TTL data book under "74181." In essence, the basic circuit breaks down to a 4-input to 1-output multiplexer, whose 2 select lines are driven by the 2 operand input bits, and whose 4 data inputs are driven by the function control lines.

It makes me wonder if the designers of the Alto patterned its instruction set after the 74181 modes. They could have run 5 instruction bits straight into the ALU's 4 control inputs and logic/math mode input. Their own control circuitry might only be needed for controlling jumps and stack operations. The disk and display controllers might have been more complicated than the CPU control. What I'd really love to see is the Ethernet interface!

## YOU PUBLISH! OR WE PERISH!

We hate to say it — still more to have it said — but this ENGINE is a bit thin. Despite a bold request for articles all over July's back cover, we never received that one extra contribution that would have given October some real heft.

Now that the word "interactive" seems inseparable from CD drives and sound cards, we'd like to promote its older, richer and more personal sense. The ANALYTICAL ENGINE is an interactive magazine; the people who read it also must write for it, or it won't be here to read.

If you like reading the ENGINE, please try your hand at an article. There's no pleasure quite like seeing your best efforts in print — a pleasure we'll be thoroughly glad to share.

## NEW SUN HARDWARE REFERENCE

CHAC member James Birdsall has completed Part One of his truly extensive reference listing of SUN hardware. This section includes the Overview and CPU/chassis detail, and as the author says, is intended

"....to cover Sun-badged hardware in detail sufficient to be useful to buyers and collectors of used Sun hardware, much of which comes without documentation. Details on hardware commonly used with Suns, especially hardware specifically designed for Suns, are also included where available.

The next several parts are currently under construction and include detailed jumper/switch/connector descriptions for as many individual boards as possible, a Sun part number list, and any other random facts I can dig up."

Part One is a meticulously researched document that prints out to about 25 pages in single-spaced ASCII. We have made it available from our request daemon; to receive a copy, send e-mail to

engine@win.net

with a *subject* line of

sunref1

and no message body. You'll receive a copy by return mail.

## SPOTTER ALERT

Copies of the ENGINE, the FAQ, and project information have been pouring out to media, especially in Silicon Valley. We have tearsheets of the ink we know about. But is there ink we haven't heard of? Once more, with feeling: 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 Palo Alto 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 Palo Alto address.

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

Thanks! (And thanks to the spotters who have given us invaluable help with keeping up so far.)

## NOMADNESS NOTES AVAILABLE

Steve Roberts, muscular pioneer of mobile computing, now makes his occasional *Nomadness Notes* available for remailing from the ENGINE request daemon. The current issue, #26, is titled "The Maiden Voyage of the Microship" and details the fascinating (and harrowing) first outing of the Sea Moss Microship mentioned in April's ENGINE.

Request this two-part file by sending e-mail to

engine@win.net

with a *subject* line of

nomad26-1

or

nomad26-2

and no message body. This issue isn't computer history *per se,* but you'll want this vital background when Steve starts computerizing the Microship!

## SPOTTER FLASH

Radio, radio! CHAC's first, thoroughly enjoyable national broadcast exposure arrived with the June 7th *Osgood File* on CBS. Charles Osgood interviewed KC primarily on the subject of early micros, especially our SOL-20. (See July's cover.)

"From Glass Houses to Glass Cases," in *CIO Magazine* for September 1, gives a thoroughly upbeat assessment of our vocation's progress. "Computer-history associations are springing up around the country," it asserts, "and computer makers are opening museums.... What's more, collectors are making some serious cash." Short and sweet! Also the first publication of our new address — which brought in a fair amount of mail.

CHAC member Tim Swenson's collection of over fifty computers was featured in the July 1 *Skywrighter,* newsletter of Wright-Patterson Air Force Base in Ohio; and Tim made sure to mention your Association during the interview. Thanks, Tim!

Here's a mystery.... John Jarrell at Children's Mercy Hospital in Kansas City, MO, e-mailed news of "an article about CHAC in *Windows Sources* recently." But no other friend of CHAC has corroborated the appearance, and two calls to the publishers of *Windows Sources* were never returned. If any reader has a copy of this page, a quick fax of it to +1 415/856-9914 would be more than appreciated.

## DESPERATE PLEA FOR MONEY

It feels to us as if, having moved to Palo Alto, the CHAC has become much more serious. Being surrounded by institutions and companies like Stanford University, Hewlett-Packard, Adobe, Amdahl, DEC, Informix, Oracle, SUN, T/Maker, Xerox.... Frankly, the list seems endless, and so does the electricity of inspiration.

These places *do* want to know about the CHAC. That's what they've told us! They *will* hear our case — that's why they've begun to invite us in! And they *will* lend their support. That's what our faith tells us.

But at such a time, professional appearance becomes all-important. The ENGINE, our handouts and correspondence, and our presence on the Net have to have a clean, striking look that helps the CHAC stand out from thousands of other nonprofits clamoring for attention. And on our tiny budget, that takes real ingenuity.

*We* have the ingenuity if *you* have the money. A year's subscription to the hardcopy ENGINE — by far the more popular edition — pays for itself *and* gives the CHAC twenty-five energetic dollars. In the heart of Silicon Valley, *making contact makes money work harder.*

Your subscription to the ENGINE now does more for the CHAC than ever before. And as you receive each new issue, you'll see that subscribing does more for *you* too. With your support, the ENGINE will become a bigger, prettier, more comprehensive magazine.

Please, if you've been reading the ENGINE as shareware, subscribe today. It's a better deal than ever.

## AND SPEAKING OF MONEY....

In July, the CHAC passed a big hurdle; our first ENGINE subs came up for renewal. Naturally it was only polite, as well as in our own interest, to let our friends know their subs had expired.

To begin with, paper copies for expiring subs had yellow address labels; electronic subscribers were notified by e-mail. *A colored address label, or an e-mail notice, will always be your first warning that your sub is ending.* If you subscribe to the paper edition, you'll also find a sub blank tucked into your copy.

Most people re-subscribed, and promptly. (Thank you all.) Some didn't, so on September 22 we sent out a round of nag letters. Those brought in most of the rest. (You too.)

It's an industry rule of thumb that, of people who subscribe to a magazine for one year, 35% will subscribe for a second year. But of the ENGINE subscribers who were invited to subscribe again, *eighty-four per cent have so far.* That says a lot about the CHAC's friends and, we like to think, about the ENGINE itself.

Note to those who haven't re-upped: For a small nonprofit, nag letters are expensive and time-consuming. If your ENGINE sub expires, you get one polite reminder, one sub blank and *one* nag letter. After that, we assume you know where to find us!

# OVERVIEW OF BUREAUCRATIC PROCESSES

## INTERNSHIP

With our nonprofit status accomplished, we can recruit an intern to help with typing and filing. This is in process — we've had an expression of interest from one volunteer. More as it happens.

## IMPROVED STORAGE

On August 7th the remainder of the Association's collection and archive — including the two minis — was collected from the El Cerrito storage and from Aaron Alpar's apartment, and moved to expanded storage in Redwood City. Volunteer help was crucial to this process, as was the apparently boundless strength and experience of Berkeley's Mercury Moving.

At last everything we've acquired is secure in a central location, but we're now spending more on storage than we can afford indefinitely. It can't be said too often that WE NEED SPACE. We've learned in the last eighteen months that time, money and inspiration — though often in short supply — have always trickled in at a rate that would keep the Association going; but the struggle for storage is unrelenting. *Please, help us find a decent home for our collection.*

## MUSEUM EXHIBIT

We intend to create a pilot public exhibit of computer hardware and ephemera, somewhere in the Palo Alto-Mountain View area, between now and next spring. This is primarily a staff training exercise, but we'll be delighted to provide guided tours for visitors. Details to be announced.

## ANOTHER ROUND WITH VISA PROVIDERS

CHAC is negotiating with two more credit-card providers, one in Palo Alto and one in San Diego, and we'd say our chances of success are improving. With luck, paying for an ENGINE sub will shortly be a lot easier — especially for international customers. Thanks for your patience!

# ACQUISITIONS

## ALTOS 1000 MINI

This tower-case mini comes to CHAC as a deeply appreciated donation from Frank McConnell.

The Model 1000, Altos' most successful product ever, was first released about eight years ago and has a reputation of being rock-solid. (Kim Naru at HP Cupertino, who sold this one, remembers that during the 1989 Loma Prieta earthquake a different 1000 toppled out of its rack and kept working.) Many of these boxes are still in use for communications-intensive jobs such as payroll.

This particular Altos has an Intel 386/20 CPU, 16 mb RAM, a 140MB SCSI hard disk, 250MB SCSI cartridge tape, 13 serial ports installed of a possible 256, built-in Ethernet, a 5.25 floppy drive, a Wyse terminal, and SCO UNIX on tape. Dusty deck? Like heck! We might use it as an e-mail server.

# LETTERS

## APPRECIATION FROM SOUTH AFRICA

Hi there Americans!

Found a January copy of your newsletter skulking away on a forgotten mainframe the other day. Must say I enjoyed it. Just love what you are doing to preserve the heritage of our so-new but yet so neglected history. I cringe when I think that the original Colossus and its mates were chopped up after the war without any attempt to preserve even one of these machines. I can remember a local university dismembering (in the early seventies) its vintage 50's computer and selling off the bits to local Ham radio buffs. Nobody really thought about preserving these things then. Just an outdated and outmoded hassle to be got rid of! I would love to help financially but three things prevent this: Our exchange rate is so poor that it take a week's wages to get $50, I at present cannot afford a week's wages, and it is becoming increasingly difficult to get money out of this country. But my thoughts are with you anyway!

God bless!

*Eugene L. Griessel, Sysop, DYNAGEN*

## MORE ON THE CANON CAT

I think the Canon Cat is version 2. Version 1 was the Swyftcard, a plug-in ROM card for the Apple //e that turned it into something Cat-like. Jef Raskin came to a Washington Apple Pi meeting way back when to give a presentation and demo the thing. It was pretty nifty, and obviously designed to be simple, general, and powerful. The things that stick out in my memory:

(') available at power-on (which was why it was in ROM). (a) No DOS, diskette directories, or formatting. You just stuck a disk in, pressed <save>, and whatever happened to be in memory at the time got written on the floppy in one format-and-save operation. (b) There was some support for telecommunications in the thing. (c) There was some way to escape into a FORTH-like language for extensions. You wrote your "source" as part of the in-memory document. This wasn't expected to be used by most folks. (d) There was some way to partition the in-memory document, so you could have (e.g.) a letter and an address database for mail-merge kinds of things.

If I dig around I can probably find my old WAP Journals and maybe find a review (maybe even with a mention of the meeting).

*Frank McConnell*

## CD-ROM DATABASE OF IC'S

There is a CDROM index of all currently manufactured electronic components, everything from ICs to transistors to relays and resistors. We have it at the U of Iowa Libraries. It runs into hundreds of CDROMs, because they store a fax-style image of the data sheet for each device in the index. The problem, from the CHAC point of view, is that when the publisher releases updates, they recall the disks that have been updated, and as chips fall out of production, their documentation fades — first, the data sheet goes, then the pinout, and so on. Still, the thing is useful. I've found essentially all the rare semicustom chips used in the PDP-8/E in the index, and in most cases, I've found current local distributors for the modern pin-compatible replacements for these chips.

The Librarians call the product the IC-discrete database; it is published by Information Handling Services, 15 Inverness Way East, Englewood CO 80112-5704.

*Doug Jones*
jones@cs.uiowa.edu

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Some IC databases do exist in electronic form for several purposes, like CAD circuit design and automated testing. Unfortunately, they are parts of commercial packages.

There was even one module for the Commodore 64 by REX Datentechnik, which recognizes 74-series digital ICs. It even tells whether the chip has standard or open-collector outputs.

The method of identifying unknown ICs is discussed in "How to Identify Unmarked IC's" (BP101) by Kenneth H. Recorr. ISBN 0 85934 076 7 Bernard Babani (publishing) Ltd. 1982. Fold-out sheet 640 x 450 mm. Cover size 176 x 120 mm. Originally published as an article in "RADIO-ELECTRONICS" magazine.

There has been several attempts made to collect and cross-index the IC catalogs or databases that already exist, but the IC Master seems to be the only large and organized project.

Title: IC MASTER
Part Title: 1985
Publication: Garden City, NY : Hearst Business Communications
Publ. (Part): , 1985
Mater.(Part): 2 parts <5294> s. : kuv

The newest volume in our library seems to come in three parts:

Title: IC MASTER : 1989
Part Title: 1 : Integrated circuit selection guides, indexes & directories
Publication: Garden City, N. Y. : Hearst Business Communication
Publ. (Part): , 1989
Mater.(Part): 1944 s

Title: IC MASTER : 1989
Part Title: 2 : Manufacturers & dist. directory, advertisers product index, advertisers technical data
Publication: Garden City, N. Y. : Hearst Business Communications
Publ. (Part): , 1989
Mater.(Part): S. 2001-3469

Title: IC MASTER : 1989
Part Title: 3 : ASIC/custom & design automation, P development systems, microcomputer boards
Publication: Garden City, N. Y. : Hearst Business Communications
Publ. (Part): , 1989
Mater.(Part): S. 4001-5064

Without any doubt, it is the best reference for ICs. Is has references both by operation and part number. The main index is by part numbers in alphabetic order. Alas, they remove "obsolete" entries each year, but too soon, I would say. So, you need several volumes for full coverage.

As I mentioned, also smaller attempts have been made. All my equivalence books come from the same source:

International Diode Equivalents Guide
(BP 108)
Adrian Michaels
ISBN 0 85934 083 X
Bernard Babani (publishing) Ltd.
1982. 144 pages.

International Transistor Equivalents Guide
(BP 85)
Adrian Michaels
ISBN 0 85934 060 0
Bernard Babani (publishing) Ltd.
1981. Reprinted 1988. 320 pages.

Digital IC Equivalents and Pin Connections
(BP 140)
Adrian Michaels
ISBN 0 85934 115 1
Bernard Babani (publishing) Ltd.
1985. 320 pages.

Linear IC Equivalents and Pin Connections
(BP 141)
Adrian Michaels
ISBN 0 85934 116 X
Bernard Babani (publishing) Ltd.
1985. Reprinted 1987. 256 pages.

There are also others, each of which is touted to take advantage of "the latest computerized techniques".

Their address is:

Bernard Babani (publishing) Ltd.
The Grampians
Shepherds Bush Road
London W6 7NF
England

*Jouko Valta*

## FTP SITE FOR CIRCUIT DIAGRAM REFERENCE

Archive-Name: auto/sci.electronics/ftp-site-with-16-000-circuit-references

It seems to me that at least half of the postings here are concerned with circuit-related questions. Many would be answered by a database that we have recently mounted on an anonymous ftp site. The database contains the following features:

- SHAREWARE (requires registration for continued use or distribution)
- menu-driven front end to allow searches on devices and keywords on titles or circuit abstracts
- dBASE-compatible format for those wishing to search other fields
- references to >16,000 articles/papers containing practical electronic circuit designs, from >350 different magazines/journals
- availability of photocopy/fax of most original articles (author registered with CCC [Copyright Clearance Center])
- covers virtually every field of science and technology
- updates (annually or semi-annually, depending on response)

To download, ftp to gaitlab1.uwaterloo.ca and log in as "anonymous". The main database (~3M PKZIPped, ~10M after PKUNZIPping) is contained under /pub/circuits/main

A smaller demo version (if you want to try it first) is under /pub/circuits/demo.

Be sure to give a bin command before getting these files.

Suggestions, comments, questions and any other feedback would be appreciated.

*Peter Sawatzky*

## HP 110 INFO: WELL, WE ASKED!

There were two flavors of Portable: the HP 110, called the Portable, and something else of unknown model called the Portable Plus. Neither was PC compatible (nor were they HP 150 compatible, which was widely regarded as a bonehead move, although both would run plain-jane MS-DOS applications). Both came out of the Corvallis Portable Computing Division.

I had access to a couple of Portables at my previous job at University of Maryland. They didn't get enough use (they were check-outable) to entice us into trying further experiments with portable computers until after HP had dropped the Portable Plus, so I don't know much about the Plus. Last time I was back there I noticed that one of the Portables was still back in the datacomm room with a cable I'd made for it so it could be plugged into most of the asynchronous modems we had for a quick reprogramming.

The Portable was a little laptop-of-sorts (really smaller than most laptops, more like a thick notebook) with an 80C86 CPU, 80x16 non-backlit LCD display, keyboard with somewhat abbreviated key travel and 1-key rollover, 300 baud modem, serial port, and HP-IL interface loop. It had enough ROM to hold MS-DOS 2.something, PAM, MemoMaker (for simple word processing), Lotus 1-2-3 (version 1A, I think), a terminal emulator with XMODEM support, and probably some other stuff that I've since forgotten.

When I first got the 95LX palmtop I was reminded very strongly of the Portable — they both did about the same sorts of things in as small a package as was practical for the technology of the day, and both used execute-in-place ROM code to maximize available RAM. But I'm getting off track....

The Portable had enough RAM (512KB?) that you could split it between the RAM disk and system RAM and still get stuff done. (You could move the partition.) If you really needed more disk space, or needed to exchange files, there was a battery-powered 3.5" drive (the 9114) that could connect up via HP-IL. You could also hook a printer (ThinkJet) up that way.

Once upon a time I took the Portable and disk home to do some Pascal programming (using the HP-supplied Microsoft Pascal com-

piler). I never tried this again, for several reasons:

(a) The disk was dog slow. Given that HP-IL is a two-wire serial loop, this isn't too surprising.

(b) The display, not being backlit, worked fine in full daylight or an office with good fluorescent lighting. In my poorly-lit bedroom I had a choice between not having enough light to see what was on the screen, or having enough light with too much glare to see what was on the screen.

(c) The keyboard had a short travel and 1-key rollover — it was uncomfortable to use at first, and once I got used to it, it dropped characters on me. Grrr.

That said, there's still a lot of people who swear by these machines; they hold up to abuse very well, and if you can get what you want to fit in the machine itself most of the time (and have good light to work in) they're relatively hassle-free.

The Portable Plus had some other goodies, like 80x24 display, more RAM, and a couple of ROM drawers in which you could install applications. I remember thinking that this would probably have been a lot better for us because we could have got WRQ's Reflection (HP terminal emulation) in one of those ROM drawers. (No, the built-in datacomm program didn't emulate an HP terminal beyond doing ENQ/ACK flow control.)

I also recall that there was a third party who would modify the display on the Plus to include a backlight. Of course, this cost you running time as the battery drained that much more quickly.

*Frank McConnell*

## ONLINE COMPUTER COLLECTOR'S MARKETPLACE FROM UNUSUAL SYSTEMS

How would you describe the difference between the histories you publish and those published in the *Annals?* As you know from my flyer on the Commercial Computing Museum, I'm a grass-roots kinda guy and I'm trying to preserve the grass-roots history of a typically very complex subject matter. Your pub and David's [*Historically Brewed*] too, are so important that I don't see them as amateur compared to the *Annals;* they are instead another side of the same history.

Because you've included mention of my work several times I want to make sure you understand that my museum would be a private, for profit venture.

My book will be available in September. There are ad's in the next issues of the Annals and HB. What does a computer collector do when he's done his book? He begins his new online service for collectors called the Online Computer Collector's Marketplace. Will it be on the Internet? Nope, not until I can finance my own WWW server and anyway there are way more people out there with PC's and modems than there are with USENET id's. Will it run on a PC as a BBS? Nah, it would be hypocritical to buy'n'sell old computers on a Pentium, so the Marketplace will run off a multi-user MAI, Honeywell, or GEAC (remember good ole' GEAC?). I'll send you more material on this system in October.

Thank you for your attention. Take care and be full of care.

*Kevin Stumpf*

## MICROPROGRAMMING AND PAGING: REPLY TO ROBERTSON

Andrew Robertson asked:

*1.) Which were the first computers to use microprogrammed architectures as opposed to hard-wired architectures?*

Babbage's analytical engine was to be microprogrammed. The prototype mill (CPU) for the engine, built by his son around a century ago was microprogrammed. This machine is currently housed in the Science Museum in London. The microprogram was stored on a music-box mechanism, right next to the hand crank on the lower right side of the mill.

Microprogramming was reinvented in the 1950's by Wilkes. The technology that made microprogramming of electronic computers feasible in the 50's but not in the 40's was the widespread availability of inexpensive solid

state switching diodes — early microprograms were stored on hand-wired diode matrices. Read "Memoirs of a Computer Pioneer" by Wilkes.

Microprogramming was reinvented again in the 1960's by the people at Hewlett Packard who developed the 9100 calculator. Computer Structures, Readings and Examples, by Bell and Newell covers this in one chapter. Don't confuse this early 1970's book with the later edition! The two editions of this book are essentially different! Any computer historian needs to have both editions!

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

Atlas, built by Ferranti, was the first machine to support demand paged virtual memory, where page faults led to the transfer of pages between core memory and drum. This is a 1960 technology! The key papers on this were: "The Atlas Supervisor," by Kilburn and Payne, in the proceedings of the 1961 Eastern Joint Computer Conference, and "The Atlas Scheduling System," in *The Computer Journal*, 1962, page 238. If you look in Bell and Newell, you'll find this reprinted.

Of course, the word paging is ambiguous, as it also refers to an address space expansion technique, as used, for example, on machines as varied as the 6800, the PDP-8, the DDP 516 and the SDS 930. On these, the direct address field of an instruction couldn't address all of memory, so memory was divided into pages. Direct addresses referred only to locations on the current page, as determined by the high bits of the program counter. Indirect addresses could reference any memory location.

Again, Bell and Newell contains the answers you want!

*Doug Jones*
jones@cs.uiowa.edu

## KRAUSE ON HADDOCK

I bought this book in the computer museum in Boston, and I think it's worth $14.95. It contains photos (partially in a poor quality) of many (perhaps 50%) of the computers, and short summary of the systems: in most cases CPU-type, clock rate memory size and kind of periphery. No technical details.

There is also a collector's value, but I don't know if that makes sense: here in Germany I can find an Osborne 1 on one flea market for $25 with full docs, and on the next for about $1000.

There are two lacks in my eyes in this book: There is no description of the Intersil IM 6100 single board computers, the Intersil 6960 sampler and the Intercept Junior system. Only on page 41 is a short description of the Intersil IM6100 with a serial interface; I think he is speaking about the Intersil sampler without having any information about it. But it is probably impossible to list every microcomputer system that ever existed.

The second, more severe lack is the complete absence of the early development systems: Intel Intellec 4 / 40 / 8 and 8-80, NSC Pacer, Signetics Twin and so on. They should be included in such a book, because they are certainly available on flea markets and in surplus stores and they are worth to be collected.

The main value of this book is for identifying an unknown micro computer system which is announced without any other information: 'Xitan Alpha 2 to sell, no information available'.

*Klemens Krause*
*Universitaet Stuttgart*

## SOURCES WANTED ON EARLY COMMERCIAL SOFTWARE

Does anyone know of a good book or where there can I find some reading material on the early commercial software industry going back to the early 1960's and 1970's?

Obviously this would be mostly mainframe covering mainframe and some mini-companies. Companies such as Computer Sciences Corporation or Management Science Atlanta, etc...

I am doing some research in this area and I am finding that there is a lot of stuff on hardware companies at that time (particularly IBM), no one seems to have documented much on the software industry (not hackers but legit

businesses) until micro-computers rolled around in 1976. Any suggestions or ideas?

*Robert Dubicki*

## SOURCE FOR TELETYPE PAPER (YAY!)

### CANARY TELETYPE

Paper, that is. You get a giant roll, 8-1/2" wide by very long on a one inch core. How long? The OD of the roll is 4-5/8" and it weighs about 3.5 lbs. We are not about to unroll it and measure but it is a lot. [I think it was 300 feet. — Ric] It is Comcode No. 400 214 110 and the stuff they used to print teletypes and telexes on. They still may, for all we know. Try it for a group project drawing a frieze for the classroom. Or a "Happy Birthday, Grandma!" banner. Or mount it on a rod near the telephone as an endless message pad.

22261 Paper Roll, 8-1/2" wide $3.50/each

Address:
American Science and Surplus
3605 Howard Street
Skokie IL 60076

Order phone: 708-982-0870 (0800-1750 CDT)

$10 minimum plus shipping charges ($4.50 on up to $20 order)

*Eric (Ric) Werme*

## SMOKE SIGNAL BROADCASTING: A BRIEF HISTORY

Here's a little bit of extra info about Smoke Signal Broadcasting that I can contribute. Their address in 1977 was:

Smoke Signal Broadcasting
P.O. Box 2017
Hollywood, CA 90028

(Phone: 213-462-5652)

By the end of 1978, it was:

Smoke Signal Broadcasting
31336 Via Colinas
Westlake Village, CA 91361

(Phone: 213-889-9340)

I think that they kept the latter address for a while. As Kip says, their boards and systems were fully compatible with the SWTPC (Southwest Technical Products Corporation) SS-50 bus. This was a pretty cool bus which competed with the S-100 bus in its day - the most interesting thing about it, to me, is the fact the SWTPC motherboards had twin rows of 25 fairly thick pins, rather than a card-edge socket like S-100 machines. The SWTPC boards then had the sockets/connectors for these pins. A reasonable number of other companies, besides SWTPC and Smoke Signal Broadcasting, also made boards and other add-ons for SS-50 bus systems.

At any rate, most of the early Smoke Signal Broadcasting (SSB, from here on) offerings were add-ons for SWTPC systems, such as a floppy disk system (Basic Floppy Disk System - BFD-68) that came with patches for SWTPC BASIC and the resident editor/assembler, a 16K static memory board (M-16A), various configurations of EPROM boards (P-38) with an external power supply kit, an external EPROM programmer (POP-1), and later floppy drive subsystems like the 8" LFD-68 single and double floppy systems. Slightly later (mid/late 1978?), they offered complete systems called the "Chieftain", as Kip mentioned. At least originally, these were 6800 systems - maybe they used 6809s later. The Chieftain I used 5.25" floppies, while the Chieftain II used 8" disks. They both ran DOS68, Smoke Signal's disk operating system, and came standard with 32K of memory (expandable to 64K), a 9-slot motherboard, and a cabinet finished in leather-grain, which (I guess) was in keeping with their Native American motif and logo. I really don't know anything about their later systems.

Smoke Signal Broadcasting also offered software, such as a 6800 FORTRAN compiler. The software ran under DOS68 on SSB systems, and came with a copy of DOS68 and hardware mods (?) for SWTPC system owners. I assume that SWTPC system owners who ran SSB software had to run DOS68 rather than SWTPC OS's such as FDOS or FLEX.

*Bill von Hagen,* wvh@transarc.com

# 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 Palo Alto address, and we will store and forward.

## APRICOT PC XI

I've just had an Apricot PC XI come into my possession. It's a 8088 based machine similar to an IBM PC, but not 100% compatible. According to the documentation that came with it there exists a program for it called IBM, which would allow it to run PC software. Not surprisingly this program didn't come with it.

Does anybody have this software? Please email me if you can help.

Many thanks,

*Bob Entwhistle,* bob@wimpol.demon.co.uk

## ATARI 400

The very first computer I ever owned and operated was the ATARI 400. I had it fully equipped, with a thermal printer, 300 baud modem, and a tape drive. A few years ago I sold it at a garage sale, after I had moved onto bigger and better systems (Commodore 64, ATARI 1040ST). Unfortunately, I miss the classic video games that I had with it: Pac Man, Dig Dug, Star Raiders, Pole Position, just to name a few. I know a few of these games were ported to the IBM compatibles, but the only ones I've come across are ancient and don't take advantage of VGA graphics and Sound Blaster sound. Are there any high quality versions of the classic video games we grew up on, or am I going to have to buy an old ATARI?

Thanks,

*Justin Davenport,* justinad@vt.edu

## BIRTHDATES....

Does anyone know the birthdates of Bill Atkinson, Ted Nelson, Peter Vogel (Fairlight Music Workstation inventor) or James Moorer (3-D analysis of music waveforms at Stanford in the 70s)? I'm putting together a timeline project and having trouble tracking these down.

Thanks in advance.

*Dave Williams,* dwilliam@ilstu.edu

## BURROUGHS B 91

I'm trying to refurbish a B 91, in particular I'm looking for a CMS bootable disk.

Anyone know where such a beast can be found? Thanks all,

*Eric -B91- Salem*

## COMMODORE VIC-20

I have had a VIC-20 since '82, but I haven't touched it for about 8 years now. The problem is that at that time I *knew* everything so I didn't write it down. Later I have been through University, work and lots of different machines, and my knowledge about VIC-20 has gone beyond reach.

I bought a "turbo tape" for it (from England), but the instructions are gone after various moving. This was an add-on chip (cartridge). I have an expansion board with 5 slots, 32K RAM, debugger, graphics, games, ... I can manually set which memory locations the RAM should use.

Thus for the turbo tape I need to know what memory location it is at, where it starts (the memory location to "sys ...") and instructions for use. I remember something about "<-L ...", and then there was something different for fixed-location files. Instructions for the assembler-part would be nice too. I need this to be able to run "old" programs and games that I have on tape. Information will be greatly appreciated! (or pointers to information.)

*Bjorn Halvor Solberg*

## COMPAQ PORTABLE BIOS

In trying to rescue an original Compaq portable (2 FD, 512K) from a date with the salvage company, I seem to have run into a problem. Apparently my Compaq has BIOS revision B, a fairly early revision. Because of this, I am experiencing three big problems:

1. I am limited to 544K of memory.

2. I can't seem to get any rev of DOS later than 3.0 to boot.

3. It steadfastly refuses to look at the nice WD1002 and disk I found for it. :-(

According to Compaq tech support, a Rev. C BIOS or later will fix problem 1. (They couldn't tell about the other two.) Unfortunately, BIOS upgrades for the original portable are no longer available. :-( I have even tried one of the larger aftermarket BIOS dealers and was told the same thing.

By chance, does anyone have a Rev. C BIOS from a Compaq Portable or Plus that has gone on to meet its maker? As an alternative, I have access to an EPROM programmer; is there anyone out there who could send me a dump of the BIOS. (BTW, what kind of EPROM would I need?) ....I am willing to prove that I do, in fact, own the Compaq.

As a sort of alternative, a long time ago, when I bought my first XT disk upgrade, I seem to remember a utility disk coming with it. On this disk was a sort of "pre-boot" utility that would allow original IBM PC's (not XT's) which had old BIOSes to see and to boot from an HD. Would anyone still happen to have such a program lying around?

Thanks in advance...

*John Ruschmeyer*

## COMPUTER AUTOMATION

Can anyone give me a short history/status on Computer Automation computers? Their mini was used as process controller on many of the Korad Lasers that I worked on during the late 70's. I haven't seen their equipment used or advertised lately.

*Michael Robertson*

## DATAPOINT 2200

I have one completely working CTC Datapoint 2200 "PC" and would like to get some software and documentation to it. I bought ($0.2) this machine from local paper mill where it was used for warehouse book-keeping and inventory from 1975 to 1993. Nowadays there is a HP mainframe/Reflection/Windows combination doing (well, if those 386 PCs had to be replaced with 486s, you can draw your own conclusion) this job.

Other than that book-keeping program, I don't have any other material for this boat anchor and would be interested getting some sort of operating system, etc. for it. I would also like to see those articles mentioned couple of days ago in these magazines: American Heritage of Invention & Technology, fall 1994 and Analytical Engine, January.

Some notes about this overweight typewriter to those not familiar with it: it is a complete computer including a keyboard, a green CRT and two cassette drives. This one has got whopping 12 kilobytes of RAM (16 max) on three 15x20 cm "SIMMs". There are *fifteen* printed circuit boards in it and the cooling plate is adequate for a dozen of Pentiums. Also the logics on cassette drives would make your ordinary tape deck jealous.

If you can help, please contact following address, thanks.

*Jari Porhio,* eppu@cc.tut.fi

## GENERAL INSTRUMENT SOUND CHIP

Has anyone out there used the "Noisemaker" card on an S-100 or Apple II system?

Does anyone have the application note that engineers at General Instruments (now Microchip), possibly on an unofficial basis, issued on the AY-3-8910 sound chip? They also produced a 28-pin '8912 which didn't have the I/O port. I have heard that the '8910 was actually developed by Western Digital, and that W.D. engineers may really have been responsible for the Application Note; I have not been able to confirm this.

What I'm looking for is not the Data Sheets. This Application Note was put together by some engineers; it's 40 pages or more, and it's typewritten with hand-drawn drawings. It's not typeset.

I'm looking for information on making better-sounding sounds, besides simple beep tones. I want to make it sound like a bell ringing...

*Boston-Baden,* hazel-chaz@netcom.com

## ITS (YES, THAT ITS....)

I'm looking for any information you might have about the Incompatible Time-sharing System. If you have manuals or any documentation what so every available online, please get in touch with me. Pointers to any (paper) documentation are also welcome.

*Mikael Cardell,* mc%closet@lysator.liu.se

## MEMOTECH

Has anyone had any in-depth experience with Memotech's machines? I have a MTX 512 non-disk unit. The machine has also been available with floppy and/or hard disk configuration (although as I recall, that version had a separate box for the computer and a separate keyboard. Mine is the 'all-in one' version with the RF modulator. I was wondering if this machine could utilize the CP/M supplied with the disk system. There were some other differences besides the disk controller. The disk units had 80 column cards and also 1 channel sound (as opposed to the 3 channel version in this version). Didn't the disk units have the same TI sound chip? Am I having a dream thinking it wouldn't be too hard to run CP/M on this?

Any one has any appropriate technical documents for the MTX?

*Petteri Jäntti,* pjx@ichaos.nullnet.fi

## MONTE DAVIDOFF

Whatever happened to Monte Davidoff, the third member of the triumvirate that developed Altair BASIC for MITS? Davidoff was a classmate of Bill Gates at Harvard and he wrote the floating-point math routines for the BASIC interpreter that was sold for the MITS Altair 8800 computer.

*Rick Shane,* richard66@aol.com

## OSBORNE ONE

I have recently purchased an original Osborne 1 computer. I have no boot disk and am currently looking for one. This computer came with no book of any kind. If you have any info or know of an archive I can get some software from it would be appreciated.

Thanks in advance.

*Todd Walsh,* icswalsh@world.std.com

## PDP-10

I am interested in corresponding with anyone out there who has had personal experience with the PDP-10, either using TOPS-10 or TENEX. Reply to me by e-mail....or by Ma Bell (202) 357-2828. Anyone know where I could look at or obtain TOPS-10 or TENEX manuals? Xeroxes would be OK; I'll even do the Xeroxing myself.

*Paul Ceruzzi, Smithsonian Institution*

## PDP-11/03-L

I just rescued a pair of PDP11/03-Ls from Certain Doom. My next question is the obvious, "Now what?" Does anyone have any info on these? I would like to get them working and set up, but I don't know anything about them. Any information or pointers to information would be greatly appreciated, as would any manuals anyone could find...

As for the machines themselves, they each have a CPU unit, a dual 8" floppy drive, and 2 (5M?) disk packs which I can't seem to get open. Under the CPU unit is another weird unit with a whole bunch of DB25 (serial?) connectors growing out of it. Is this for ter-

minals? That's my guess, because the machine doesn't seem to have a designated "console".

The person I got them from didn't have a lot of information, but said they run RSTS.

Any info on how to get these beasts to boot, or where to get software for them, would be greatly appreciated!

*Mark D. Roth,* roth@uiuc.edu

## PDP-11/60

I'd love to correspond with people who used the PDP 11/60, RSTS/E, RT-11 or who own and use a DECmate. Those were the days!

*David Moisan, N1KGH*
*86 Essex St. Apt #204*
*Salem. MA 01970-5225*

## MicroPDP-11

If anyone has a M7555 (RQDX3), M8639-YA (RQDX1), or M8639-YB (RQDX2) QBus module that needs a good home, I have a MicroPDP-11 that could sure use it. I need a card to control the RX50 and RD52 in order to get it back in working order.

While I'm at it...If anyone has a MicroPDP-11 back panel (I have no idea what these look like) please let me know. The MicroPDP I have seems to have been de-installed by ripping the back panel off and snipping all the serial lines. The back panel is nowhere to be found. Any and all help would be greatly appreciated. Thanks!

*Seth J. Morabito, Cornell University, Ithaca, NY;* sjm1@cornell.edu

## PERTEC

I am looking for the address or phone number of Pertec Computer Corp. or any info about them. They were located in Los Angeles, CA, in the 1980's. They bought the MITS company that made the Altair microcomputer, but I can't find Pertec now. Did someone buy them out? or did they go bankrupt? Can anyone provide any leads? Thanks very much.

*Mark Greenia, Lexikon Services*

## ROCKWELL AIM-65

Amongst my array of archaic computers I have two Rockwell AIM-65 single board computers (one with FORTH ROMs!). I really never did anything with these beasts because I have no peripherals for them, etc.; what other accessories were out for this "toy"? Is there any way I can connect a terminal to it so I no longer have that miserable 24 character bubble LED readout?

Does anyone have any AIM trivia/folklore etc?

*Jonathan Disegi*

## SHARP BUBBLE MEMORIES

I still have a Sharp portable sitting in the attic, which uses bubble memories for storage. The bubble memories are contained in a small blue metal case, with a 30-pin card-edge (female) connector and a small reflective patch on the side, which you can cover with a piece of masking tape to make it read-only. The type number of these is CE-100BF. Does anyone know more about these memory modules, or the portable that uses them? I think it came with MS-DOS 2.11 in ROM.

*Marcel Melters,* mac@mcc.iaehv.nl

## SILICON VALLEY HISTORY

I'm interested in what factors led to the development of Silicon Valley as we know it today. Some factors would be the proximity of Stanford, the early location there of high tech companies like HP, etc. Eventually there was a landslide of co-location. Did the government of California play any roll in the development. Do folks consider "America's Technology Highway" (Rte. 128) near MIT to be comparable in scope and/or origins?

If people could help me out by pointing out any books, articles, etc. or opinions on the subject I'd appreciate it. I'd also appreciate any suggestions about a better place to post or ask these questions.

Thanks very much,

*Steve,* squeegee@cris.com

## SONY NeWS-STATION

Some days ago I bought one old Sony Net-Station (NEWS-1850). This machine works fine for me, but I'm becoming tired of recompiling all those stuff that I find useful on newer Un*xes, so:

1) Are there any archives on the net holding software and information about these machines?

2) Are there any mailing-lists and/or news-groups related to Sony's? Any hints welcomed.

*Guido Thater*, gt@sky.gun.de

## STAR TREK (THE GAME)

I'm looking for sources (FORTRAN or C) to a version of the classic "Star Trek" written at the University of Texas. I played it in 1982 or so on their CDC mainframe, and I've seen it on a VAX as well.... Mail or posts will be welcome.

Thanks,

*Doug McNaught, Towson State University*

## TI PROGRAMMABLE TERMINAL

Anyone remember a programmable terminal that TI marketed around 1974 or so? It had dual cassette drives and a rather powerful (but syntactically simple) programming language that allowed it to do just about anything you could ask of a small computer of the era.

I contracted with a small outfit that intended to sell these as general purpose computers to do some programming — I think the only other programmer they had was a smart 12 year old, which should have told me something.

Anyway, I had contracted to write a text formatter, which I did, but they seemed to be on such tenuous financial ground that I bailed out of the project before I had it all debugged. Just as well, as real desktop computers with useful software were just around the corner. (Still, I should have rewritten that formatter for CP/M and made, oh, about $500 in royalties...;-) )

Anyone remember this box? And did anyone else write any code for it?

*Michael J. Edelman*

## TRS-80 MODEL 4

A friend of mine needs a boot disk for a TRS-80 Model 4 computer. If you have one and would like to help out please contact me via private EMail. If you have any other software laying around for the TRS-80 please also contact me, so I can relay it to him. Thanks...

xeno@clark.net

## TX-0 AND PDP-1

Can anyone out there give me a list (and description) of the instruction set of either (or both) the TX-0 and the PDP-1. I believe there are some similarities since the PDP-1 incorporated some of the TX-0's features when it was designed. I have DEC's book "Digital at Work" which gives a basic summary of both machines, but I would like MUCH more detail if possible. Anyone who knows anything about either of these machines, or who can point me to a FAQ will be much appreciated. Thanks!

*Don Congdon*

## VICTOR VI

Where can I get a short history of the Commodore/Sirius/Victor lineage? My Victor VI is a jump-wired nightmare. A friend who worked for Victor (in Scotts Valley, California) tells me that at one point, they had a 50% out-of-the-box failure rate!

*Kenneth Freeman, San Diego, CA*

## WANG LAPTOPS

I have come across a couple of ancient Wang laptop computers, V30 IBM compatibles with 10 meg hard drives and built-in printers.

1. One has a dead hard drive. It is a SCSI. Does the Wang laptop use a standard SCSI drive?

2. They have an external port to connect a floppy drive. it appears to be SCSI also. But it

said I had a block size error when I tried to connect my Seagate drive to it. And when I connected the floppy to my ST-02 controller on my XT, it ignored it.

Where can I find drivers...

*Maxwell Froedge*

### XEROX 1108

I just bought a <<supposedly>> working Xerox 1108 Lisp workstation. However, I was not given instructions on how to boot the system...I held down both the Reset and Alt keys on the front panel, and I heard some hard disk activity for a minute, but then the numeric LED display started flashing 0201 — what does this mean? Is it an error? Plus, when I turn the computer on, the screen is completely blank — does it stay this way until it is booted?

I am desperate to get this thing running...thanks a lot!

*Jonathan Disegi*

## ARTICLES NOTED

"Practicing Safe Software," Billy Goodman, *Air & Space Smithsonian,* September 1994, p. 60ff. Behind-the-scenes of Apollo mission software development and debugging, with attention to the careers of John Norton, Margaret Hamilton and John Garman.

"ASAP Legends: Douglas Engelbart," Owen Edwards, *Forbes ASAP,* October 10, 1994, pp. 130-1. A brief appreciation of the inventor of the mouse and much else. Good photo.

"Unix at 25," Peter H. Salus, *Byte,* October 1994, pp. 75ff. A rich and anecdotal history of Unix from Multics to Mach and beyond; derived from Salus' new book, *A Quarter-Century of UNIX* (Addison-Wesley)

"Unforgettable Grace Hopper," J. A. N. Lee, *Readers' Digest,* October 1994, pp. 181ff. A summary of the Admiral's long and varied career, including folkloric detail like the famous nanosecond wire.

## PUBLICATIONS RECEIVED

[Omissions are inadvertent and regretted; we're still getting snail-mail by the bagful from our old address.]

*An Annotated Bibliography of the History of Data Processing.* James W. Cortada; Greenwood Press, Westport CT, 1983. 215 pp. From Kevin Frank.

"A Brief History of the Rice Computer, 1959-1971." Adam Thornton and Joel Cyprus. Draft, 35 pp. A history of the computer built at the Rice Institute (later Rice University) in the late 1950's to provide computing power comparable to Los Alamos' MANIAC II. From Adam Thornton.

Charles Babbage Institute *NEWSLETTER,* Volume 16 Number 4, Summer 1994. New CBI director Bob Seidel; Griswold papers; Tomash Fellowship; INRIA conference; Fortieth anniversary of NORC; more. 8 pp. From Judy O'Neill.

*IICS Chapter Notes,* newsletter of the International Interactive Communications Society. April 1994; July 1994, 12 pp. News and calendars of San Francisco Bay Area activity in multimedia. From Sheila Farrell.

*The Mathematical Intelligencer,* Volume 16 Number 3, Summer 1994. Articles on the history and culture of mathematics. US$39 or equivalent per year (four issues). From Chandler Davis, University of Toronto.

*The Z-Letter,* newsletter of the CP/M and Z-System community. Number 32, July/August 1994. Kildall obituary; Pascal programs; Echelon; new 22DISK; Software testing; correspondence, resources and technical discussion. 22 pp. US$18 for 12 issues (2 years); Canada/Mexico, US$22; International, US$36. From David A. J. McGlone.

## ADDRESSES OF CORRESPONDING ORGANIZATIONS

Charles Babbage Institute, 103 Walter Library, 117 Pleasant Street SE, Minneapolis, MN 55455. Judy E. O'Neill, associate director.

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

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

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

International Interactive Communications Society, 2601 Mariposa Street, San Francisco CA 94110. Sheila Farrell, membership secretary.

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

*The Mathematical Intelligencer,* Springer-Verlag New York, 175 Fifth Avenue, New York, NY 10010. Chandler Davis, editor-in-chief.

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

## THANKS TO....

Aaron Alpar, Joann Green, Bill Matison of Extra Storage, Frank McConnell, and Mercury Moving for Mini Rescue II.

Allen Baum for a shoeboxful of wonderful docs including CDC 6600, DEC PDP-8, Fairchild MSI, HP 2100, IBM 1620 and System/360, Motorola 6800, TENET, Varian 520/i, 620/i and 620/L.... (All in a shoebox! Really!)

Leigh Buchanan for our concise but comprehensive appearance in *CIO.*

Phyllis Cangemi for her donation.

Robin Donald for early *PC Magazines* including Volume I, Number 1.

Kevin Frank for the Cortada bibliography, plucked out of a university library discard pile. Eternal vigilance....

Jon Herron at AE Press for his usual nice job on the ENGINE, and in a hurry!

Gail Lee for first-class coordination and taping of the *Osgood File* episode.

Jim Lundy and Doug Abramson of Worldspan L. P. for trying to get your Managing Editor a ticket to London in time for the Bletchley Park dedication. If it hadn't been World Cup summer!

Frank McConnell (again) for purchasing, donating, *and storing* our new, potent and classy Altos mini.

Tony Napolitan, Henry Lowood and Robin Rider for working lunches.

Bill von Hagen for his donation.

## NEXT ISSUE / COVER ART

Oh, well! Presumably *some* of the seventeen people who've promised to write articles will come through by January! These are the hopes and fears that make an editor's life so interesting!

The cover: Hal Layer's Intel Intellec MCS-8 Mod 8, captured in pen and ink by Jil Weil. Scanned at Creative Computer Workshop, and detailed by Tom Ellis.

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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.

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## 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.

During the rest of this year we'll be working to make e-mail delivery more robust; and it does seem that the USPS has finally learned to treat the paper ENGINE with appropriate respect. Still, two subscribers that we know of never received the July ENGINE that was originally sent.

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

## NINES-CARD

### PRINTER, SPARE THAT TREE!

(a college CS story from James M. Putnam, Silicon Graphics International)

In 1974 I was working in the computer center of St. Andrews Presbyterian College, Laurinburg, NC, which had an RJE card reader/printer connected to Triangle Universities Computation Center's twinned 370/168s. I had figured out how to up the CPU and page limits for PL/C (a PL/1 student load-and-go compiler) jobs. I was running a Monte Carlo simulation, and the numbers from the random function didn't look very random, so I thought I'd print out every hundredth one just to eyeball them. The simulation was trying to approximate PI with Buffon's Needle method, and I kept getting told that PI was 3.0, or some damn thing. Somehow, in the next run, I misplaced a page feed statement in the outer loop, and since the simulation ran a million iterations, the program then tried to print out ten thousand pages, each with a single ten digit random number in the upper left-hand corner.

This shouldn't have been so bad. If the college operator were paying even the slightest attention, he would have stopped the job after the first half-box or so of paper. At some point even my expanded page limit would have shut it down. Unfortunately, the operator on duty was Earl, one of my closer friends, and someone for whom intoxication from various sources was all but irresistible. Working in the campus computer center didn't require much in the way of higher brain function, so Earl tended to get a little tanked before his shift.

I was in the keypunch room, and was listening to the printer. Something seemed wrong, but I couldn't figure out just what it was. It wasn't until I wandered into the computer room, in time to see Earl load a fourth box of greenbar paper, that it hit me. I slapped the power switch on the printer, and rang up the TUCC operator to cancel the job, and stood there meekly while he called me, among other things, an idiot.

Earl allowed, "You know, I was wondering when that thing was gonna quit. I was hoping we weren't gonna run out of paper. What were you going to do with all that stuff?" I admitted that I had made a teensy error in judgment, and told him that if he ever saw anything like that again, he was to gun the job first and ask questions later. "Fine", says Earl, "but what do we do with all this paper?". I admitted I didn't know, but suggested that he just put it out with the other used paper.

It's funny, but for six months after that, I kept finding those sheets of paper *everywhere*, in my room, in the cafeteria, at the radio station. The only thing I can think of is that Earl found a use for it after all.


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