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# UNIX™ WORLD

THE MAGAZINE FOR MULTIUSER, MULTITASKING SYSTEMS

OCTOBER 1985 $3 IN USA £2.20 IN UK A TECH VALLEY PUBLICATION

## NEW GRAPHICS FRONTIERS

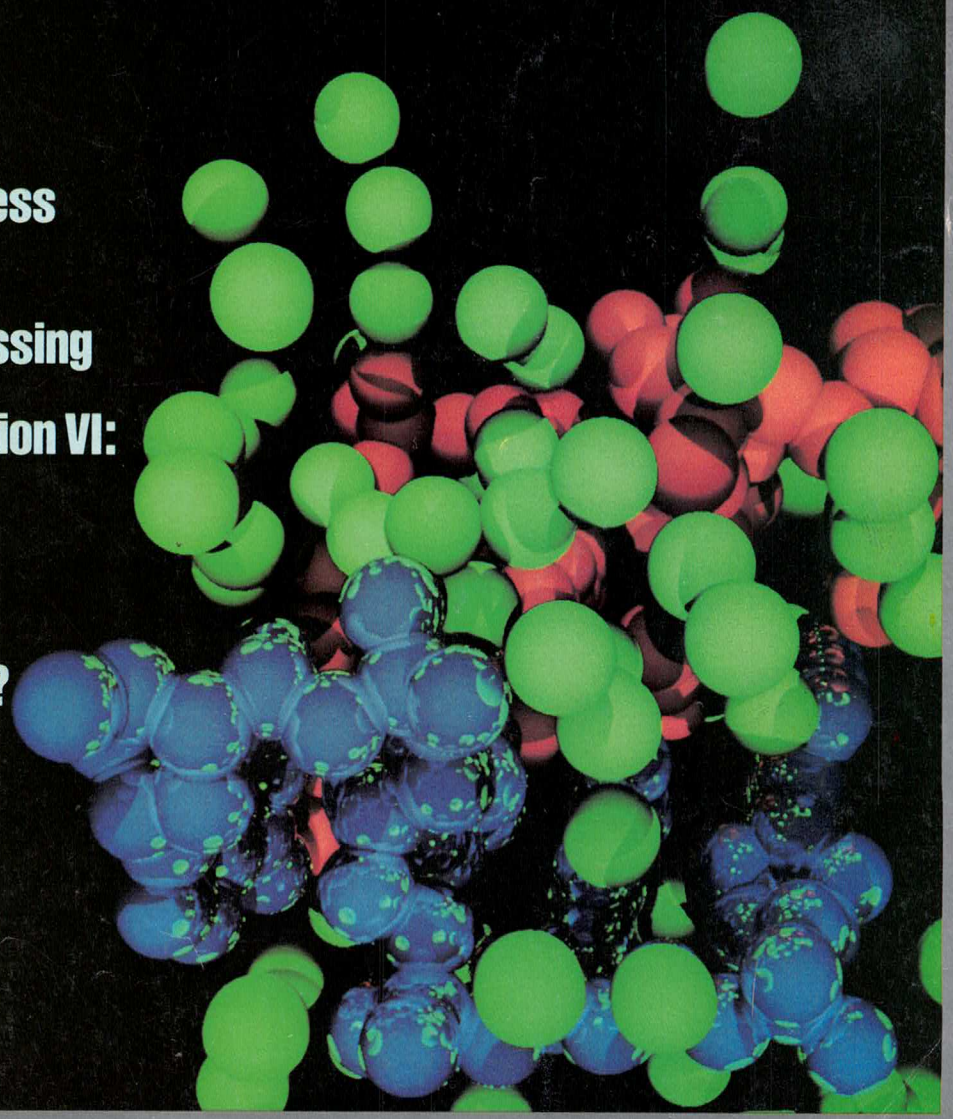
REVIEW:
CCI Officepower
To The People!

Exploding The Paperless Office Myth

Intro To Image Processing

Systems Administration VI: Adding And Deleting Users

Inside Edge: Wither Supermicros?



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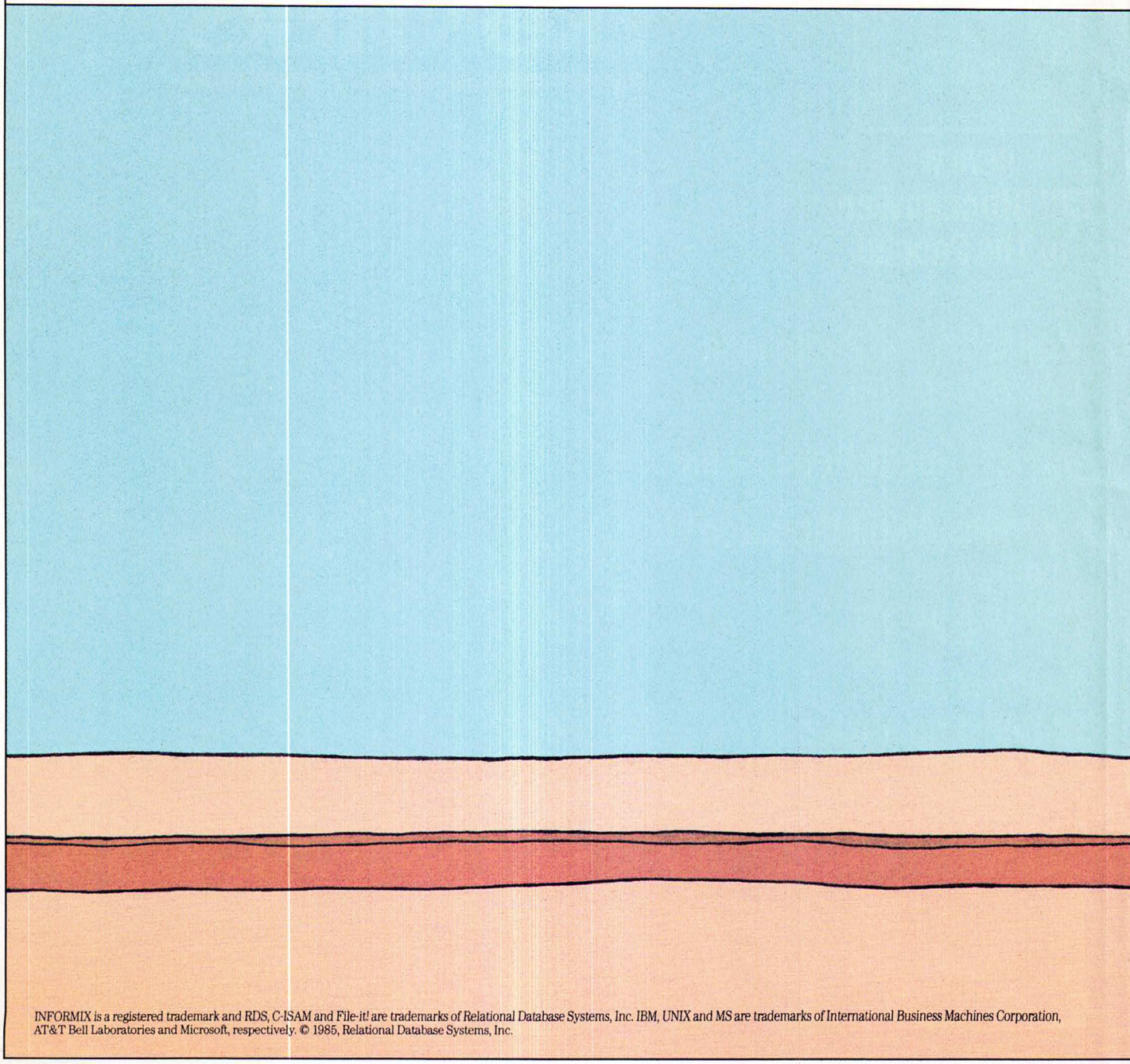

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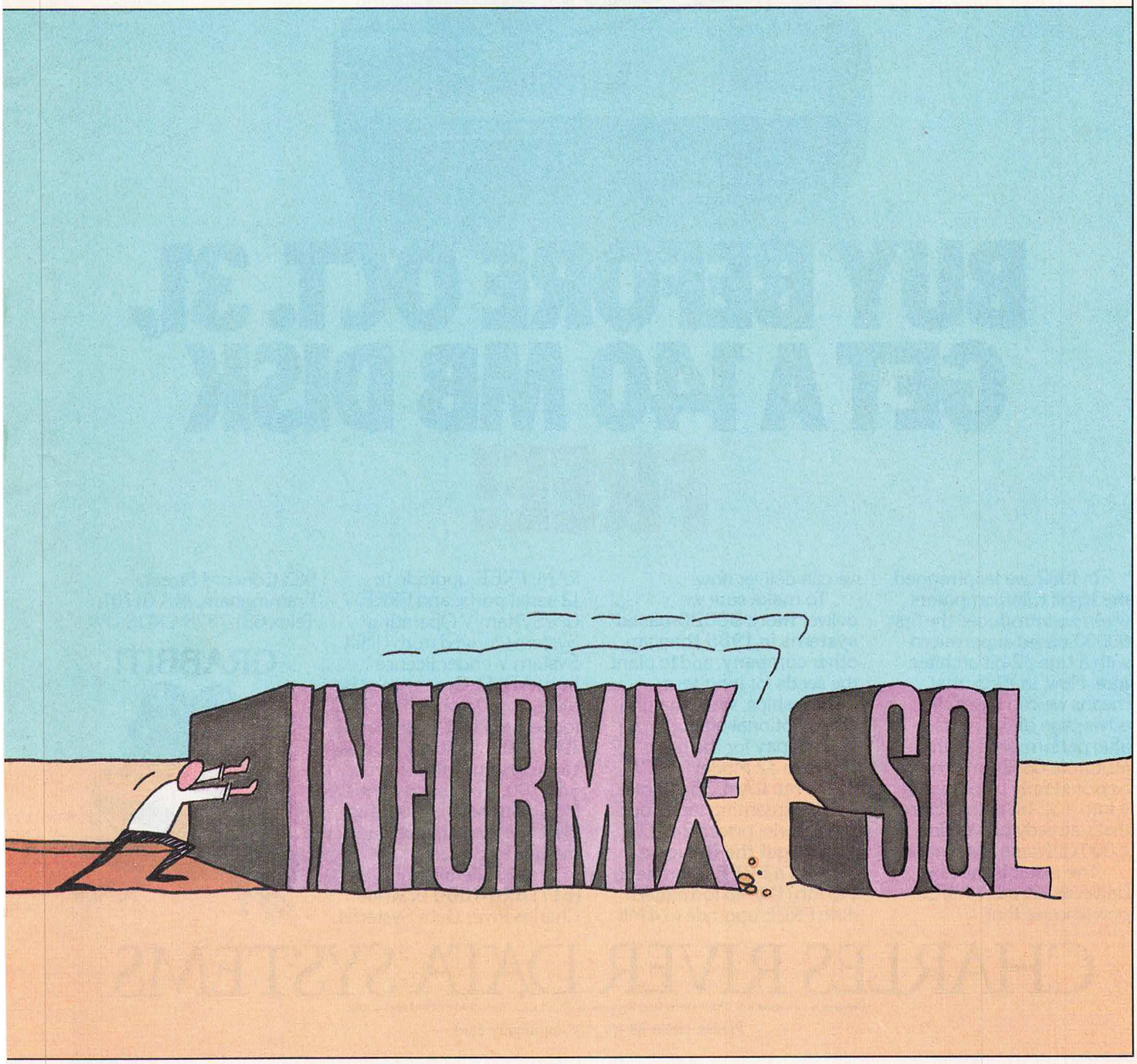

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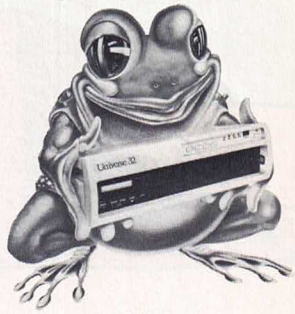

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VOLUME II, NUMBER 8

# CONTENTS

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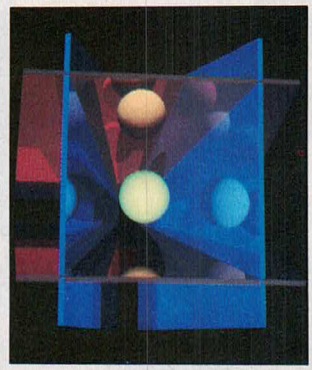
## THEMES





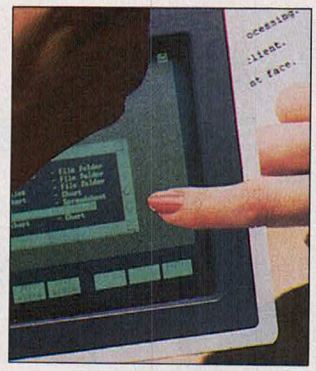
30

## REVIEW



## JOURNAL





38

## TRENDS



## TRAINING



## /etc



## NEXT MONTH

XENIX
- BILL GATES ON THE FUTURE OF XENIX
- ZILOG SYSTEM 8000 REVIEW

UNIX/WORLD (ISSN 0739-5922) is published monthly by Tech Valley Publishing, with offices at 444 Castro St., Mountain View, CA 94041, Telephone 415/940-1500. RETURN POSTAGE GUARANTEED. Postmaster, send Form 3579 to UNIX/WORLD, P.O. Box 1929, Marion, OH 43305.

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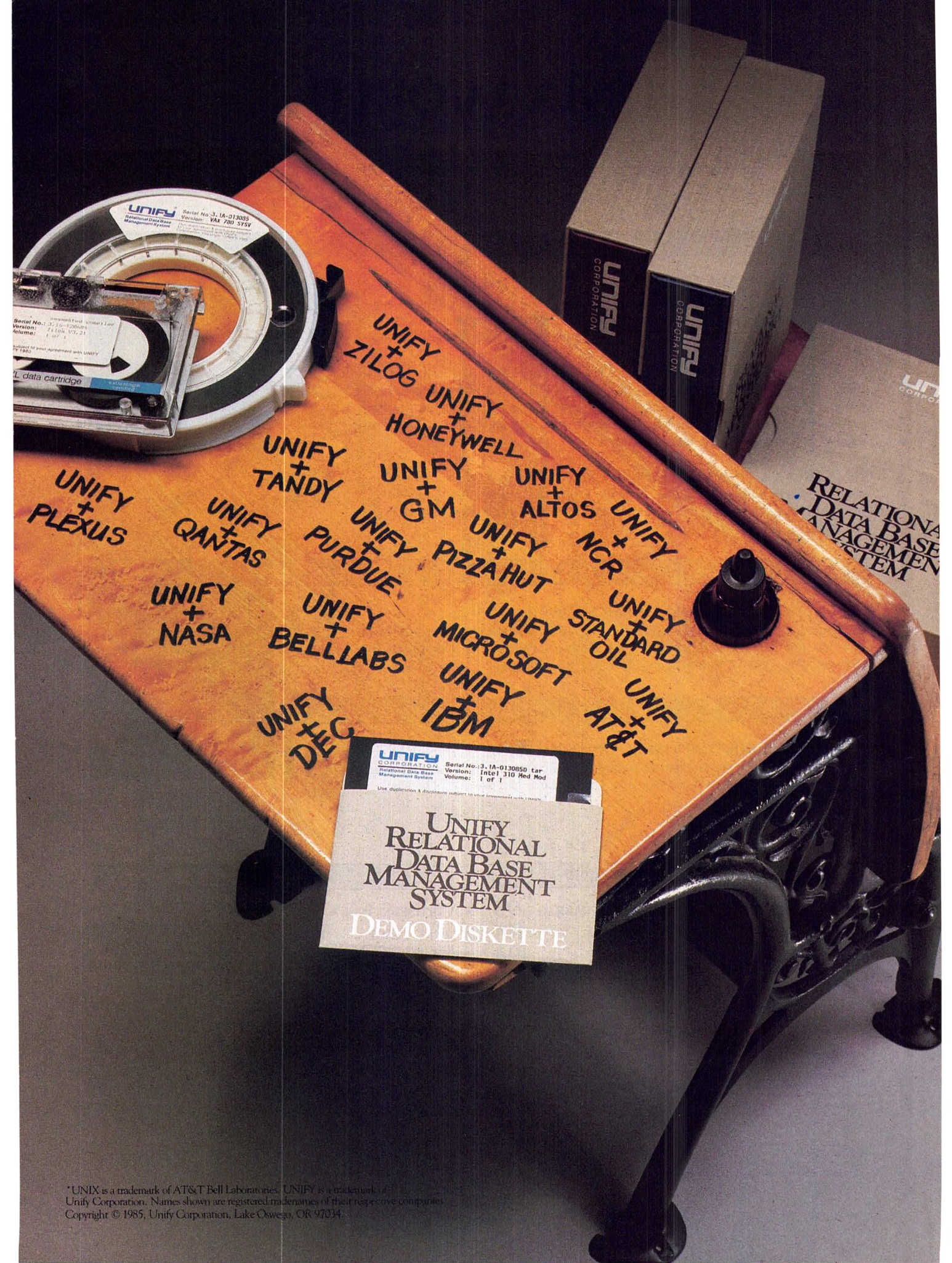


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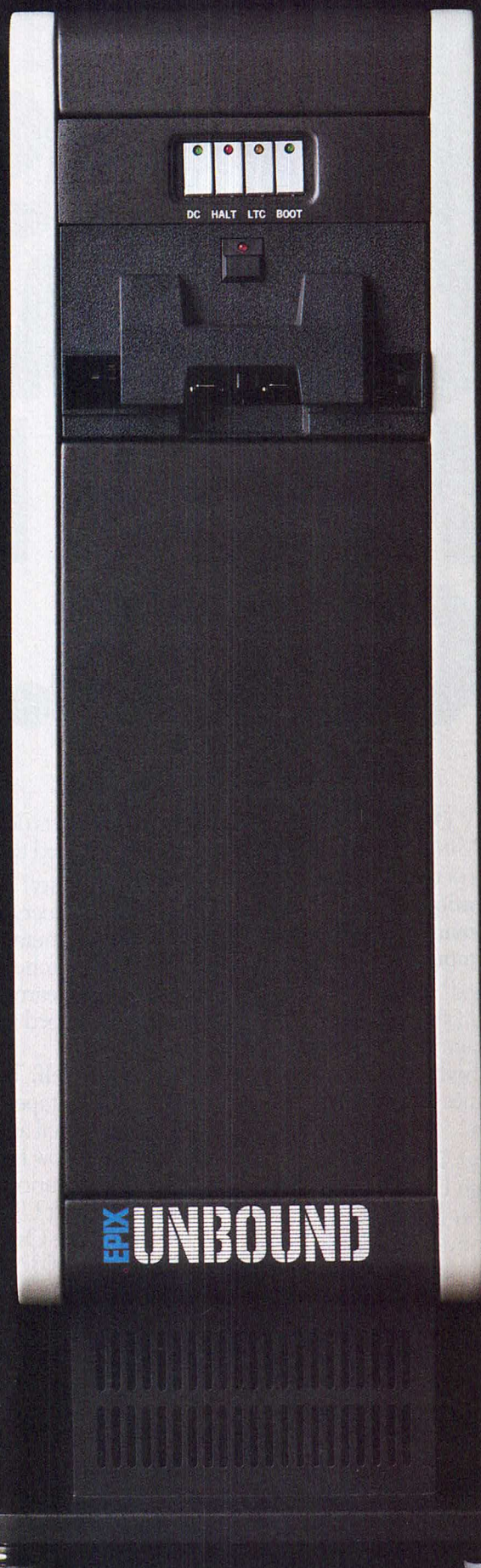


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# EDITOR'S CONSOLE

Computer-aided design, manufacturing, and engineering; image processing, in-house electronic publishing systems—three exciting frontiers in computer-graphics applications. To users, these mean the application of state-of-the-art graphics technologies to perplexing old problems. To vendors, they represent untapped business opportunities.

You've probably heard quite a bit about the CAD/CAM/CAE market, and how important this new application of computer technology is to maintaining and improving the worldwide competitiveness of both our high- and low-tech industries. Old stuff, right?

What you probably haven't heard is that the Unix system has made substantial inroads into the CAD/CAM/CAE marketplace. In fact, in the workstation arena, it's safe to say that the Unix system (particularly the Berkeley flavor, sometimes with a New Jersey accent) is quickly making itself the *de facto* standard operating system. Vanessa Schnatmeier, a frequent UNIX/WORLD author, explains this in "The Unix System Gets the Picture: Getting Into *CAD/CAM/CAE*."

Next up is Ashley Grayson on "An Introduction to Image Processing." Yes, image processing is a rather esoteric computer graphics application. UNIX/WORLD thought the topic deserved some attention precisely because of that distance from the mainstream.

The last among of the applied graphics frontiers we've targeted this month—in-house electronic publishing systems—causes me to smirk. Not so long ago, the general, business, and trade press pronounced the imminent arrival of the office of the future, a place where all information would be stored and retrieved electronically, nary a sheet of paper or a wastebasket in sight.

We all know now that such an office was nothing more than vendor hype, a myth. Truth is there will never be a paperless office. The drive to automate the office has failed miserably to eliminate paper. My gut instinct—and that of many others, some of them experts in office automation—tells me that far more documents have been created in the office than if office automation had never been invented in the first place. Now, this is not to say that office automation has failed in its other goals; it has succeeded in making some office workers more productive, and their work cleaner and more presentable.

The first generation of in-house electronic publishing systems have already arrived—Interleaf and Alis, to name two. More are on the way. Most are based on Unix systems for reasons our two authors, office automation consultants Thomas R. Billadeau and Lee Kauffman, discuss in "Electronic Publishing and the Myth of the Paperless Office."

One last thing: Special thanks to Visual Engineering, 3M Comtal, Interleaf, and Applix for their graphics contributions to this issue. □

*Philip J. Gill*
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# FOR THE RECORD

**Top of the News...** On the surface, this year's National Computer Conference (NCC) held in Chicago in mid-July, was something much less than spectacular: no major product announcements, no revolutionary technological breakthroughs, no discernible major trend permeating the product displays at the McCormack Place exhibit hall, and, last but not least, the notable absence of some major industry players—**Apple Computer, Digital Equipment Corp.**, and **Wang Laboratories Inc.**, to name but three. In short, an industry showing signs of a rapidly advancing mid-life crisis. Deep beneath the ennui, however, a few of the trends only talked about in previous years—parallel processing, multiprocessors/multicomputers, artificial intelligence, optical disks—were beginning to take hold in the form of tangible products, though most were in varying stages of readiness. In short, all the bricks we need to start building commercial-grade expert systems are being put into place. This is not to say that these long-awaited developments are an actuality, just that they are in sight. Significant shipments of any products based on these technologies or concepts are at least two to three years off.

Not all was for the future, however. At least one development of importance to the present-day Unix system community was also evident. In particular, NCC was the first showplace for the new Motorola 68020-based systems—NCR first Motorola exhibited its 68020-based Tower 32 supermicrocomputer. Granted that almost every 68010 vendor will have a 68020-based box within the next year or so or go out of business, but NCR is there now with an impressive 32-user system priced at $21,900 in its base configuration, including Unix system license. Also showing a 68020 system in an effort to leapfrog the competition was Charles River Data Systems. . . .

New machines do not a trend make, but the week after the NCC show, **Convergent Technologies Inc.** was busy previewing its 68020 machine—the much rumored but incorrectly dubbed "MidiFrame"—to selected members of the press and analyst community. This machine, officially christened "MightyFrame" and configured similarly to the NCR Tower 32, promises to be a real scorcher. And it's competitively priced as well, with its quantity one tag rumored to be about $16K to $17K for large OEMs. . . .

**Siggraph Paints Different Picture...** The calm and even outright boredom of NCC had lulled many into expecting just a so-so atmosphere the following week at Siggraph '85 in San Francisco. On the contrary, though, Siggraph won hands down as the most exciting show of the year so far. As one marketing executive put it: "This show is filled with engineers, scientists, university people, and artists. Engineers, scientists, university people, and artists still have money. . . . "

High on the list of Siggraph attractions were demos of *Star Wars* special-effects technology by **LucasFilm Ltd.**, San Rafael, Calif., and spectacular computer-generated real-time videos from Robert Abel & Associates' **Abel Image Research** subsidiary of Los Angeles. To get demos at either booth, you had to wade through crowds 15 to 20 feet deep in some cases, but the effort was well worth it. . . . In addition to its image processing demo, LucasFilm's Computer Systems Division was showing off its in-house-developed Pixar Image Computer. This computer can have up to eight processors, each based on the AMD 2901 bit-sliced ALU microprocessor and each of which runs at an incredible 40 MIPS per processor. According to LucasFilm, the high throughput is achieved by the use of a proprietary, 200-Mbit per second comm channel. By the way, the Pixar runs 4.2BSD. . . . The leading role the Unix system is taking in the forefront of new graphics applications was also evident at Siggraph. Besides the Pixar machine and products from Abel Image Research—much of whose real-time video work is done on **Silicon Graphics Inc.** workstations— products on the floor based on the Unix system included those from Cadmus, Sun, and Kodak, to name just a few. . . .

**Price Cuts...** As expected, **Sun Microsystems Inc.**, Mountain View, Calif., has cut prices on some models of its Unix system-based CAD/CAM/CAE workstations. In addition, the company has introduced two new products and Motorola 68020 upgrades (take that Intel!) for its VME bus-based products. Sun said the "price cuts were made possible by a steady decline in component costs over the past year" but added that "the move also signals the company's strategy in the months ahead, as strong competitive pressures increasingly affect the workstation industry. . . . "

**Rumors of the Month...** This month, one apiece about IBM and AT&T. First off, AT&T: Reliable reports say the firm will introduce its next addition to its workstation family—a combined Unix system and DOS machine based on the Intel 80286 chip—on September 20 at a New York press conference. The machine, which sources say curiously comes *without* a DOS/Unix system file conversion utility—reportedly has been dubbed the 8500. . . .

Now for IBM: About the same time AT&T rises to the PC AT challenge with the 8500, a usually reliable, veteran IBM watcher claims, Big Blue will fire its initial volley at the CAD/CAM/CAE workstation vendors **Sun Microsystems** and **Apollo**. After years of speculation, IBM will show its RISC-based, 801 processor packaged in a PC AT shell and running a combined System V/4.2BSD Unix system. The source says users can network up to eight of the machines together on a token-ring network that is also SNA-compatible. All for a market-busting, base configuration price tag in the $8K-$10K range. . . . Even more important, the same source said, is that IBM will deliver on its token-ring LAN promises with the arrival of this box . . .

**Contracts... Interactive Systems Corp.**, Santa Monica, Calif., has signed an agreement to provide IBM with non-exclusive, world-wide distribution rights for certain Interactive Systems Software. The first software products to be distributed by IBM under the new agreement are part of the Interactive Executive/370 (IX/370) licensed program announced in February by IBM for its mainframe computers. IX/370, which runs as a guest under IBM's Virtual Memory/Systems Products operating system, is available only from IBM. . . . **Computer Consoles Inc.** (CCI) has announced a non-exclusive distributorship contract with **Standard Telephones and Cables, PTY. Ltd.**, STC of Australia, valued at a minimum of $5 million over a three year period. Under the terms of the agreement, STC will purchase and distribute CCI's POWER 5 and POWER 6 computer systems, as well as OfficePower, CCI's integrated office automation system, in Australia, New Zealand, and Papua-New Guinea. Initial shipments will begin in the third quarter of 1985. . . . The **Wollongong Group** Palo Alto, Calif. has landed an agreement with IBM to provide TCP/IP under IBM's IX/370 operating system (Unix System V) for System/370-class processors . . .

**News From AT&T...** AT&T and **Elite Data Processing Inc.**, Los Angeles, which produces time-billing and accounting software for the legal profession, signed an agreement today making Elite a direct value-added remarketer (VAR) of AT&T computers. Under the terms of the agreement, Elite will purchase the AT&T Unix PC and 3B2 microcomputers and remarket them to law offices with the Elite System software. . . . **Amdahl Corporation's** data communications products and systems will be purchased under a multi-year contract with the Large Business System Division of AT&T. The Amdahl products, used in high-speed data communications network, will be used internally by AT&T, as well as be sold to worldwide customers . . .

**Corporate... Elxsi**, San Jose, Calif., and **Trilogy Ltd.**, Cupertino, Calif. have signed definitive merger agreement following an earlier announcement of an agreement in principle to merge the two companies. Under the agreement, which is subject to Elxsi shareholder and certain regulatory approvals, Trilogy will issue or reserve for insurance approximately 38 million shares of Trilogy common stock to Elxsi security holders. This will represent slightly less than 59 percent of the common stock of the combined companies on a fully diluted basis. Elxsi will be structured as a wholly owned subsidiary of Trilogy upon consummation of the merger. Trilogy, founded in 1980 by Dr, Gene M. Amdahl, is a developer of high performance semiconductor based technologies. . . .

**Noted... System Strategies Inc.** said it has delivered the first of a series of IBM-emulation software products to AT&T Information Systems for use with their multi-user Model 3B2 microcomputers and 3B5 minicomputers. Products licensed to AT&T include Systems Strategies' CSNA/3270, CBSC/3270, and CAPI/3270 software packages. . . . **Bridge Communications Inc.** and **3Com Corp.**, both Mountain View, Calif.-based makers of local-area network (LAN) products, have jointly been awarded contracts from GTE **Service Corp.**, Stamford, Conn. The contracts are expected to be worth up to $10 million to the two firms over the next eighteen month. □

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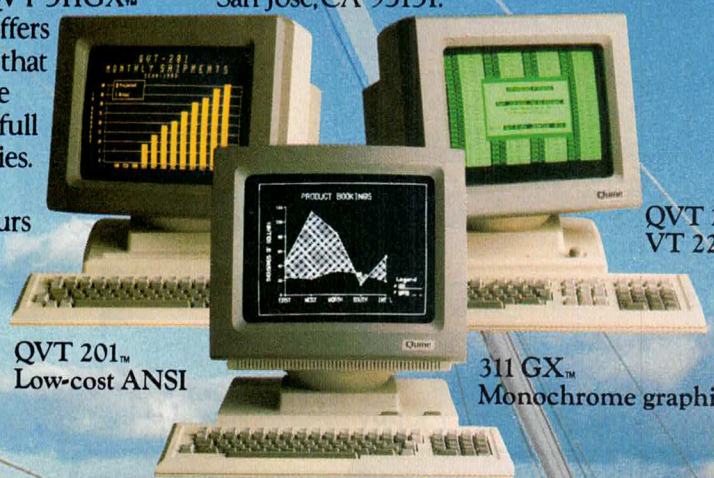

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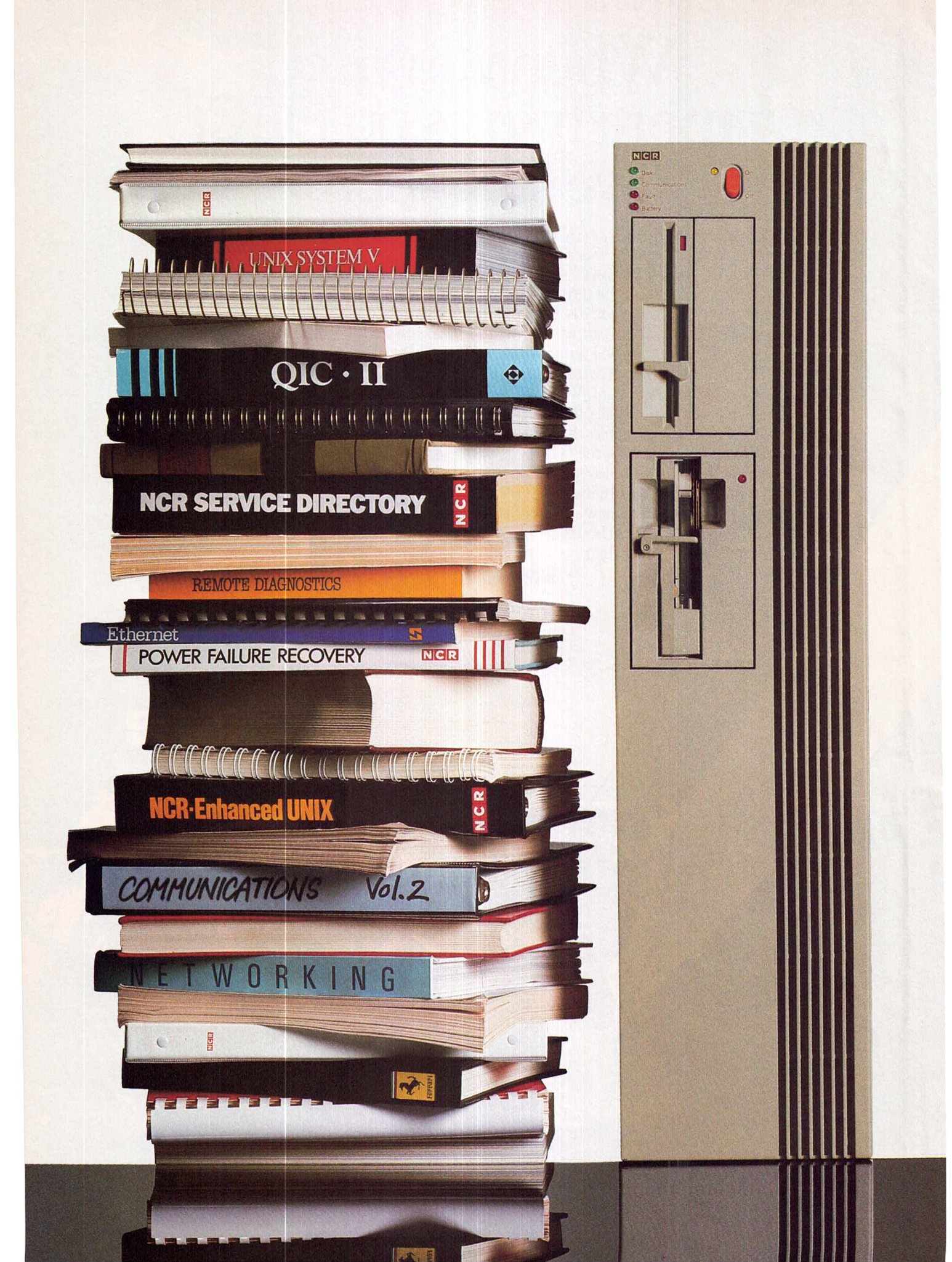
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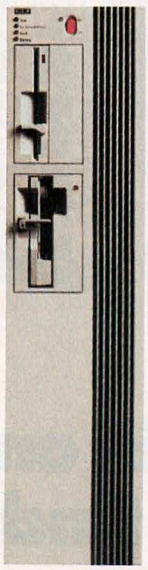

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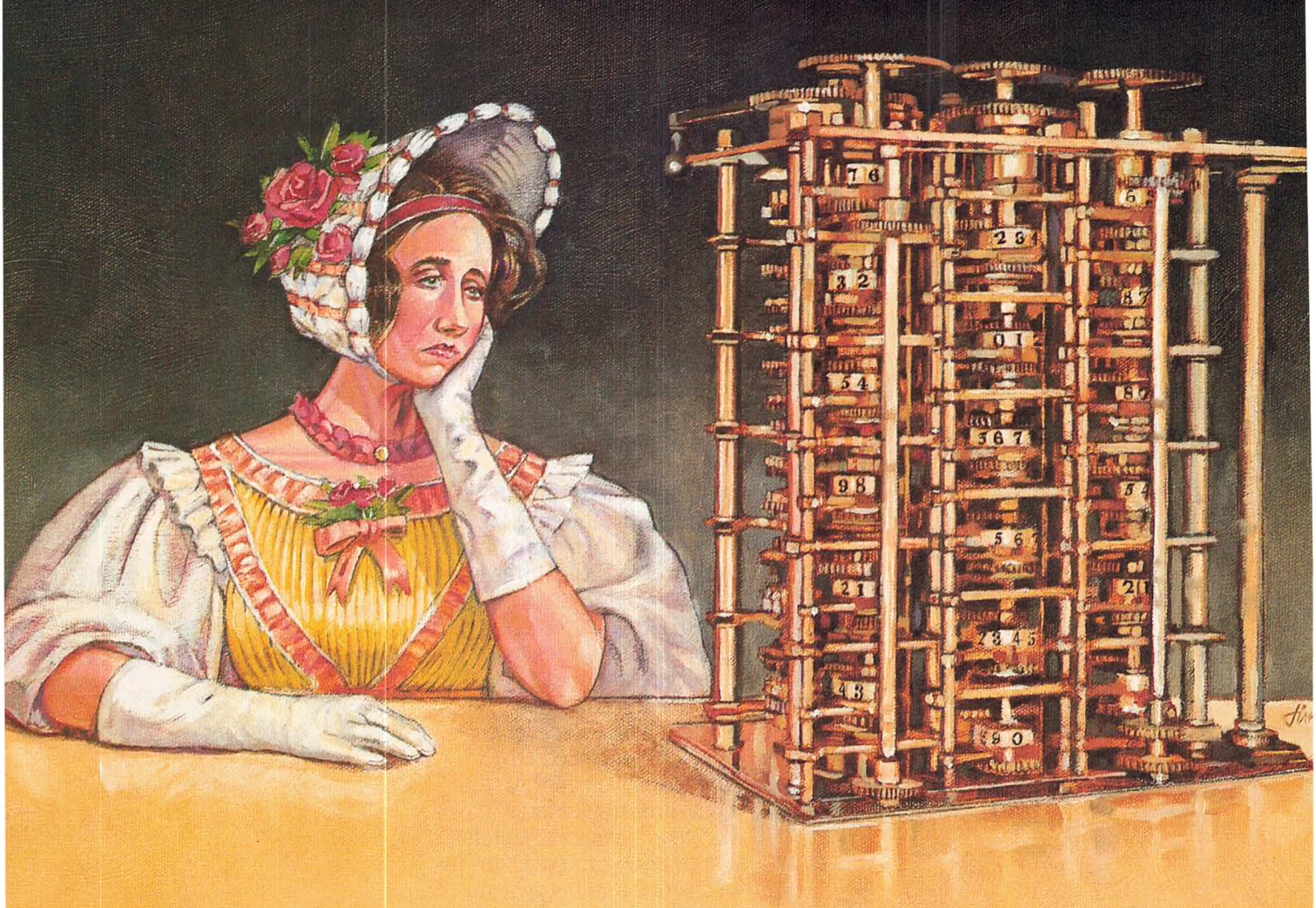

# Sorry, Countess, this is one computer where you won't find VADS™!

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## BERKELEY D-E-F's

Dear Editor:

I read with interest your article "The ABC's of the Berkeley Unix System," by Nancy Blachman and Phil Ngai. I found most of the article accurate except for a few items, which may be little things, but which are important points to understand if you are (attempting) to manage a Berkeley Unix System.

The last paragraph of the section discussing sendmail configuration files states that "these changes cause sendmail to invoke `uux` in a mode where it immediately calls up the neighboring site to which the mail was routed." `uux` (actually `uucico` through `uuxpt`) will cause a site to be called only during those times specified in the time field of the L.sys file (/usr/lib/uucp/L.sys).

The name of the program "biff" is not an acronym but rather the name of a creature (dog) that performed a similar function in real life for the program's author (Heidi Stettner—no relation, we think). I know, not a good way to name programs . . .

In discussing the placement of `/tmp`, it was suggested that if one has more than one disk drive that one should place the root file system on the first partition of the first drive and `/tmp` on the first partition of the second drive. This is not a good practice at all. I would suggest that one use the first partition of the second drive as a backup of the root (keeping it relatively up to date with known-to-run kernels, etc).

This practice is especially important on systems where the disk media are of non-removable type (Winchester drives). This backup could mean a lot if the real root were to fall prey to some catastrophe; just think of the time saved compared to booting from tape (or worse yet, FLOPPIES!!!).

If necessary, one could use the second (b) partition of the second drive for `/tmp`. This brings up a recommendation that the article does not seem to mention: One could use the second partition on the second drive as an extension (interleaved) to the swap partition (usually the second partition (b) on the drive containing the root). This would increase the swap space (also used for the page file) and spreads the disk arm load (that is caused by swapping and paging) out over two arms instead of just one.

The file that suppresses the printing of the message of the day is called .hushlogin not .hughlogin (a typo, I assume).

The program write was not a product of Berkeley but originated from earlier Unix systems from Bell Labs.

I'm glad to see that you are publishing information on system administration—a much-neglected area of Unix documentation.

Sincerely,

Armando Stettner
Senior Software Engineer
Digital Equipment Corp.

*Authors' Reply: We would like to respond to Armando Stettner's comments on our article "The ABC's of the Berkeley Unix System".*

*His more detailed description of the* `uux` *process is accurate, but since the article was not a uucp tutorial we glossed over the details.*

*We appreciate the truth about the origins of the name "biff". As we said, it could also be an acronym for "Be notified IF mail arrives and who it is From".*

*Regarding the placement of* `/tmp`*, we feel it depends on the reliability of your disks. Phil has had a VAX-750 for a year and never lost the root file system (or any other file system). If the unlikely were to happen, it would be relatively quick and painless to recover. Just use the copy program on the distribution TU-58 to load in a mini-root from the distribution tape on the swap partition, boot the mini-root, and run restore. If you do expect to lose the root file system often, then the strategy suggested by Armando can speed up the recovery process.*

*It is much the same tradeoff as letting syslog do a* `sync` *every time you access it; we don't feel the*

*performance degradation is worth the extra security but it is really a matter of taste.*

*The recommendation for swap partition setup is a good one. However, our article was too long as it was and we did not have room to discuss it.*

*Phil Ngai*
*Nancy Blachman*

## DIFFERENT SLICES

Dear Editor:

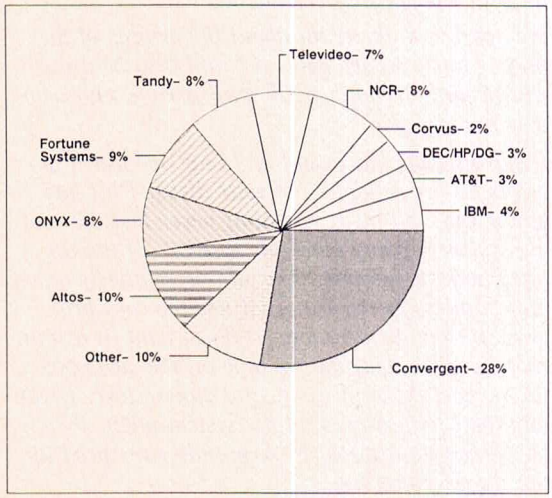
I am enclosing the two pie charts that were published in our report *#1526 Multi-User Microcomputers: Impact and Opportunities Update, February, 1985.*

We updated the information in these pie charts showing the 1985 Vendor Market Share of Multi-User Microcomputer Systems prior to publication.

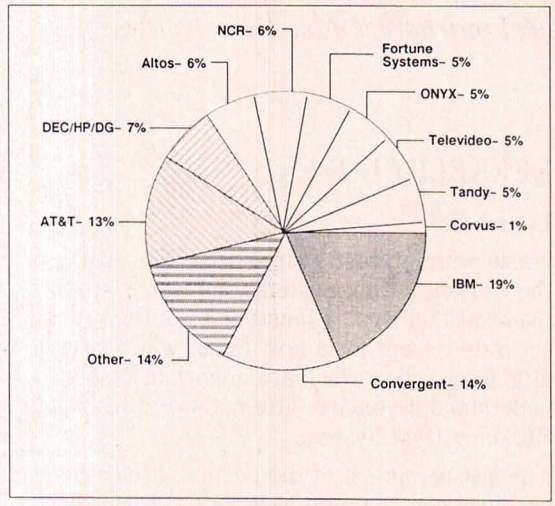
If you would share this corrected information with your UNIX/WORLD readers, it would be appreciated by all involved.

Sincerely,

Terrence Johnson
Manager/Office Systems
Information Systems Group
Strategic Inc.




*Vendor dollar share of the multi-user microcomputer market: 1984 total value in OEM sales: $980 million.*




*Vendor dollar share of the multi-user microcomputer market: 1985 total value in OEM sales: $1.9 billion.*

*Editor's Note: These pie charts are meant to correct mistaken information that appeared in our June 1985 issue on* The Unix System in Small Businesses. —Philip J. Gill

## IBM'S 'AT' STILL STRONG

Dear Editor:

Your Short Notes section of the column "Inside Edge" in your May issue was in error when it reported that shipments of the IBM Personal Computer AT "have been suspended pending resolution of hard disk problems."

Shipments of the Personal Computer AT have not been suspended. In fact, production has increased substantially as IBM is striving to meet the demand for the machine.

While we have had some reports of problems involving AT's fixed disk drive, the overwhelming majority of AT users have reported no problems.

Sincerely,

James C. Reilly
Vice President,
Communications and Marketing Services
IBM

*Editor's Reply: We stand corrected.*
—Philip J. Gill. □

# WHATEVER HAPPENED TO THE SUPERMICRO MARKET? PART 1

BY OMRI SERLIN

When supermicros began hitting the market in 1981-1982, their prospects appeared unlimited. Based on 16/32-bit MPUs such as the Intel 8086, Motorola 68000, and Zilog z8000 (the "big three" at that time), these systems promised mini and even supermini performance levels at about ½–⅕ the price. Given this potent combination, it seemed reasonable to assume that supermicros would capture substantial territory from conventional minis and superminis, and would open up vast new areas of applications that previously had been unreachable by conventional suppliers.

A survey of the supermicro scene today shows a very different picture. Instead of laughing all the way to the bank, most of the supermicro suppliers that are still operating are struggling to keep their heads above water. Shipment levels lag in the thousands, instead of reaching the projected millions. True supermicro success stories are rarer than hen's teeth; with the exception of Altos and possibly Tandy, no one is making money in this business.

Vendors and analysts tend to explain away the problem by blaming the industry-wide downturn, which began late last year and by now has resulted in significant layoffs and plant closings at leading U.S. computer suppliers. Even IBM, which as recently as April projected a "strong" second half, now admits that the sharp earnings drop experienced in the first half of '85 may not be over quite yet.

However, the problems faced by supermicro suppliers began much earlier, and are endemic.

## WHAT IS A SUPERMICRO?

To understand why, it is first necessary to agree on terminology: "Supermicro" is a much-abused term. At least one company calling itself "The Supermicro Company" offered an architecture in which a collection of essentially 8-bit personal computers were packaged in a common cabinet.

This author (who, incidentally, coined the term in early 1982), always regarded the supermicro as a computer system based on one or more of the more advanced 16- and 32-bit MPUs, in contrast to the 8-bit and 8/16-bit MPUs used in most personal computers unveiled during 1981–1984.

Within this broad characterization exist a number of subcategories.

**Personal Supermicros.** In the Apple Lisa and Macintosh computers, the power of the 68000 MPU was harnessed principally to create a personal computer offering a rich, "software-ergonomics" environment. Other early examples of the personal supermicro were the 8086-based Convergent Technologies' IWS and later AWS lines. More recently, the 286-based IBM PC/AT and its clones joined this category. In terms of intended usage, pricing, and distribution channels, these powerful machines are (with the possible exception of the networked Convergent Tech workstations) actually personal computers that share few characteristics with the next, most important category.

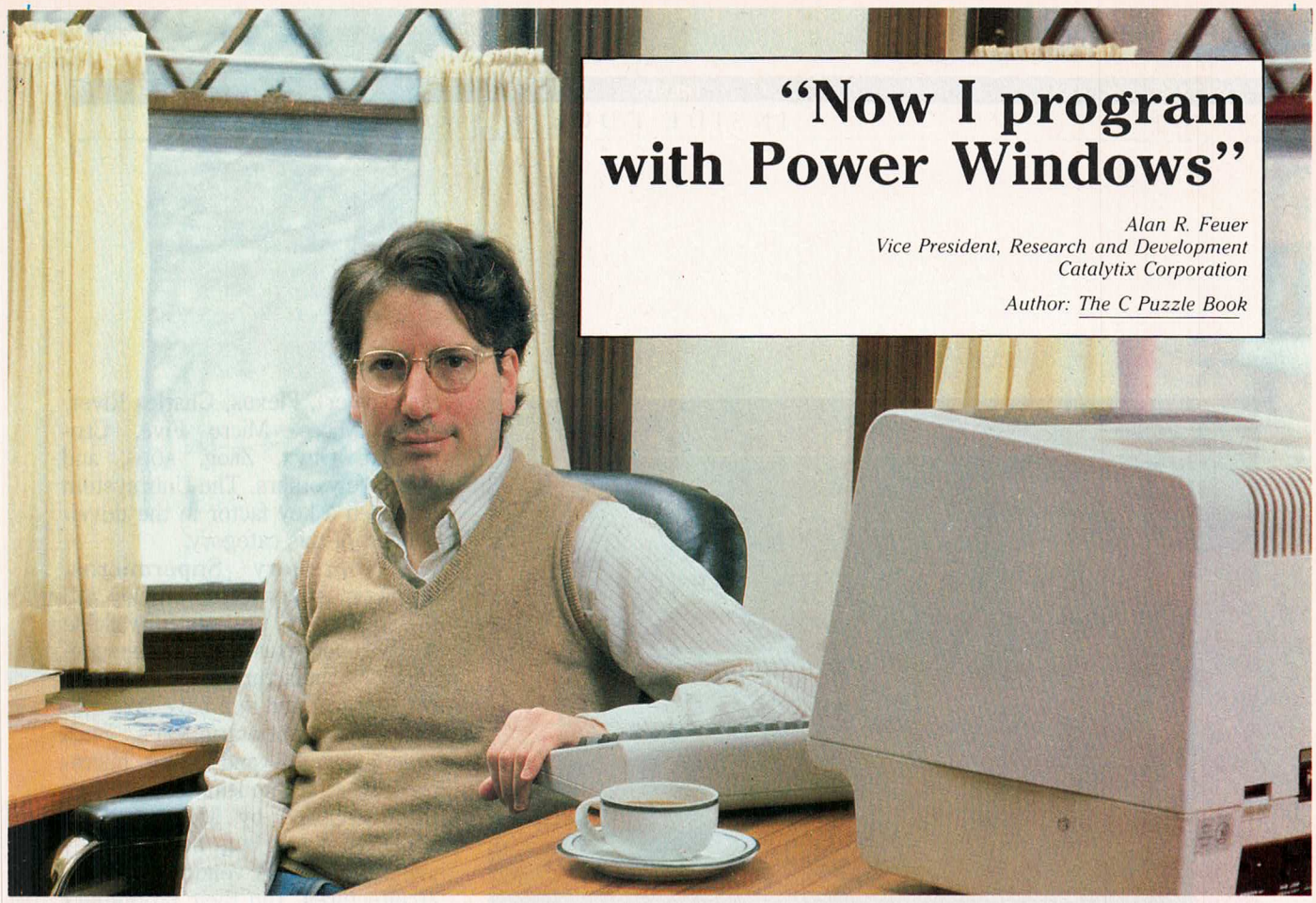
**Multiuser Supermicros.** These make up the true "heartland" of supermicrodom: machines based on off-the-shelf, 16- and 32-bit MPUs, intended to act as a shared, multiuser facility for many of the same applications as minis and superminis. In this category are the Altos 68000-based and 8086-based machines (recently enhanced with 68020- and 286-based models); the Tandy 68000-based Model 16, 16B, and, most recently, Model 6000; and a long list of similar offerings from Convergent Technologies (MegaFrame and MiniFrame), Fortune,

### NEWS SUMMARY

**Only three to four years ago multiuser supermicros, offering supermini capabilities at ½–⅕ the price, seemed on the verge of a major success; now they seem hopelessly stalled. The key problem: The potential user demands the same sales attention and post-sale support and service as a supermini user, but the low supermicro price precludes direct sales.**

**Small VARS/VADS, the key supermicro distribution channel today, can't or won't supply support. Supermicro suppliers must resolve this issue quickly, since they are under increasing pressure from networked PCs and proprietary supermicros (such as the DEC microVAX II).**

**Although the Unix system figures prominently in the supermicro arena, it is neither the root cause of the problem nor a panacea. In the long run, the reliance on the Unix system creates a commodity-market situation.**



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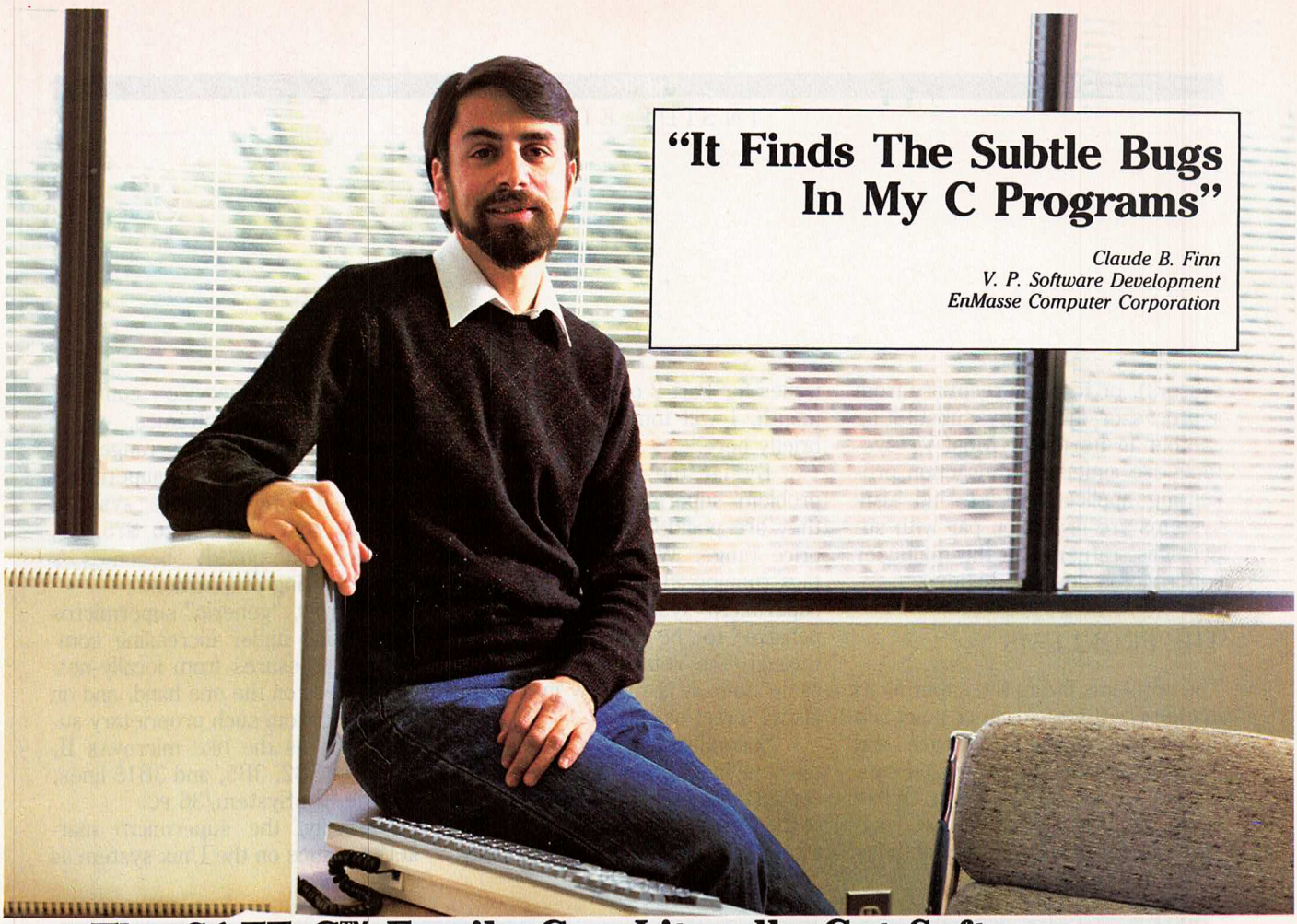
NCR(Tower), Plexus, Charles River, Alpha Micro, Micro Five, Cromemco, Onyx, Zilog, ADDS, and quite a few others. The Unix system has been a key factor in the development of this category.

**Proprietary Supermicros.** "Generic" supermicros employ off-the-shelf MPUs, i.e., MPUs available on the open market from semiconductor manufacturers. AT&T, DEC, DG, HP, IBM, and NCR have products based on proprietary MPUs. Such proprietary 16- and 32-bit microprocessors are no less "super" than those supplied by Motorola, National, or Intel; but, because they implement specific vendors' "closed" architectures, run their proprietary operating systems, and are not (with the recent exception of AT&T's 32000 MPU) available to system builders, they occupy a distinctly different niche in the marketplace. In fact, the availability of such proprietary supermicros is part of the problem that generic supermicros face today.

**Multiprocessor Supermicros.** A small but growing group of suppliers are bringing to market architectures in which one or multiple co-operating systems orchestrate multiple MPU-based processors. The multiple processors are employed for one of two purposes: (a) performance and (b) fault-tolerance. Performance oriented systems (e.g., Sequent, Encore, Flexible) allow the system's processing capacity to grow to meet a growing multitasking load by merely plugging in additional processors in the field. Recently, some of these suppliers are addressing **parallel processing** applications as well (Sequent, Flexible).

Fault-tolerant (FT) systems (e.g., Stratus, Sequoia, Tolerant, Parallel) use processor replication either to detect failures (by comparing results from two or more pro-



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cessors), or to allow recovery from a processor failure by substituting another in its place. Most FT systems are aimed at transaction processing applications; FT and MMP systems are priced on par with superminis, rather than the multiuser supermicros described above.

## THE PROBLEMS

The problems facing the supermicro market are threefold: price point and distribution channels, service and support, and the double-edged connection to the Unix system. While space limitations require that I reserve an in-depth discussion of these issues for Part 2 of this article next month, I will touch on them quite briefly here.

By far the most fundamental problem supermicros face is that they are positioned in an awkward price range. With typical systems tags running $15,000 to $30,000, a supermicro system is far too expensive to be handled properly through the retail channel; at the same time, it is too low in price to justify direct sales.

Secondly, industry experience till now has shown that users are comfortable paying about 10 percent of the total system price per year for a standard, Monday-through-Friday, 8-AM-to-5-PM service contract. That's fine for mainframes, where complete system prices range into the millions. But in the supermicro market, where complete systems typically cost $50,000 to $75,000, this formula quickly becomes a money loosing proposition.

Thirdly, "generic" supermicros are coming under increasing competitive pressures from locally-networked PCs on the one hand, and on the other, from such proprietary supermicros as the DEC microVAX II, the AT&T 3B2, 3B5, and 3B15 lines, and the IBM System/36 PC.

Finally, the supermicro market's reliance on the Unix system as

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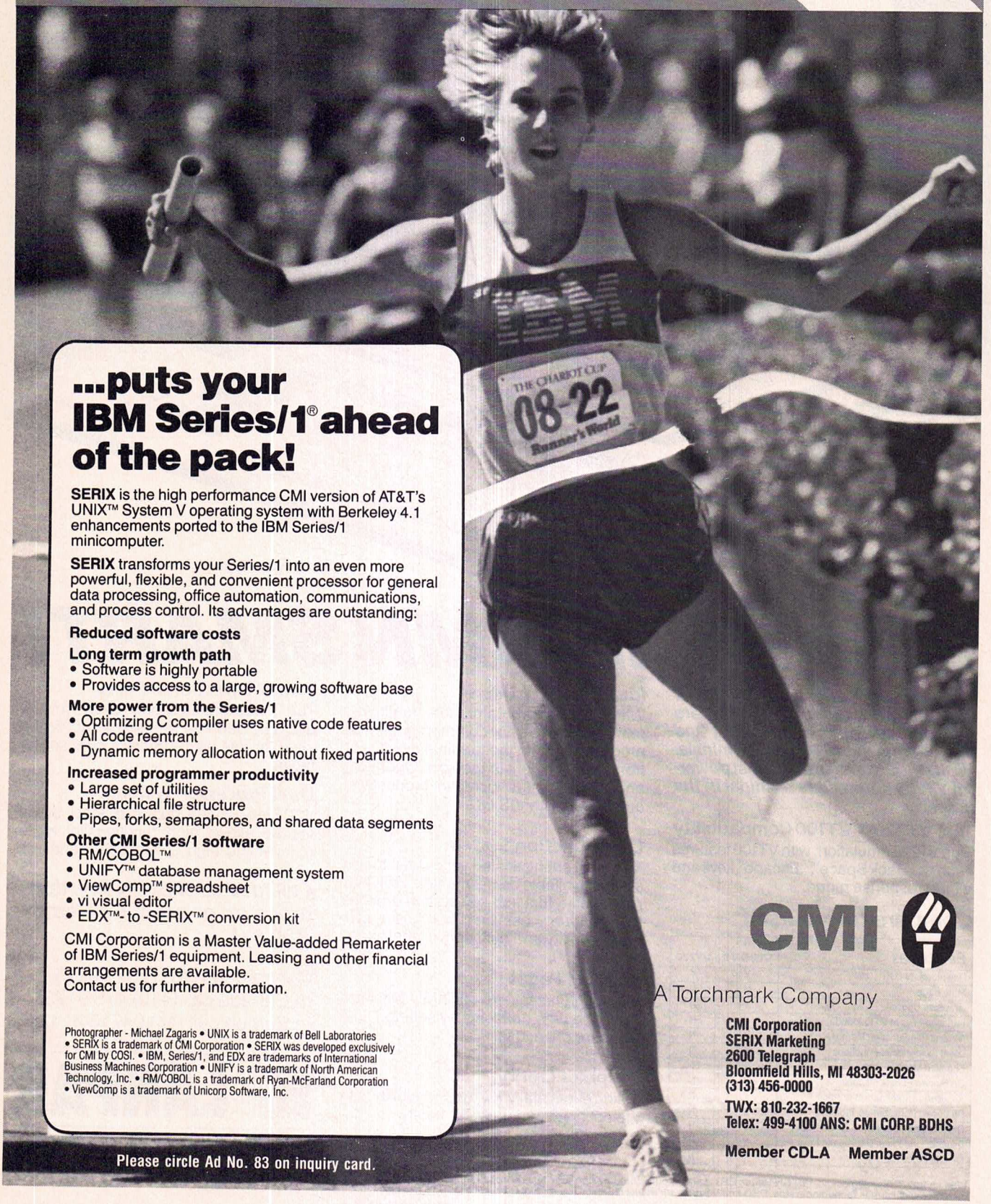


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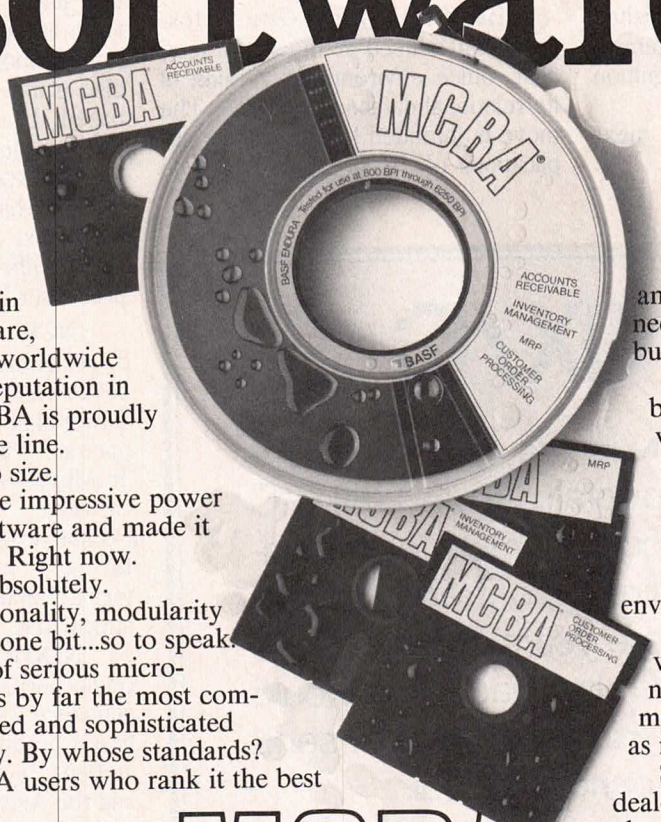


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its standard is a double-edged sword. First, the Unix system's vaunted "portability" is still more fiction than fact, at least in terms that most consumers would understand. Secondly—and perhaps more important—if a standard Unix system emerges, supermicro vendors risk being caught up in a commodity market, a situation that typically entails a loss of product differentiation and of customer loyalty. Only AT&T, IBM, and a few other well-established suppliers have the financial stamina needed to sustain brand-recognition in such a market.

Enough for now. More next issue.

## SHORT NOTES

**AIM TECHNOLOGY** (Santa Clara, Calif.), the originator of Aim the benchmarks for the Unix system, has named ex-Wollongong president Frank Zehna president and COO. Founder Jim Geers remains chairman and CEO. AIM plans shortly to introduce new Unix system performance tuning tools, beginning with a disk reorganization utility.

**BRITTON LEE** (Los Gatos, Calif.) introduced at the NCC a low-cost, office environment version of its relational database machine. The move is intended to expand the applications of the product, which so far has found use mainly in research labs with VAX machines.

**CONVERGENT TECHNOLOGIES** (San Jose, Calif.) has a new multiuser model, dubbed Midi-Frame, which fits between the Mini-Frame and MegaFrame. All family members are 68000-based and run the Unix system.

**ENCORE COMPUTER** (Marlboro, Mass.) debuted its product line, including the Multimax MMP, at a press preview on July 3 at its Marlboro plant. The company also planned to exhibit the NS32K-based, Unix system-running Multimax at the National Semi booth at the July NCC in Chicago. The Hydra group, which is responsible for the Multimax, recently changed its name officially to Encore Multiprocessor Systems Division.

**NCR** (Dayton, Ohio) introduced in late June the Tower 32, a 68020-based top-end member of the Tower family of multiuser supermicros. With 1 Mbyte memory, a 46-Mbyte Winchester, a 45-Mbyte cartridge tape, a 69010-based I/O subsystem, Unix System V and Business BASIC, the system lists for $21,900. 4Q85 shipments are anticipated.

**NIXDORF COMPUTER** (Paderborn, W. Germany) is set to announce a sweeping, Unix system-based product line, including workstations, supermicros, superminis, and the Auragen-derived fault-tolerant system. September unveiling is expected. Nixdorf is one of the six European manufacturers that recently agreed to adopt the Unix system, apparently as an anti-IBM move.

---

*Omri Serlin heads ITOM International Co., a research and consulting firm in Los Altos, Calif. He writes the* Supermicro *and* FT Systems *newsletters.*

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## THE UNIX SYSTEM GETS THE PICTURE

# GETTING INTO CAD/CAM/CAE

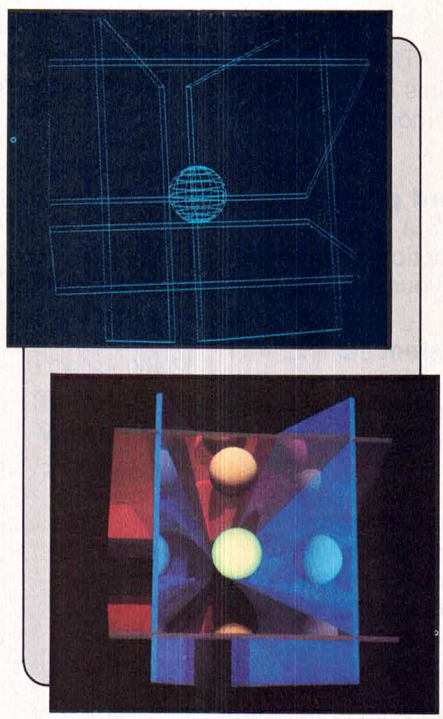
BY VANESSA SCHNATMEIER

*Can ivory-tower Unix systems handle themselves well on the assembly line?*

The Unix system is renowned worldwide for its prowess in the fields of text processing and software development. But when it gets on the factory floor, what then? Can ivory-tower Unix systems handle themselves well on the assembly line?

The Unix system made its home primarily in academia for a long time and did not become a force in the manufacturing and design world (with the exception of the old Bell System) until quite recently. Not so long ago, Unix-based CAD/CAM/CAE applications for the engineer, the designer, or the builder could have been counted on the fingers of one hand. As the Unix system has established itself in the marketplace, though, an increasing number of companies have either added the Unix system to their existing offerings or plunged in and written applications from scratch.

The Unix system may have started life as a pale, callow system thought suitable only for R&D, but over time it has developed into a kind of journeyman laborer that can do heavy design and manufacturing work on a multitude of machines.



***Wireframe:*** *This is a wireframe model at medium geometric approximation of 4 intersecting planes and a sphere.*

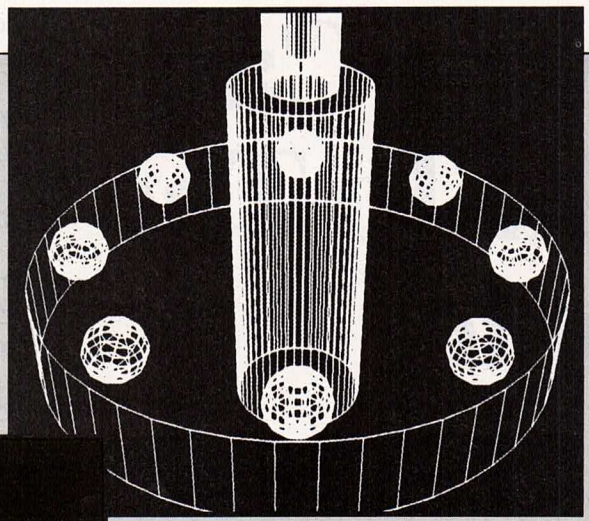
***Global Shading:*** *This rendering was achieved using the same database and applying ray-tracing.*

That is, the portability of the Unix system has brought it into favor for applications in which it was once ignored.

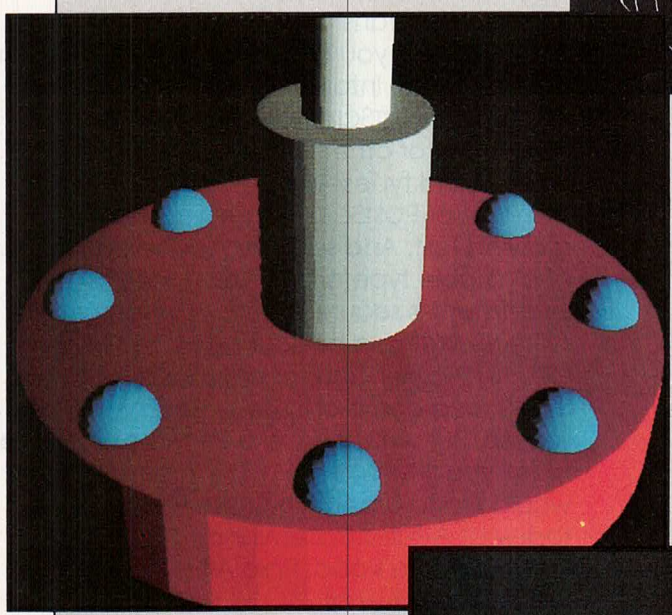
### WHAT DO THOSE INITIALS MEAN?

A brief moment to explain our terms here: *CAD* usually means computer-aided design; some write it as *CADD*, or *Cadd*, or *CAD/D*, meaning computer-aided design and drafting. Under this umbrella term, you find a set of computer-supported tools that aid designers, drafters, and engineers in producing various sorts of product designs. CAD comes in handy throughout a business. Engineers can use CAD tools to design parts; PC board designers can capture schematics layer by layer, and production managers can improve the layout on the factory floor.

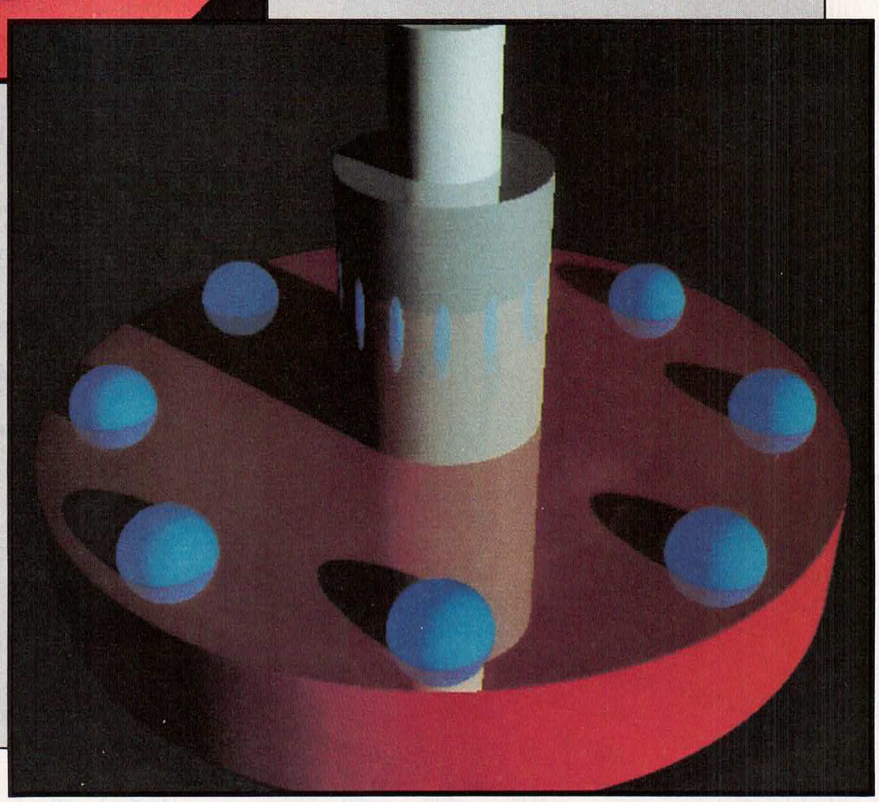
*CAM*, or computer-assisted manufacturing, includes not only automated process control, but also the hardware and software that put your raw materials through their paces along the assembly line, such as the robotics that perform the rote, repetitive work.



***Wireframe:*** *This is a wireframe model at high geometric approximation of a mechanical part (a bearing). It contains 11 objects. In designing parts, wireframe is often used to show quick renderings of the design, and to allow the designer to see the interrelation between the visible and non-visible portions for the object.*



***Facet Shading:*** *This rendering of the same part was rendered from the same database. Three different colors have been used to differentiate three standard components. All hidden surfaces have been removed and the corrected color for each "facet" has been calculated and produced. Shading is the result of one light source.*



***Global Shading:*** *This rendering was achieved again using the same database and applying ray-tracing. The red and white components have been given reflective surfaces. Note that the white and blue objects now cast shadows and that the white objects reflect the red and blue objects as well as their shadows.*

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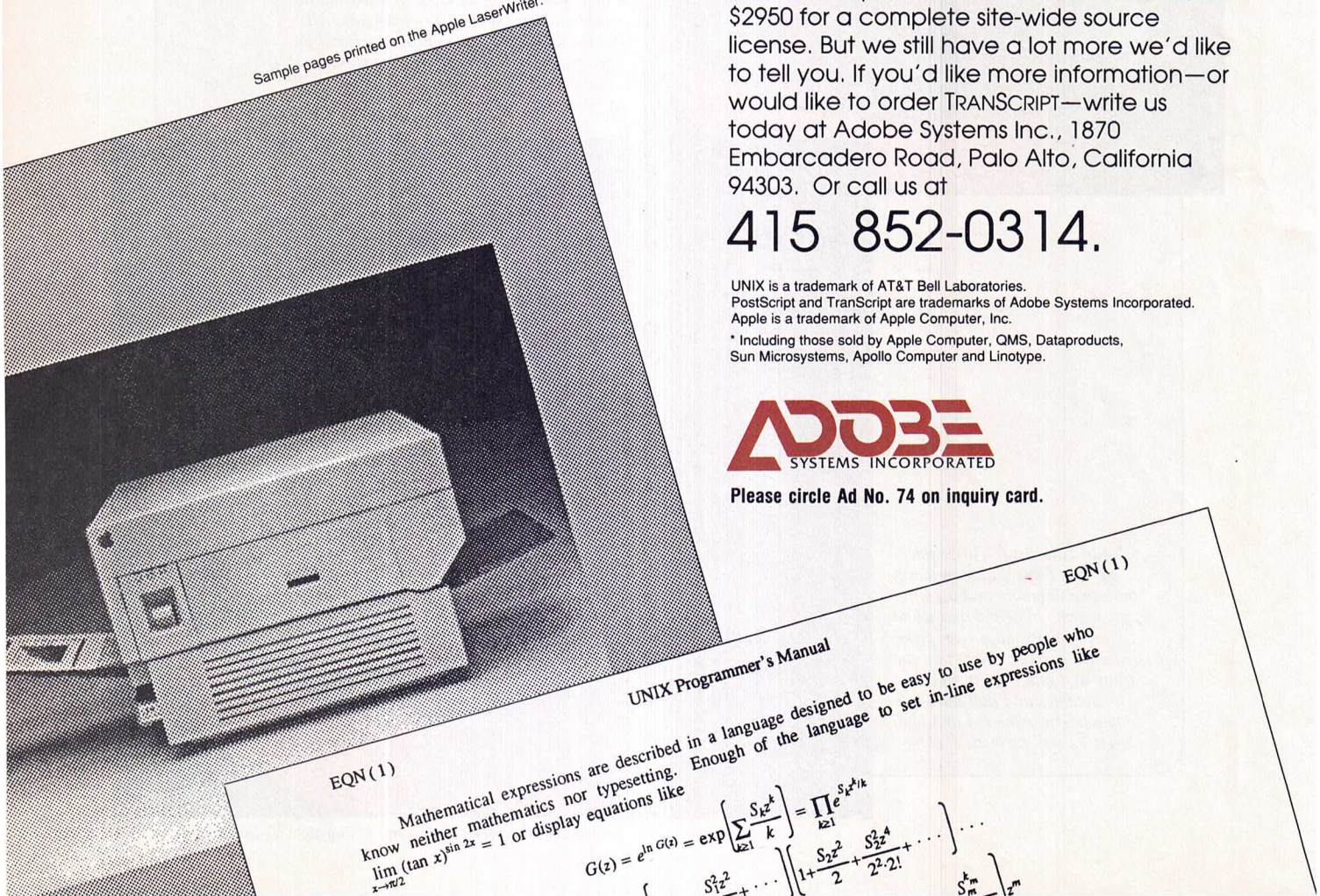

*CAE*, computer-aided engineering, encompasses elements of both CAD and CAM: CAE helps the engineer pinpoint the excessive stresses on a bridge or the eddies and fingers of liquid flow through labyrinth seal geometries.

All of these combine into *CIM*, or computer-integrated manufacturing. In CIM, computers are present through every step of the manufacturing process—the designer uses the computer to build the three-dimensional model from which another computer supervises the production and polishing of the finished product. So far, CIM is more utopian ideal than reality because most companies (except for some of the peskily innovative Japanese) have been reluctant to commit themselves to such a heavily automated and computerized workplace.

One drawback to the finely tuned CAD/CAM systems is that many of them require heavy customization. This doesn't sit well with turnkey vendors, who may feel they cannot make money selling customization along with their systems.

The customization requirements have until recently worked against users who favor the Unix system. As CAD/CAM companies take stock of the Unix system's portability, though (more on this later), the system has wormed its way out of the schools and onto the vendors' product lists.

## ABOUT CAD/CAM SYSTEMS

CAD/CAM/CAE systems come in handy in a huge variety of fields. Anywhere you create and manipulate two- or three-dimensional geometric models, wherever you need to save drawing time or repetitive artwork, and wherever you need precision mathematical and graphic representations of processes or space, you're advised to investigate CAD/CAM.

According to Richard Stover, author of *An Analysis of CAD/CAM Applications* (Prentice-Hall, 1984), 32-bit computers provide optimum throughput for CAD/CAM applications, and they allow the graphics applications to be integrated completely with structural analysis and logic simulation programs.

In the old days, CAD/CAM systems used to be based on 16-bit minicomputers or on mainframes running under proprietary operating systems; the result was that the Unix system was left out in the cold. However, 32-bit superminicomputers and microprocessors, many of which are optimized for the Unix system, are now becoming the norm; the Unix system is attaining near industry standard status in the CAD/CAM market, as the likes of DEC, Apollo, Sun, Tektronix, Prime, and others continue to develop new offerings.

**Without exception, manufacturers pointed to the Unix system's portability as its chief asset.**

CAD/CAM/CAE workstations range in complexity from the simple Volkswagen-ish terminal, with an alphanumeric keyboard and maybe a mouse, to the Rolls Royce workstation that has dual graphic CRT displays, a digitized table for large documents, and a separate digitizer tablet for selecting your symbols, as well as a hard-copy device to reproduce your designs. You can select your choice from a complete spectrum of prices, as well; the lower shades of the spectrum start at around $15,000, but you can undoubtedly find a system to complement your exact needs.

## WHERE THE UNIX SYSTEM SHINES

Without exception, the manufacturers I've questioned have pointed to the Unix system's portability as its chief asset in the CAD/CAM market.

Ashok Suri, vice president of engineering at the CAE Systems Division of Tektronix, told me: "The major reason for using Unix is portability. We wanted to be hardware independent. We want to protect the customers' investment. Eighty five percent of their investment is in the database. Fifteen percent is in the training of the operators, the macros, and only five percent is in the actual hardware. If the technology advances, you want to make use of more powerful hardware for the same price. But if you lock someone into a piece of hardware, you're stuck. Our philosophy has been to make switching easy."

Frank Naranjo, vice president of Automated Impact Inc. (Teterboro, N.J.), concurred. "Unix offers hardware flexibility now and in the future. Most people who work on Unix may migrate to other [hardware] systems, but with Unix no relearning process is really necessary."

Rick Samco, of the design and analysis division of Mentor Graphics, pointed out another way of looking at it: "Given the rapid growth and lack of stability in the workstation vendor area, it's to the advantage of our company to be able to move from workstation to workstation. Unix gives you leverage in that area."

Another part of Unix system portability hinges on its being written in C. Tektronix's Suri said that C compilers in the Unix system environment produce efficient code. "Software written in C is most portable, and now there's a *de facto* C standard. I call C the modern FORTRAN II."

Ray Rothrock, market development manager of CAD/CAM/CAE products for Sun Microsystems (Mountain View, Calif.), said that compared to most programming languages, the Unix system has better utilities, and they are better debugged. "FORTRAN may still be the standard in CAD/CAM applications, but as CAD/CAM moves down from mainframes to micros, people have been turning to the power of C. When you start talking about bit-mapped graphics, you're getting out of mathematical formulas and application mathematics. A lot of old FORTRAN hackers are reluctantly learning C."

## WHERE UNIX IS WEAK IN CAD/CAM

Standards. Yes, the Unix system is weak as far as graphic standards are concerned. In the Unix system marketplace, numerous variations have proliferated. The good news is that every other system is in the same boat. Samco of Mentor Graphics said that "this is a major factor in areas like ours. Engineers have trouble there." For instance, as with the Unix system, CAD/CAM graphics have several competing proposed standards, the top two being Graphics Kernel System (GKS) and Programmers' Hierarchical Interactive Graphics System (PHIGS). The latter is a European standard.

According to Samco, the Unix system is also lacking in local networking capability, or close and transparent communications between workstations, (With the exception of some Berkeley releases, of course). "Unix may be multiuser, but it's still designed for one processor," he said.

## WHERE YOU FIND CAD/CAM ON UNIX

Despite the above, CAD/CAM is not available on Unix systems everywhere. The */usr/group Products Catalog for Spring 1985* lists only nine CAD/CAM application software products from five companies. Where you are most likely to locate Unix system CAD/CAM is on workstations that have proprietary or third-party software. The ubiquitous Sun workstations come to mind immediately; Sun's Catalyst catalog of third-party referral software and hardware lists 35 CAD/CAM/CAE entries. Apollo also offers several CAD/CAM packages under the Unix system.

Other companies that offer stand-alone workstations include Hewlett-Packard, which offers, among other CAD products, the HP-Spice application for simulating analog electronic circuits on its HP 9000 Series 500 computer. (Hewlett-Packard will be bringing out some more "well-known" CAD/CAM software later in the year.)

Also offering terminals with workstations and some software are Charles River Data Systems, Masscomp, Cromemco, Mentor Graphics, Via Systems, Data General, and Cadnetix. Superminicomputer manufacturer Prime Computer fits this category too, since Primix, its Unix

### WORKSTATION FUTURES: LOWER PRICES, HIGHER PERFORMANCE, AND THE AT?

**Price erosion, performance improvements, new competitors. Just three spectros on the CAD/CAM/CAE workstation marketplace's horizon. The most interesting prospect on the horizon in the hotly competitive Unix system-based workstation arena, however, may well be the recent arrival of the IBM PC AT—typically equipped extra hardware and an appropriate Unix system port—on the scene as a credible challenger. In short, while archrivals Apollo Computer and Sun Microsystems capture the public's eye as they chase each other along the price/performance curve, the IBM PC AT is moving up at both of them (as well as others) from the bottom.**

**Recently, the first three such AT-based products appeared: The TekStation AT from the Tektronix Inc. CAE Systems Division's San Jose, Calif.-based CAE Systems Inc. subsidiary and a two-workstation product family—the Personal Logician DNIX, and the Advanced Personal Logician DNIX—from Daisy Systems Corp., Mountain View, Calif.**

**Both CAE Systems' TekStation AT and Daisy's Personal Logician family are based on enhanced IBM PC ATs. For instance, the TekStation AT combines a standard AT with Tek's CAE 2000 design software, a 10MHz National Semi NS32016 co-processor, 85 to 280 Mbytes of hard disk storage, a graphics card, and 2.5 to 4.5 Mbytes of main memory—all for a base price starting at $25,000.**

System V offering, reportedly runs applications written for Primos, the company's mainstay operating system.

CAE Systems, Inc., a division of Tektronix, announced an intriguing CAD/CAM product a few months ago: the TekStation AT. What makes this more interesting is that it's one of the only CAD/CAM products using a version of the Unix system on a "personal" computer, the PC AT, which is a very hot item these days. The AT is big enough not to be hobbled by the memory constraints you might find on CAD/CAM systems on most personal computers—it remains to see how much effect the name of IBM will have on the CAD/CAM market.

## A FEW SAMPLE SYSTEMS

Now let's take a brief look at some of the CAD/CAM products, systems and software, that show just how far the Unix system has come from the ivory tower.

Automated Impact sells a turnkey system called NUBEUS, intended for the architectural and woodworking industries. "This is the first real application for the woodworking industry," said vice president Naranjo. The company aimed this two-dimensional working and shop drawings system at architects and production graphics people, from manufacturing to electrical design. Automated Impact will also be offering the Atlas 3-D displaying and modeling system, designed for visual, marketing, and presentation graphics; this system is scheduled to ship in October.

For engineers who work in fluid mechanics, Creare, Inc. (Hanover, N.H.) has created FLUENT, an interactive computer program for simulating fluid flow in aerodynamic design, chemical and process engineering, fire research, nuclear reactor containment analysis, and architectural design.

Unicad, Inc. (Boulder, Colo.) has put its Unicad System up on Sun workstations; this system is an integrated collection of development tools and utilities enabling the more sophisticated end-users to create their own CAD/CAM systems.

Cadnetix (Boulder, Colo.) offers its Cadnetix system, a hierarchical, object-oriented system based on an Ethernet link, for electronic circuit design and schematic capture.

## WHAT TO LOOK FOR IN A CAD/CAM SYSTEM

Dr. Carl Cork, engineering physicist and electronics group leader at the Stanford Synchrotron Radiation Laboratory, recently bought a Cadnetix system for schematic capture and PC board design. He offered several pointers on finding the CAD/CAM setup to suit your needs.

Cork emphasized that if cost is a big concern, don't forget to look at the numbers in your maintenance contract because the price of proper maintenance can run from $500-$1000 per month and more.

Will the company disappear? This is no laughing matter in the Unix system market. You'll be living with the financial investment for a long time—examine the company closely. Also, if you're using a Unix system, you'll be working with relatively new software for the most part, but look for systems that don't depend on antiquated software.

Cork recommended further that you examine the current development efforts of each company—will it make frequent changes and updates? He felt you're often better off with systems houses—the companies that mix and match with designer separates that fit your special situation (see the customization argument above)—than with being locked into a "captive system."

He pointed out that for companies that have a large number of "power users" and people who would love nothing better than to tinker with the innards of the system, you should be sure to purchase a package that lets users peek underneath the application shell. Yes, Virginia, some people must have access to the Unix file system—otherwise you're dooming them to frustration and yourself to their complaints.

## A BRIGHT BUT HAZY FUTURE

The Unix system is being accepted in CAD/CAM/CAE, not for its speed and performance but for its portability and malleability. As companies learn that the Unix system exists (they could hardly avoid it), they discover that even a system tagged as being text-oriented can be adapted to their needs. The Unix operating system, as a multiuser, networkable system that's becoming its own standard, will eventually convince even graphics users that it can hold its own in the factory as well as the software house. □

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*Vanessa Schnatmeier, UNIX/WORLD's Editor-at-Large for Features, lives in Redwood City, Calif. Her latest work for the magazine "No Business Too Small . . . No Business Too Large," appeared in the June 1985 issue.*

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# ELECTRONIC PUBLISHING AND THE MYTH OF THE PAPERLESS OFFICE

*"..You have as much chance of having a paperless office as you do a paperless bathroom."*

BY LEE KAUFFMAN AND THOMAS R. BILLADEAU

The push for office automation in the mid to late 1970s brought about the concept of the "paperless office," which was based on the notion that every office worker would soon have a conveniently packaged office-automation workstation. By now, most of us are painfully aware that neither the ubiquitous terminal nor the paperless office has arrived.

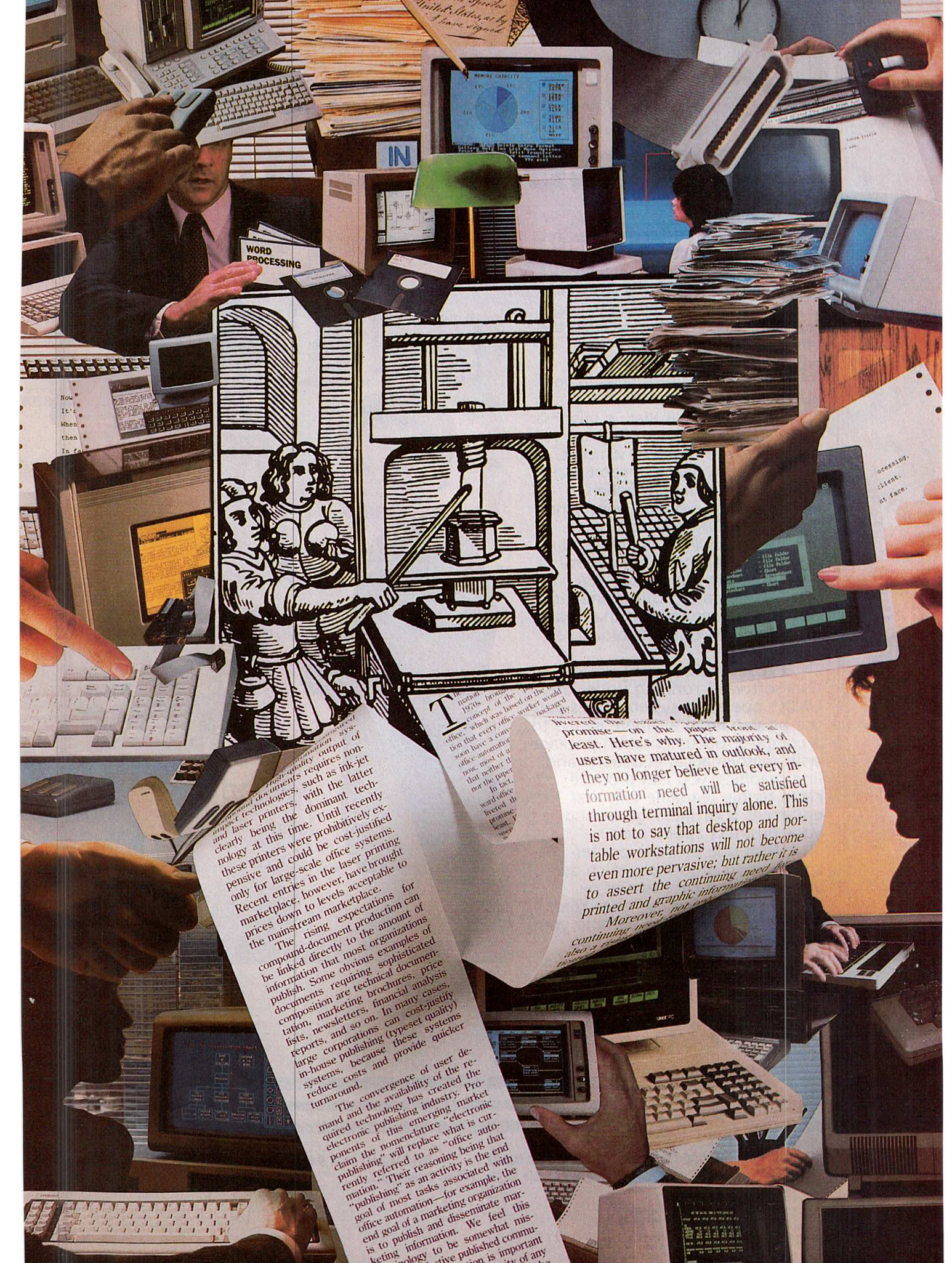
In fact, the headlong drive toward office automation has so far delivered the exact opposite of its promise—on the paper front at least. Here's why. The majority of users have matured in outlook, and they no longer believe that every information need will be satisfied through terminal inquiry alone. This is not to say that desktop and portable workstations will not become even more pervasive; but rather it is to assert the continuing need for printed and graphic information.

Moreover, not only is there a continuing need for hard copy but also a rising expectation for sophisticated page composition. Unfortunately, compound documents—those composed of multiple fonts, information, graphics, and so on—cannot be produced simply on traditional, character impact printers, the prevalent output device configured with most office-automation systems today. High-quality output of compound documents requires non-impact technologies, such as ink-jet and laser printers, with the latter clearly being the dominant technology at this time. Until recently these printers were prohibitively expensive and could be cost-justified only for large-scale office systems. Recent entries in the laser printing marketplace, however, have brought prices down to levels acceptable to the mainstream marketplace.

The rising expectations for compound-document production can be linked directly to the amount of information that most organizations publish. Some obvious examples of documents requiring sophisticated composition are technical documentation, marketing brochures, price lists, newsletters, financial analysis reports, and so on. In many cases, large corporations can cost-justify in-house publishing (typeset quality) systems, because these systems reduce costs and provide quicker turnaround.

The convergence of user demand and the availability of the required technology has created the electronic publishing industry. Proponents of this emerging market claim the nomenclature "electronic publishing" will replace what is currently referred to as "office automation." Their reasoning being that "publishing" as an activity is the end goal of most tasks associated with office automation—for example, the end goal of a marketing organization is to publish and disseminate marketing information. We feel this terminology to be somewhat misleading. Effective published communication of information is important to the survival and prosperity of any enterprise, yet it is certainly not the sole activity. Administration, manufacturing, and finance are at least as dependent upon efficient data manipulation as they are on high-quality hard copy.

From this perspective, we define *electronic publishing* as the composition and output of high-quality, compound documents, typically containing graphic data and text. We choose this somewhat broader definition as we believe the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bulk of in-house corporate publishing activities will occur below the "typesetting" segment of the market. By *typesetting,* we mean extremely high-resolution photographic techniques for the production of masters or printing plates. Although large corporations can justify the cost of electronic publishing systems capable of typesetting, for economic reasons the bulk of companies will gravitate toward office-automation systems that have high-quality compound-document processing and output. We see this as the dominant trend.

Therefore, with the exception of typeset-quality electronic publishing systems, the bulk of electronic publishing activities will represent a subset of office systems. To understand the stakes in the market, we will briefly examine the office-automation market size.

## MARKET SIZE AND TRENDS

It is becoming obvious that all office-automation vendors must offer reasonable electronic publishing functions on their systems. In years past, vendors that offered office systems with substandard word processing were heavily criticized. In the near future, those that offer office-automation systems without electronic publishing software will again face the same dilemma. With this in mind, the stakes for developing cost-effective and user-friendly electronic publishing systems are enormous.

To quantify this statement, we can examine the size and growth projections of the office-automation (OA) market. Figure 1 shows that by 1989 revenues from sales of office-automation systems will account for approximately 20 percent of overall data-processing (DP) sales, or approximately $50 billion. If we broaden the definition to office-



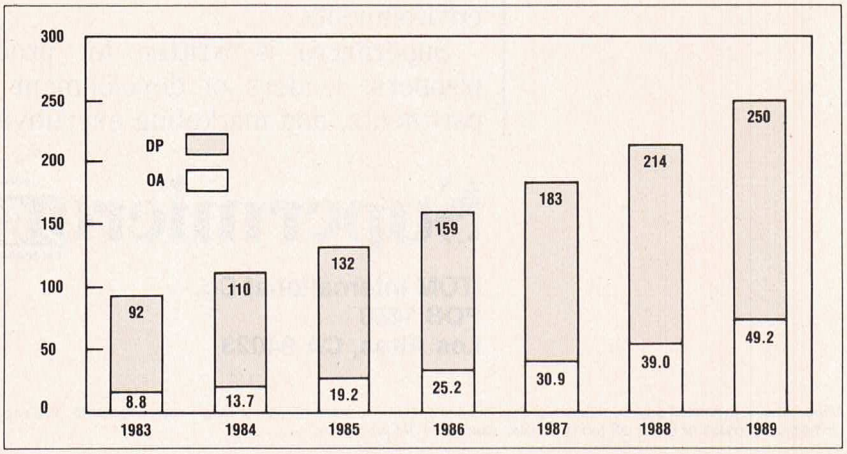
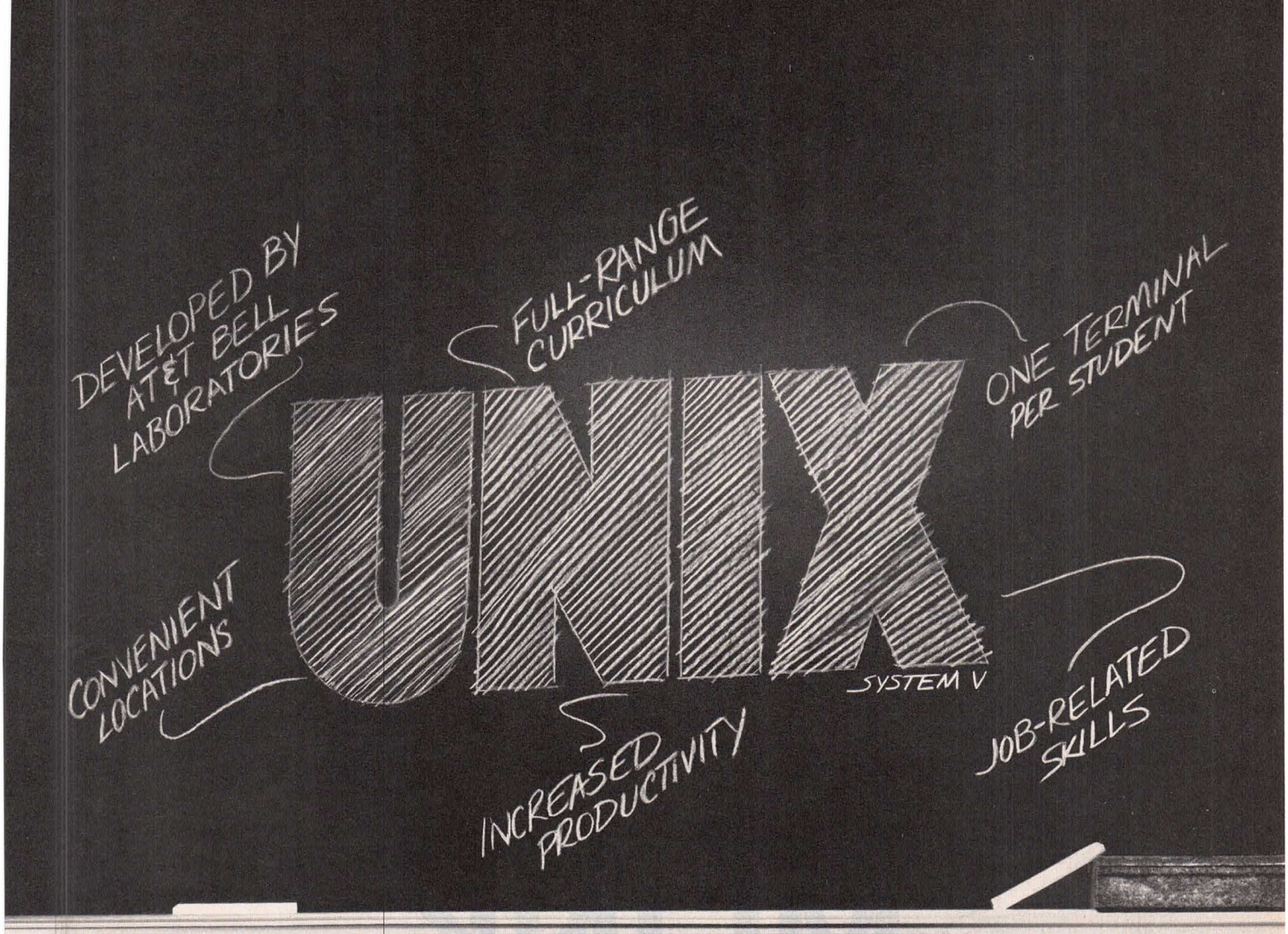



FIGURE 1: WORLDWIDE OA REVENUE PROJECTIONS OF U.S.-BASED VENDORS (BILLIONS)

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| Multiple Modem Support | Yes | Yes |
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| File Transfer Lists | Yes | Yes |
| XMODEM Protocol Support | Yes | |
| Compatible with Non-Unix Systems | Yes | |
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| User Variables | Yes | |
| Labels | Yes | |
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| Subroutines | Yes | |
| Arithmetic and String Instructions | Yes | |
| Debugger | Yes | |
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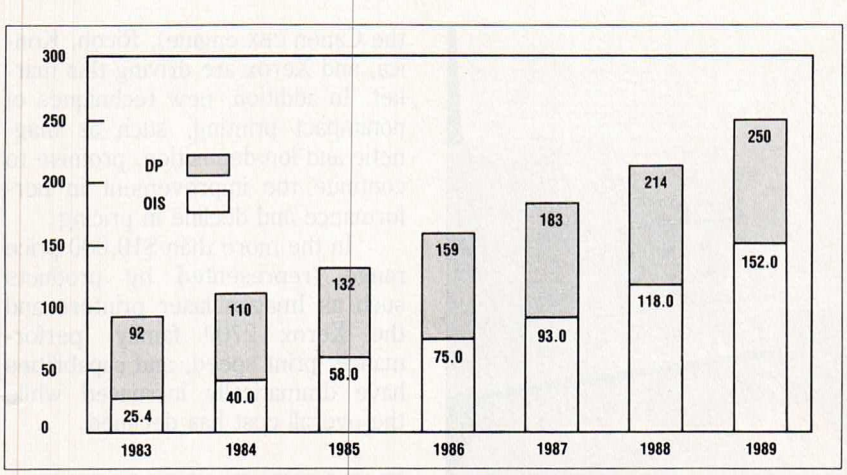



FIGURE 2: WORLDWIDE OIS REVENUE PROJECTIONS OF U.S.-BASED VENDORS (BILLIONS)

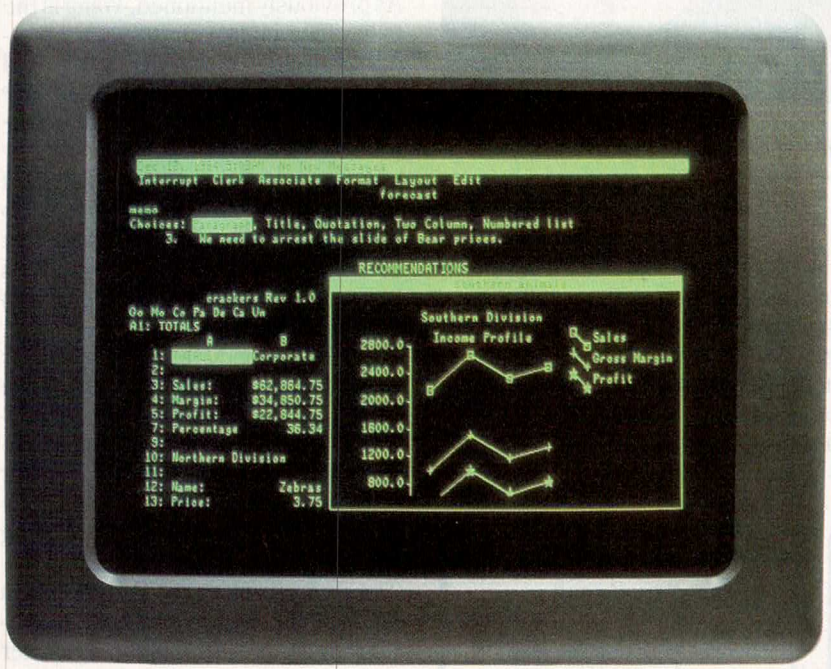



*FIGURE 3: Applix Inc.'s Alis software is a general-purpose, integrated office information system that can also provide sophisticated, compound-documents, including combined text and graphics.*

information systems (systems V that integrate standard OA, financial, CAD/CAM, and so on), we see that these systems will account for over 60 percent of overall DP sales, approximately $152 billion, in 1989. (See Figure 2.) The office information systems (OIS) market is the segment that most major vendors are beginning to address. Electronic publishing functionality is of even greater importance in this market than in the OA segment.

With the exception of Wang, the leading office-information systems vendors have only spoken of their intentions to support compound-document processors. The Apple Lisa and more recently the Macintosh, as well as the earlier Xerox Star system, paved the way for the development of this marketplace, but neither has been enormously successful.

The vast majority of products conforming to our broader definition of electronic publishing run on the Unix system. Two relatively new products from startup ventures—Interleaf's Office Publishing System 2000 and Applix's Alis—have drawn a great deal of attention. Both represent the new generation of compound-document processors. A brief examination of each of these products will help to clarify what we believe are the main trends in this marketplace.

The cornerstone of Applix's Alis system is a sophisticated compound-document processor. As you can see from Figure 3, Alis is a "what you see is what you get" system in terms of page content. It goes one step beyond most other compound processors in that it invokes the proper editor automatically for any data type in the file, whether it be spreadsheet, graphics, or text. In addition, it performs standard administrative OA functions.

Alis was developed on Unix system-based engineering graphics workstations and performs best in this environment. Unfortunately, these workstations are prohibitively expensive for use as OA workstations. Applix is currently addressing this problem by porting Alis to systems that utilize semi-intelligent and less-expensive terminals, such as those used with the Convergent Technologies' Miniframe.

Interleaf's Office Publishing System 2000 (OPS 2000) is a niche product by comparison. The com-

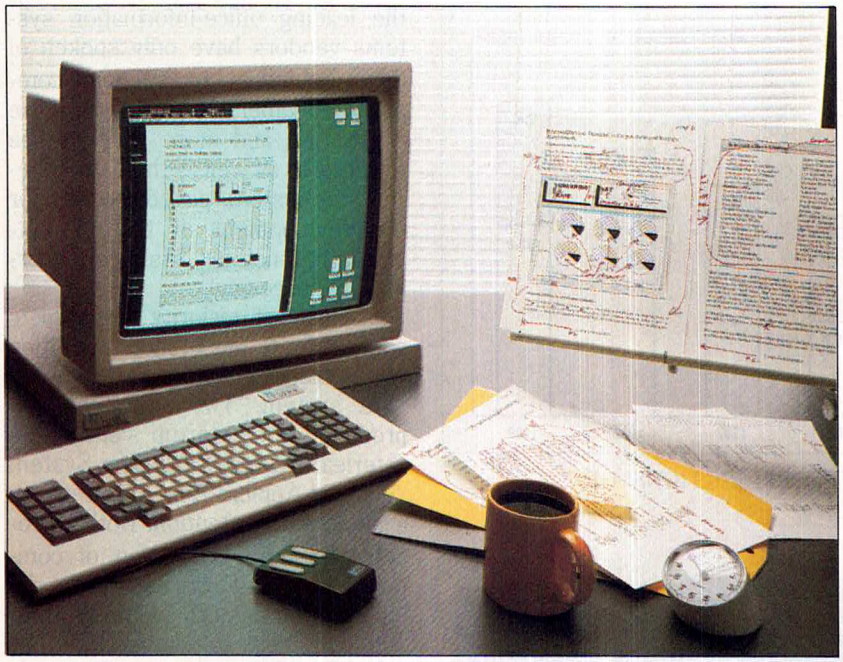


*FIGURE 4: Interleaf's Office Publishing System (OPS) 2000 is intended to serve as an in-house, electronic publishing system adjunct to standard office automation systems. Like Alis, it also produces compound text and graphics documents.*

pany is marketing it as an electronic publishing adjunct to office-information systems, rather than as an office-information system in and of itself. As Figure 4 demonstrates, the Interleaf product is also a "what you see is what you get system." Interleaf markets bundled systems, including workstations, software, and a laser printer. Base price for a single workstation system and 10-page-per-minute laser printer is $62,000. Interleaf also OEM's its software to other vendors, most notably to Apollo Computer.

Although Interleaf's pricing may seem prohibitive, you must keep in mind that the OPS 2000 product is capable of accepting ASCII input from other vendors' OA systems, digitized image scanners, and phototypesetters. Thus, this product clearly fills the niche between mainstream office publishing needs and complete typesetting and printing facilities.

Market acceptance of these products is increasing rapidly, a result not only of the demand for graphically oriented systems products, but also of the rapid decline in price of laser output devices. The first evidence of this was last year's introduction of the Hewlett-Packard Laserjet, which utilizes the Canon CBX print engine. The cost of this printer is less than $5000. Subsequent introductions (in the under $10,000 price range) of low-cost laser printers by Apple (again utilizing the Canon CBX engine), Ricoh, Konica, and Xerox are driving this market. In addition, new techniques of nonimpact printing, such as magnetic and ion deposition, promise to continue the improvement in performance and decline in pricing.

**Demand for electronic publishing systems contradicts predictions of the paperless office.**

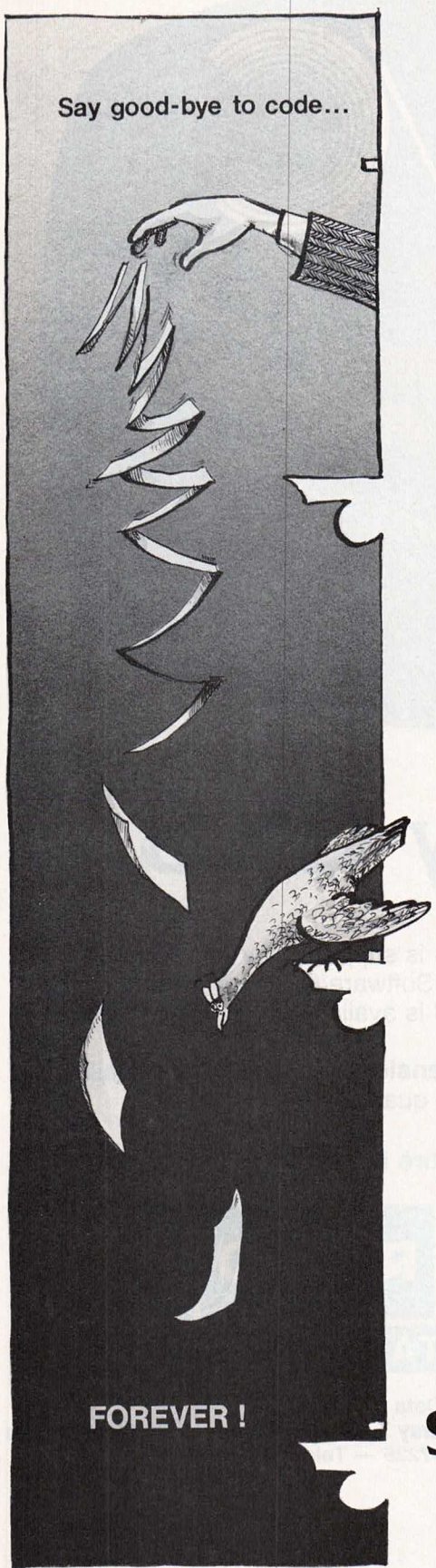
In the more than $10,000 price range (represented by products such as Imagen laser printers and the Xerox 2700 family) performance, print speed, and capabilities have dramatically increased while the overall cost has declined.

## THE UNIX SYSTEM AND ELECTRONIC PUBLISHING

As previously mentioned, Wang is the only office-information-system vendor currently offering an integrated compound-document processor (WP Plus) with its office-information system. WP Plus is a primitive editor when compared with the Interleaf and Applix products. This leads us to ask the question "Why are the bulk of compound-document processors being developed in the Unix system environment?"

The immediate explanation for this phenomenon would seem to be that, in comparison to other operating systems, the Unix system allows the development of superior graphics utilities. We decided to explore this hypothesis by questioning Unix system software engineers. The consensus was that, from a technical perspective, the Unix system does not represent a better development environment for graphics software than other existing multitasking, multiuser operating systems.

Where the Unix system has a technical edge is that C compilers are optimized for the Unix system environment. C represents a good graphics development language, as well as complementing the portability aspects of the Unix system.

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This in and of itself does not explain why so many of the electronic publishing packages are created for the Unix system. The answer is one of economics rather than one of technology.

> **"Why are the bulk of compound-document processors being developed in the Unix system environment?"**

For most start-ups, the cost of developing a proprietary operating system is prohibitive. The Unix system is in fact the only nonvendor proprietary operating system available to developers that is multitasking, multiuser, and, most importantly, portable.

From a hardware perspective, the new generation of Motorola 68000 chips is driving the Unix system market. These high-performance chips which most Unix systems use, are optimized for operating systems written in high-level languages, such as C. The porting of assembler-based operating systems employed by the major vendors is difficult in this environment.

Just as the reason for the current surge of electronic publishing packages that run on the Unix system is economical as opposed to technical, so will be the future development of electronic publishing. At this point, IBM has not committed itself to full-scale support of the Unix system environment; neither has it introduced electronic publishing systems and compound-document processors—moves that will determine the swing of the marketplace. Of equal and concurrent importance will be the ability of AT&T to influence substantially the direction of the market toward the Unix system.



What is clear is that for the next several years compound-document processors will require the use of intelligent workstations that have high-performance microprocessors. At this point, none of the major office-information-system vendors offer workstations capable of handling the screen management necessary for effective and usable electronic publishing products.

Demonstrative of this point are some of the problems Wang has had in bringing WP Plus to the market. WP Plus was introduced in October 1983. The first version was recently shipped for the Wang OIS series of processors. We have no doubt that Wang had difficulty retrofitting this software to the older architecture of the OIS series. The VS series will offer Wang some additional challenges. The processors in the Wang workstations are 8-bit Z80 processors and were never intended for the screen management utilities necessary for the production of compound documents.

The lack of product offerings from the major vendors, therefore,

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leaves the market open at this time, mostly to Unix system-based start-ups such as the two mentioned before.

## CONCLUSION

The electronic publishing market, still in its infancy, will continue to be nurtured by the innovative environments of startup companies, although the major vendors will begin to provide interim compound-document-processing solutions in the near term.

Regardless of what operating system environment dominates electronic publishing systems, we foresee continued market interest and activity, a rapid decline of prices for the associated technologies (both workstation and output devices), and the steadily increasing demand for documents with sophisticated composition.

As predicted years ago, the workstation is proliferating in numbers and declining in price. Contrary to other predictions, demand for hard-copy output has been rising both in quantity and quality. The myth of the paperless office has been dying a slow death. Perhaps 1985 will be the year it is finally buried. □

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*Thomas R. Billadeau is president of TRB & Associates Inc. and an internationally known expert in the field of office automation. He has worked with many of the major office automation vendors providing product specification, review and analysis.*

# AN INTRODUCTION TO IMAGE PROCESSING

BY ASHLEY GRAYSON

*Image processing is a much broader field than word processing or even text formatting.*

Question: If one picture is worth a thousand words, is image processing a thousand times better than word processing?

Answer: Sometimes, but image processing is a much broader field than word processing or even text formatting.

Word processing is essentially a data capturing process which corresponds roughly to the "digitizing" or "scanning" phase of image processing. Text formatting, as done by the Unix system programs `nroff` and `troff`, is concerned with the appearance of the finished output, but still doesn't approach the degree of involvement with the content of data of even the simplest image processing application.

To be even close, a word processor would have to be able to input a rough draft of a document and produce a submittable manuscript as output, filling in prose according to a variety of editorial "filters." If an author could write the skeleton of an article, then invoke, say, the "UNIX/WORLD" or "Playboy" filters, this hypothetical system would improve the clarity of the writing by smoothing fuzzy areas, making better word choices, and coming more quickly to conclusions. Only in this way could a system approximate in words the functions of an image processor in creating and improving pictures.

There are many diverse reasons—including the desire to transmit images from one place to another at high speeds, or over interplanetary distances—to improve the quality of specific images, or to produce pictures of data that were never previously presentable as images. More on this "processing into images" later.

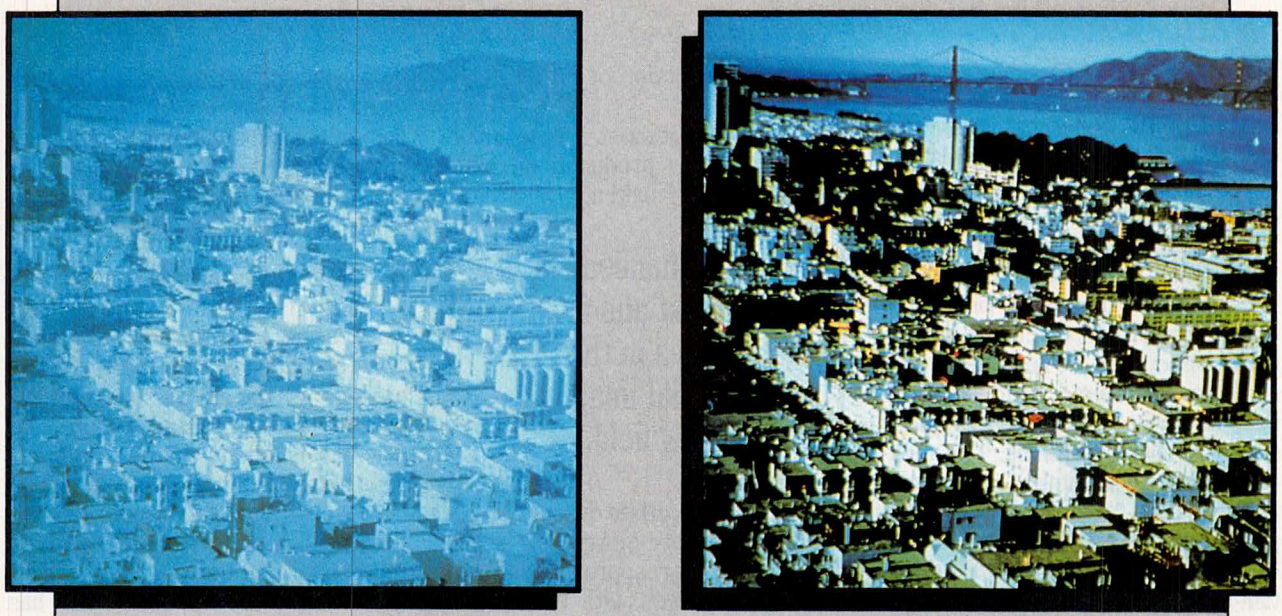
## IMAGE PROCESSING AND THE UNIX SYSTEM

Regardless of the applications, image processing is a booming field that has driven the computer industry in the past and continues to do so. It is both processor intensive and requires large amounts of data storage, requirements which have impacted developments in both hardware and software. For example, many well known features of the Berkeley 4.2 release of the Unix system (large files and faster file processing) were implemented at the request of the image processing community.

Many image processing applications are built on Unix systems for the same reason as are so many other applications: The Unix system is flexible for many environments and is available on many diverse types of hardware. However, more and more image processing applications are finding their way onto PCs at the low end and the largest mainframes.

To get a better idea of this field, let's look at some of the principal areas of image processing and see how they differ. These areas include image coding, image reconstruction, image enhancement, and image understanding.

A related field which uses much of the same special hardware but totally different software is *computer graphics*, the discipline that produces TV commercials and motion picture special effects. An example of how compatible the hardware requirements actually are is the recent announcement by LucasFilm Ltd. of a system for medical image processing that was originally developed for film effects.



*Examples 1A and 1B shows a "before and after" of a contrast stretch performed on a view of San Francisco. 1A is light, washed out. By stretching the image's intensity values over the entire dynamic range, the data is remapped to show the more contrasted image (1B).*

*Examples 2A and 2B also show a "before and after." This time, by use of color manipulation techniques, the green in 2A is changed to a more life-like flesh tone in 2B. Further manipulation would improve other colors.*

Photo courtesy of Comtal 3M

## IMAGE CODING

*Image coding* concerns itself with methods of representing the data of which the image is composed. It is of continuing interest to those involved with *image transmission.* The goal is to represent the image with the minimum possible number of bits, or to devise algorithms to ensure its reliable reception. Overcoming the challenge of limited bandwidth will become more crucial as computer data fill available channels. The applications can be as simple as facsimile transmission over existing telephone circuits and as far out as live television broadcasts from the Martian surface. Image coding is also of interest in applications demanding very high resolution of rather "simple" images.

Many, if not most, weekly magazines are now produced on electronic page makeup systems.

> **Image enhancement is the largest and most active area in the commercial image processing field.**

These, and the other disciplines described below, are more likely to use a sledgehammer approach and encode their images with the largest number of bits that can be economically applied to a pixel (picture element). Eight levels of grey are commonplace, and color subsystems supporting over 62,000 shades are available on many Unix system-based workstations.

## IMAGE RECONSTRUCTION

Recovering from losses or distortions occurring during the recording process is the focus (no pun intended) of *image reconstruction.* The goal of this field is to make poor images better. An image may be flawed because of imperfections in the optics that obtained it or because of relative motion between the subject and the camera. Anyone who has taken snapshots has at one time or

another wished for a magic box that could remove the blur from Uncle George's nose. While such a service from the one-hour photo stores won't be available any time soon, eventually it can be expected.

Space scientists, however, can use the techniques to watch satellites and other nearby phenomena. The importance of being able to deblur a single photo becomes more apparent if you consider once-in-a-lifetime photos as the stock in trade of the news agencies of the world. Police agencies also could benefit if often fuzzy surveillance photography and live video tapes of bank robberies could be sharpened up. Needless to say, the military is backing a lot of research in this area.

## IMAGE ENHANCEMENT

*Image enhancement* is the largest and most active area in the commercial image processing field. Whereas the image restoration process requires some knowledge of the degrading phenomena in order to reconstruct the subject, image enhancement attempts to improve the "quality" without any direct knowledge of either the subject or the distortion. In some cases, there may not be any "distortion," only the need to select some features of the image at the expense of others. "One man's enhancement is another man's noise" is a popular saying in the community.

Image enhancement is being applied both to prolong lives and shorten them, or at least to destroy things. Before we get into biomedical image processing and smart bombs, let's look at some of the simpler—and more common—applications.

A straightforward problem is "pulling an image out of the shadows." If the photograph in question contains both deep shadows and bright areas, one will assert itself at the expense of the other (depending on the camera setting). Portions of the picture may be fine, but the portion of the image in question may be too dark or light. The whole picture may be over- or under-exposed.

An image enhancement procedure known as "bit-slicing" (not to

be confused with the circuit design technique of the same name) can be employed to attack these problems. This resets the grey scale of the image to fill the entire dynamic range of shading. Digital contrast enhancement can be quite flexible. Other, more complex filters can be applied. An ever-present concern of this discipline is the avoidance of "artifact generation." The algorithms cannot tell the difference between the signal and the noise, and there is always the danger of enhancing the noise. This is the electronic equivalent of seeing castles in the clouds.

Much of the work in the processing of medical X-rays is of this type, improving the contrast in an existing image so that the doctor can identify tumors and other abnormalities. Surprisingly, at least to the layman, most of these applications are done in monochrome. Other medical applications, such as C.A.T. and P.E.T. scans, utilize the other principal enhancement technique: The construction of "artificial" images of data that was not previously viewable as an image. Scans of an object are made in three dimensions, and the data is organized and displayed in both cross section and perspective views. Such an application would be impossible without the aid of a computer. This is the only production application working with three dimensional images.

The area of earth resource images depends heavily on these synthesis techniques as well. The data returned by LANDSAT-type satellites and aerial surveys lies only partly in the visual portion of the spectrum. Both infrared and ultraviolet images need to be combined with visual and other data to produce meaningful results to the viewer. Whereas in other applications the goal is to find or improve one aspect of an image, usually for a single observer or group of observers—a medical team preparing for an operation, for example—remote sensing images contain vast amounts of data of interest to different groups. Because of the enormous amounts of data to be digested, the discipline is dependent on color, or more precisely, "pseudo-color." Since the human eye can differentiate only two or three levels of brightness but thousands of separate colors, it is the perfect method of locating the needle in the haystack.

Pseudo-color, the technique of randomly assigning color values to different types of data, is more common than you may at first think. It has long been the cartography tool that makes Kansas pink, Nebraska green, and roads yellow on your road map. Because no one can predict in advance what kind of patterns are going to emerge from pseudo-color enhanced multi-spectral images, workstations for these applications require both computation power and I/O bandwidth as well as a good human interface.

Consider that a single image, which can encompass a hundred square miles or more, may be of interest to planners evaluating urban sprawl, environmentalists tracking the spread of pollutants from nearby factories, and commodity brokers wanting to know when the surrounding farms will be able to ship their produce. Each group will need a slightly different enhancement pulled from the same data.

## IMAGE UNDERSTANDING

The final area of image processing, *image understanding*, draws from all of the previous disciplines—as well as from techniques of artificial intelligence—but with a completely different goal. The output of all other image processing tasks is an image, whereas the desired result of image understanding is a decision or an action.

Most implementations of image understanding, sometimes called *machine vision*, are pattern-matching applications where the question to be answered is "when does an object resemble a predefined template."

The simplest example (relatively speaking) is an optical inspection station. In this application one "Platoesque" ideal widget is known to the program, and the system scans evaluation units to see how they measure up to it. This environment differs dramatically from those previously discussed in that it requires real-time scanning of three dimensional objects. Also, the programming is not simple since the objects may not all be viewed from the same angle or under exact lighting conditions.

## COUNT AND SEEK

Two related applications deserve mention: counting systems and similarity seeking systems.

The classic counting system is the blood cell counting system. It has to solve the "how many rabbits can you find in this picture" problem. The illumination is uniform, and the program primarily seeks recognizable outlines (edges). A fingerprint matching system has a harder job. First it must scan the subject print, which may be blurred or incomplete, and identify significant characteristics. Then it must search an encoded data base for comparison subjects.

Among the flashier military applications are the "find the tank" and "smart bomb" scenarios. In the former, an "intelligent" vision system scans a scene searching for hidden objects. This is very difficult

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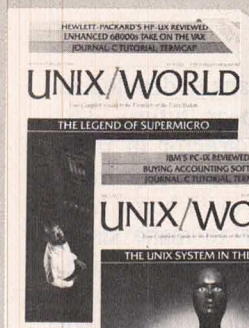


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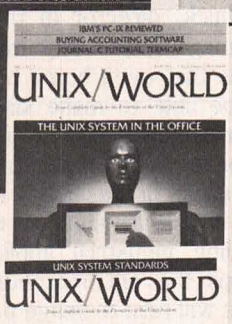


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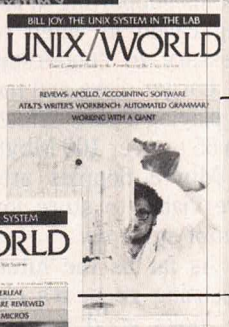


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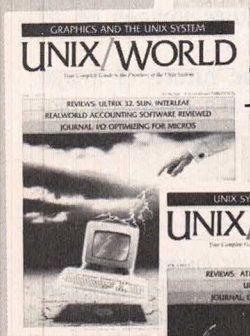


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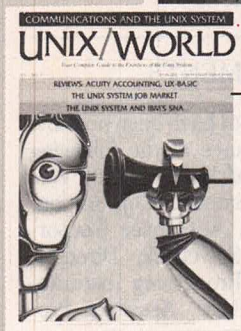


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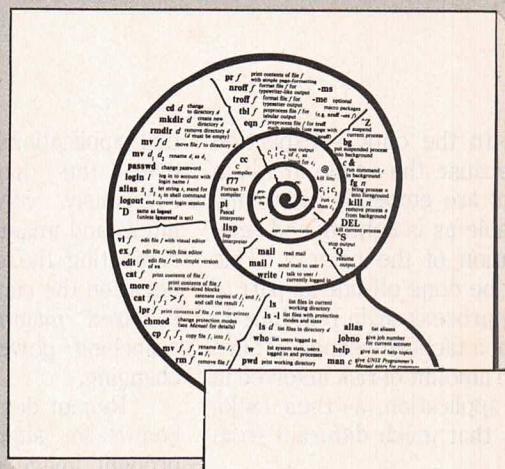

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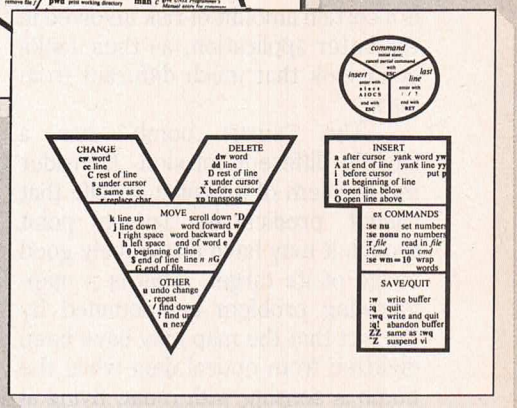


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| | | | TOTAL | |

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compared to the optical inspection system because the scene in which the objects are embedded is totally unpredictable as is lighting and relative elevation of the camera. This can either be done off-line as part of a planning process or in real time in the nose of a tactical weapon. There is a certain amount of risk involved in the latter application, as their tanks don't look that much different from ours!

The "smart bomb" has a slightly different mission. Consider the problem of a Cruise missile that cannot predict its launch point though it may have a relatively good image of its target. This is a map-following problem compounded by the fact that the map may have been digitized from optical data while the bomb is sensing with radar, flying at night or in rain, etc. To engineer a workable system one must not only solve the image processing problem but also do it at real-time speeds and miniaturize everything so that it fits in the vehicle.

As we mentioned at the start, image processing research and actual applications are spreading all over the hardware spectrum. Previously, complex mathematical filters and image reconstruction, by computing the equations of motion between the camera and the object, required mainframe-class number crunching power—but things are changing.

Recent developments in add-in boards for signal processing have brought image processing capabilities to workstations such as those built by Sun, Cadmus, and Masscomp. Applications that look at every pixel now can have virtually the power of a Cray on a single board. And the new hardware options are more than just faster FFT (Fast Fourier Transformer) boxes. The new Zip series of programmable coprocessors from Mercury Computing looks very appealing to workstation-oriented applications previously needing a VAX or better to crunch the image. Zip family processors can execute at up to 16 Mflops in pipeline mode and can be programmed in a "C-like" language. More and more image processing laboratories are adding such systems to existing VAX/Unix or VMS systems and stringing them all together with Ethernet or wide-band networks.

## ADD-IN BOARDS FOR PCs

Add-in boards are coming on the market at the PC end as well. Frei Associates offers an IBM PC enhancement for image processing that includes a menu driven software package with 50 functions. The software supports a multifunction image processing board built by Imaging Technology. It includes a 512 x 512 x 8 bit frame buffer, and interfaces for a digitizer and display monitor. Mercury's Zip comes with a software development package that runs on a PC and the company plans to develop an interface in the near future. Dr. Sandy Sawchuck, director of USC's Signal and Image Processing Institute, believes that even home hobbyists may be able to make sizing discoveries in the areas of counting, sizing, and sorting applications where expertise in signal processing is not required. As these are some of the more appealing industrial applications, perhaps the entrepreneurial programmers will turn to image processing now that there's a spreadsheet and word processor for every PC in the world.

It's not all crunch and count, however; LISP machines and other systems supporting AI languages are being called in when reasoning is necessary to "understand" an image. Larger disks and memories are also playing a part. Winchester disks with 65 to over 100 Mbytes each and 1.2 Mbyte floppies are making it more viable to store images on all sizes of systems.

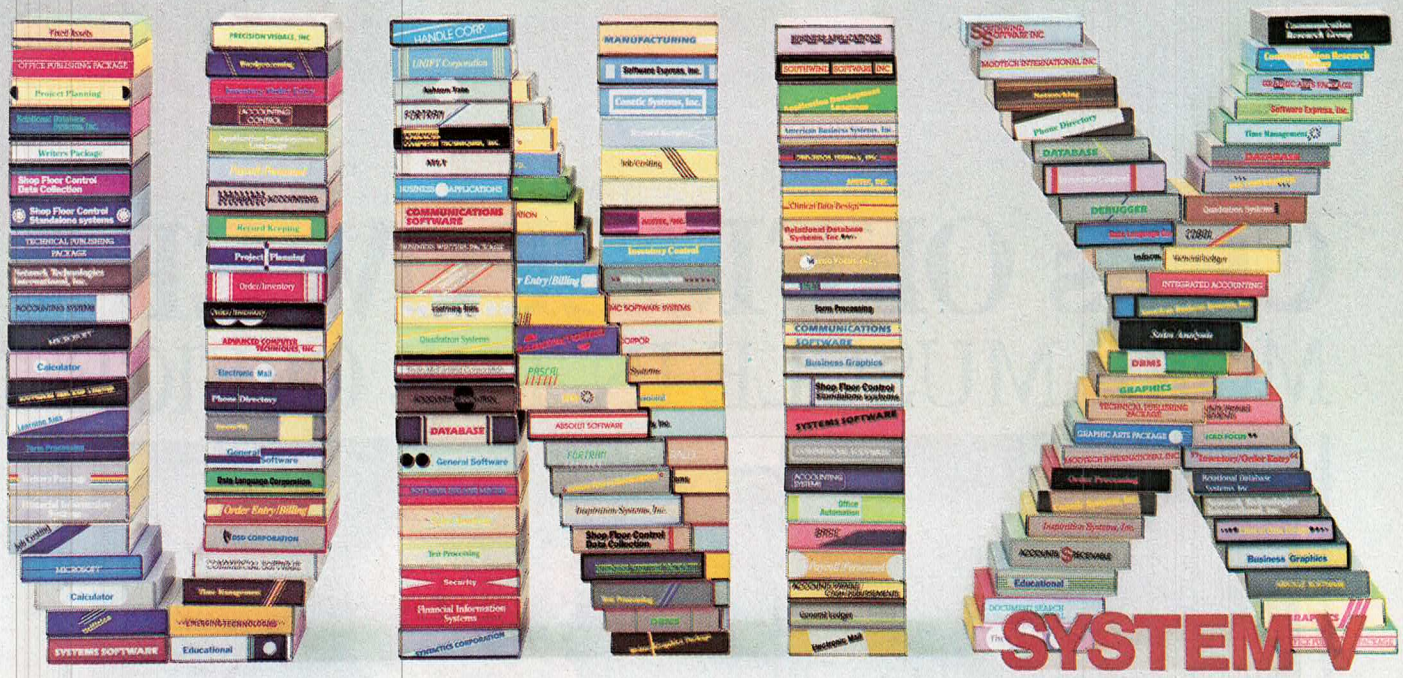
As far as the future of image processing goes, it's clear the picture looks good and can only get better! □



*Ashley Grayson is the founder of ADG, a high technology writing services company. With John Vornholt, he is the author of* Computer To Go, *a Guide to Briefcase Portables which was recently published by Simon and Schuster.*

## ACKNOWLEDGMENTS

This article would not have been possible without the assistance of the following individuals: Dr. Charles Sheffield, Vice President, Earth Satellite Corporation; Dr. Andy Tescher, Aerospace Corporation; Dr. Sandy Sawchuck, Director, Signal and Image Processing Institute, USC., Dr. Keith Price, Assistant Professor, USC.

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# CCI's OFFICEPOWER: MORE MUSCLE IN THE OFFICE

*Officepower isn't a new political movement but is instead a turnkey Unix-based office automation system.*

BY DONALD R. SHAIFER

The word *Officepower* might conjure up visions of dissident office workers, but have no fear. Officepower is not a political party but is instead a turnkey Unix-based office automation system—and a pretty good one at that. The only thing revolutionary about it is that it's a Unix system-based integrated office automation system that's here now and deliverable today!

To begin with, the appearance and performance of the trim machinery from Computer Consoles Inc. (CCI) is quite beguiling and soothing; it has the look of being very businesslike, no-nonsense, and competent, promising to fulfill a pledge of providing solid multiuser system power for up to 32 users.

While the Power 5/20 is based on the Motorola 68000 processor, the top-of-the-line Power 6/32 is based on CCI's own proprietary design and is billed as a supermini-computer capable of handling up to 80 users. The system I reviewed, the Power 5/20, is billed as a turnkey minicomputer-class office auto-

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### *Easier to Support*

The TEN/PLUS environment eliminates the errors your users make when different applications require different sets of commands. Designed around a full-screen editor, TEN/PLUS allows users to manipulate all data with the text editing commands that they use most often. This means that users can use already familiar techniques to process both text and data. In addition, the TEN/PLUS system provides self-explanatory error messages.

Here's another way to reduce support costs: adopt TEN/PLUS as a standard user environment on a variety of computers—from personal computers to mainframes. Then provide TEN/PLUS to all kinds of users: clerks, managers, and engineers. A common user environment means your computer staff will have fewer products to support.

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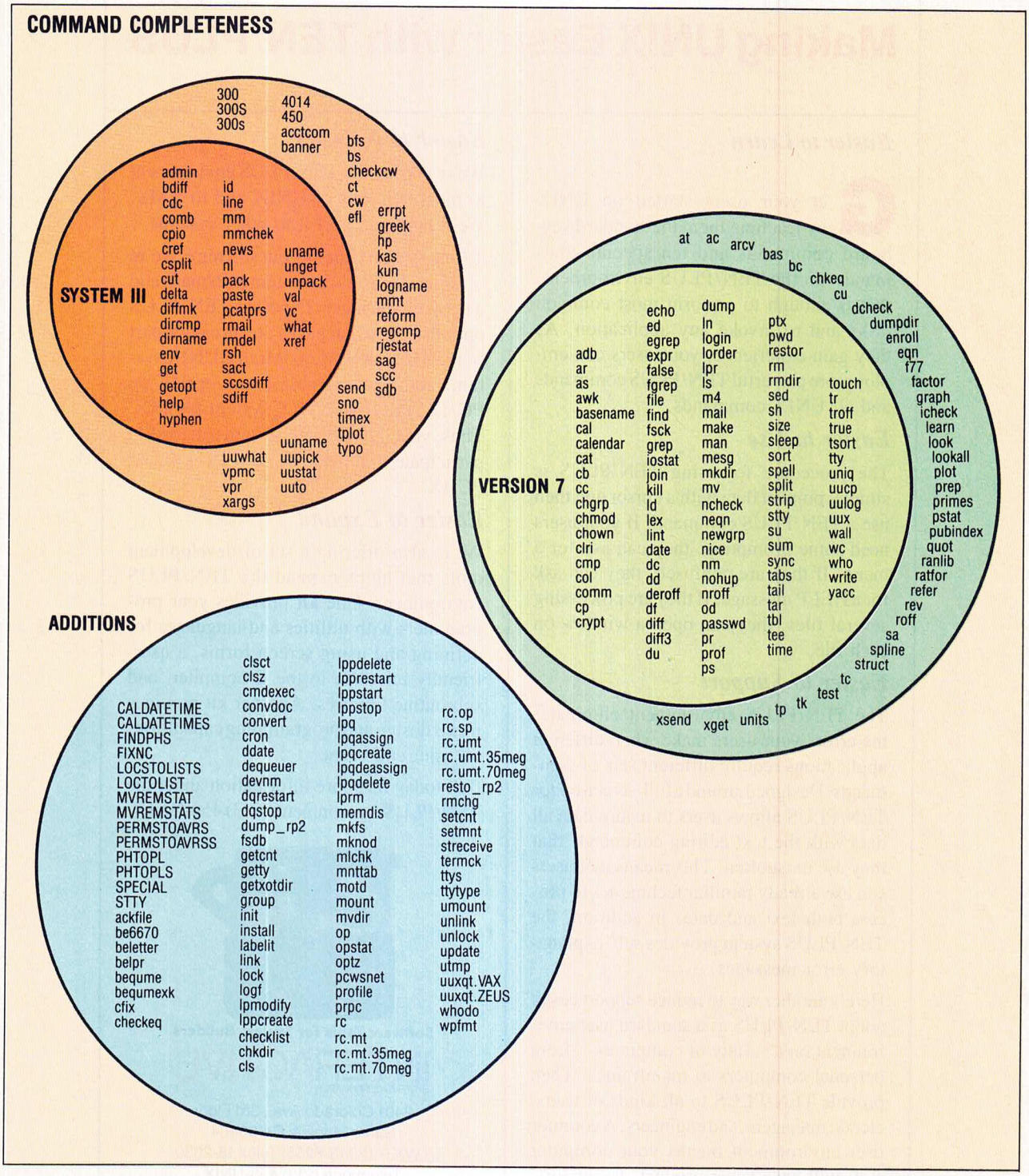
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mation system. In short, I liked the 5/20 even before we "shook hands." But would Officepower be all it proclaimed itself to be? Or was it an empty political promise?

With CCI's more than 15 years as a major supplier of "fault-tolerant" (low failure rate) computer systems to the telephone industry, it seemed to have the savvy to promote a winner. According to a 1984 *Business Week* survey, CCI ranks in the top 10 U.S. companies for research and development expenditure as a percentage of sales.

CCI has targeted information-intensive offices such as law firms, financial businesses, governmental offices, and sales firms as the market for the Officepower system. Because the Officepower turnkey package has been available for the past 18 months, it took only a little investigation to contact a few of the user firms to see how well the system has been doing in the field.

## THE PLATFORM

Officepower's platform is simple: Combine all the fundamentals of a good working office into one neat, powerful package. Of course, this package would include word processing, but there would also be memos, communiqués, folders, forms, and system management tools. In addition, CCI's approach to office automation is to take its basic Officepower software and enhance it with special tools for different vertical market applications.

For instance, a time-logging feature for recording client time and for billing is built into Law Officepower, and money-management facilities are provided for financial applications through the Money Manager system. This is a strong and important part of CCI's strategy for penetrating vertical markets, and they seem to be good at smoothly integrating a variety of office tools for each market.

I was surprised, though, to find that my configuration of Officepower did not have a spreadsheet built into it. However, I do understand that a SuperComp 20 spreadsheet is an integral part of the more potent Power 6/32 system as well as of later versions of the Power 5/20.

The system I tested was the Power 5/20 system with two terminals, a 70-Mbyte hard-disk storage capacity, the PERPOS (Unix system-based) operating system, and the Officepower applications package. This basic system could be used as a stand-alone operation or in a network with other CCI systems or a mainframe. In addition to the basic system, there are a number of options and configurations, including from 70 to 825 Mbytes of fixed media storage and 300 Mbytes of removable media.

**Officepower's plan is simple: Combine all the fundamentals of a good working office into one neat and powerful package.**

Basically, CCI tailors a system to the specific type of office, as in its Law Officepower system developed in conjunction with Hale and Dorr, the largest law firm in Boston. Their system consists of 25 Power 5/20 systems and more than 300 workstations.

Considering the variety of office tools provided with the Officepower version I tested, the basic questions before me were these: Would these items work as described? How do they work together? Is it easy to learn the system? And, most importantly, is Officepower well integrated? Does the system perform without noticeable degradation when all 32 users are fully using it? Of course, it would be rare for all users to be totally engaged at their terminals, but it is pertinent to ask if electronic gridlock would result from all of those documents flying around, files opening and closing, and mail and messages being routed about.

**COMPANY OVERVIEW**

**Corporate:** Computer Consoles Inc., Rochester, N.Y. (Corporate), and Reston, Va. (Office Systems Group), 703/648-3300.

**Management:** CEO, Herman A. Affel, Jr.; VP Marketing, Gary D. Haynes; General sales contact, John E. Mc Nulty, VP and General Manager, Office Systems Group.

| **Financials:** | 1983 | 1984 |
|---|---|---|
| Gross revenue (in thousands) | $103,550 | $131,189 |
| Net income (in thousands) | $10,392 | $6290 |
| Employees (total) | 1600 | |
| Office Systems Group | 220 | |

**Miscellaneous Data:** Units shipped, 300+; Major support centers, 89 CCI sales/service offices, with about 75% of those east of the Mississippi.

**PRODUCT OVERVIEW**

**Model:** Power 5/10; **Price:** $58,950; **Configuration:** One Power 5/20, 2 ½-Mbyte memory, a 70-Mbyte Winchester disk drive, a 20-Mbyte cartridge tape, eight terminals, and sixteen I/O ports; **Related models:** Power 5/30 (based on 68010), Power 5/55 (fault-tolerant system), and Power 6/32 (proprietary CPU); **First delivered:** 1983; **Processor:** CPU, Motorola; Cycle time, VERSSAbus; **Min. memory:** 1 Mbyte (has been upgraded to 2.5 Mbytes); **Max. memory:** 4 Mbytes; **Display:** 29 lines by 80 columns, green phosphor; **Keyboard:** Slim-line, detachable 98 keys, including 10 programmable soft keys, Qwerty layout, numeric pad, 4 cursor-control keys; **Mass Storage:** One to three hard disk drives, with 35 or 70 Mbytes per disk; **Backup:** 20-Mbyte cartridge tape; **Communications:** IBM 2780/3780, 3277; **Local-area networks:** two ports for CCI's high-speed LAN: **Communications protocol:** Transmissions Control Protocol/Internet Protocol (TCP/IP); **Shells:** Bourne; **Libraries:** Standard System III libraries; **Utilities:** Standard System III utilities; **Languages:** C, COBOL 74, FORTRAN 77, BASIC.

With the turnkey system already installed for me, I turned the key. Without much fanfare, Officepower set about its business while I followed the steps in the manual. The whole process was easy, and it closely followed the well-organized documentation. I was able to bring the system up quickly, and I gained confidence as each step worked on the machine just as it was described in the manual.

In general, I found the documentation to be well written and logically arranged, including clear instructions, definitions, and operations. In fact, a good measure of understanding is demonstrated by the smoothness and simplicity of instructions.

## STARTING UP

After the operating system banner comes up, the Officepower menu is displayed on the screen, giving options to open or manipulate files, read or send mail and phone messages, or manage the system itself. The menu is used in conjunction with the keyboard's top row of function keys, which specify what action is to be taken. When you select a menu item, these "soft keys" change accordingly, and their new functions are displayed at the bottom of the screen.

While various screens and messages came and went as I commanded them, I was beginning to be fascinated with the role of the system administrator. Here Officepower placed a good deal of attention because, as rightly presumed, the system administrator is a key to the smooth functioning of any multiuser office computer system.

An entire manual is devoted to the system administrator, who functions as the expert and mediator for the system users. There are details for maintaining the system in good working order, for backing up the file system, and for correcting errors that users can make.

Even though I have some familiarity with the Unix system, the system upon which Officepower is based, I learned many new operations as taught to the system administrator. These operations give the system administrator a good working knowledge of what to do in various problem situations, and I have rarely seen Unix system operations put as well. Documentation associated with anything based on the Unix system itself usually becomes awkward and arcane.

## WORD PROCESSING

The word-processing package is easy to learn and works smoothly. Responses to commands are fairly quick, and I got clear messages about how to correct mistakes. However, the first item a user should know is how to get out of a process or file, and this is not made clear in the documentation.

Because I didn't have a system guru to teach me simple things like these, I had to discover some of them on my own. After trying a number of incorrect keys, I finally found out—to my embarrassment—that the "Exit" key is the right one for escaping from a routine.

**CCI has targeted such information-intensive offices as law firms, financial businesses, and governmental offices as the market for the Officepower system.**

It's logical enough, I muttered afterwards, and because you get to know this function fairly quickly, the lack of a clear explanation is a forgivable shortcoming. I wondered, however, whether the new office worker just learning the system would get frustrated not knowing how to get out of a file or routine. This is exactly the information that should always be clear. Notwithstanding that one minor oversight, the rest of

the descriptions seem to be complete and correctly placed.

The text-management capabilities of the system, for instance, are quite complete, utilizing most of the inherent utilities of the Unix system, but this does not include the phototypesetting utility (`troff`) or the macro packages. This is probably just as well because those areas of the Unix system are particularly nettlesome. Still, the system is aimed more at information manipulators in general rather than documentation production. In fact, the direction seems to be to keep the data in the system, as opposed to externalizing the information.

## A PAPERLESS OFFICE?

A section of the system that works equally as well as the word-processing system is one called "Record Applications." Together, these functions threaten to do away with all manner of notes, scribbles, bits of paper, and general desktop flotsam. The "Record Applications" section contains such functions as calendar, electronic mail, telephone, reminders, name and address lists, data files, folders, computation, and archives.

All of these facilities are easy to use. In fact, getting into these sections and using them is so easy that I wondered if the message-exchange system would not develop a life of its own. I could imagine lots of messages being passed back and forth, some humorous, some snide, some very cryptic. The system seems to make it much easier to communicate with others in the office on an immediate basis without a lot of wasted time in telephone or office tag. All in all, it is possible that this messaging capability will make a large difference in—if not altogether change the nature of—office operations, and perhaps even in personal relationships of the people in the office.

After I learned how to manage my messages, I learned how to use UDAP (User-Defined Applications Package), which might be better defined as a forms generator. This capability allows you to use system-generated default forms for straightforward, routine form manipulation, or you can use it to custom design a form for specialized needs. For instance, you might want to collect standard information (name, address, phone, department, employee number, etc.) for a list of individuals, in which case you'd use the default form, which contains all the basics.

If, on the other hand, you wanted to collect special information or make forms similar in appearance to your own printed forms, you would use the customizing features of UDAP. This is done by using the word processor in conjunction with one of UDAP's features that allows you to insert "fields" into the form.

### BENCHMARK MEASUREMENTS

Aim Technology Suite 2

**Arithmetic Instruction Times (microseconds per op.)**

| | *short* | *long* | *float* | *double* |
|---|---|---|---|---|
| + Add | 1 | 2 | 144 | 190 |
| * Multiply | 7 | 67 | 154 | 262 |
| / Divide | 21 | 81 | 184 | 744 |

**Memory Loop Access Times (microseconds per byte)**

| | *read* | *write* | *copy* |
|---|---|---|---|
| Char type | 3 | 4 | 4 |
| Short type | 1 | 2 | 2 |
| Long type | 990ns | 2 | 2 |

**Input/Output Rates (bytes/sec)**

| | *read* | *write* | *copy* |
|---|---|---|---|
| Disk | 74K | 53K | 25K |
| RAM 1-byte | | | 270K |
| RAM 4-byte | | | 655K |

**Array Subscript References (microseconds)**

| short[] | long[] |
|---|---|
| 10 | 9 |

**Function References (microseconds/ref)**

| 0-parameters | 1-parameter | 2-parameters |
|---|---|---|
| funct() | funct(i) | funct(i,i) |
| 22 | 35 | 46 |

**Process Forks**
(-8370K bytes)
10 per second

**System Kernel Calls**
**(calls-per-second and microseconds per call)**

| | | |
|---|---|---|
| `getpid()` calls | 2K calls/sec or | 532 microseconds/call |
| `sbrk(0)` calls | 32K calls/sec or | 31 microseconds/call |
| `create/close` calls | 60 pairs/sec or | 16667 microseconds/pair |
| `umask(0)` calls | 2K calls/sec or | 665 microseconds/call |

Examples of fields include a last name field, a zip code field, a purchase order field, etc., and these fields have a specified length.

## OTHER ATTRIBUTES

In addition, the fields can have a number of other attributes besides length, one of which is a pattern definition. This means that certain patterns will or will not be allowed. For example, if you were creating a field for insurance carrier on a newly created employee record form, there might be only a few allowable carriers that could be inserted in that field. If a clerk, updating a record, inserted a wrong name in that field, the illegal name would be disallowed.

**Basically, CCI tailors a system to the specific type of office.**

I like the way the forms opened up when I wanted to view an individual record. I could scan an entire list of names or accounts, and when I designated a particular file, the screen immediately displayed the selected file. It was like thumbing through a folder to get a particular page, then immediately viewing the record when I got to that page.

In all of this, the system response time was very short. The surprising thing was that I enjoyed working with forms. It became not so much a chore as a nimble exercise, one in which I was not involved in the manual labor of file manipulation. I was, or at least felt briefly, more involved in the management of information.

All in all, Officepower is a well-thought-out, well-implemented information processing system that functions smoothly and easily. It seems to contain all the functions of a leading-edge electronic office, and it greatly enhances the power of its users. My conclusion is that any information-intensive firm considering automating or upgrading its offices would do well to investigate the Officepower system. CCI's very capable candidate will do justice to the office. □

*Don Shaifer holds a master's degree in architecture from the University of Oregon. Mr. Shaifer has his own firm, Innova Design, Palo Alto, Calif. An inventor, designer, and freelance writer, he has written manuals for Altos, Ampro, Olivetti, Silvar-Lisco, CAE, Tricad, and others.*

### CCI RESPONDS:

**CCI would like to clarify a few points in Mr. Shaifer's Officepower evaluation.**

***Operating systems:*** **The Power 5/20 runs Officepower software under CCI's Perpos operating system, which is based on Unix System III. The Power 6/32 and Power 5/30 computers run a 4.2BSD Unix operating system, and a Unix System V operating system will be available in late 1985.**

***Spreadsheet:*** **SupercompTwenty is a standard Officepower option. The spreadsheet is fully integrated, with the same user interface as other Officepower functions.**

***Typesetter interface:*** **Both `troff` and `nroff` are standard Unix utilities within the Perpos operating system. In addition, an interface permits sending Officepower files directly to a Compugraphic phototypesetter, enabling the creation of typeset documents without the need to use the Unix system commands.**

***Documentation:*** **The *Officepower Reference Guide* does not explain the basic exit procedure for most functions because it is intended for trained users. Basic skills are taught in customer classes and through three comprehensive self-paced training guides.**

***The User-Defined Applications Package:*** **Much more than a "forms generator," UDAP enables users to create data-entry forms and to use them to store information in a relational database. Stored data may be displayed, printed, and manipulated using one or several different forms.**

***Configuration:*** **As of January 1985, the minimum memory configuration for the Power 5/20 became 2 1/2 Mbytes.**

***Pricing:*** **Officepower system with Power 5/20 computer, equipped with 2.5 Mbytes ECC memory; a 70-Mbyte Winchester disk; a 20-Mbyte cartridge tape; eight 13-inch Power terminals; sixteen I/O ports; a sixteen-user Perpos operating system license; and a sixteen-user Officepower application license . . . . . $58,950.**

**Wayne Donnelly, Manager**
**Corporate Marketing Communications**
**Computer Consoles Inc.**

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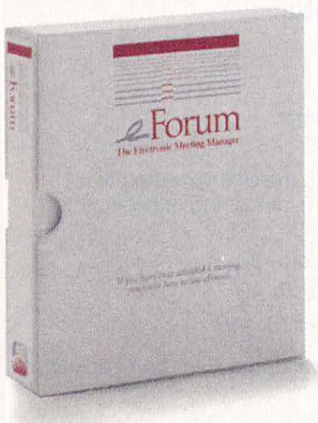


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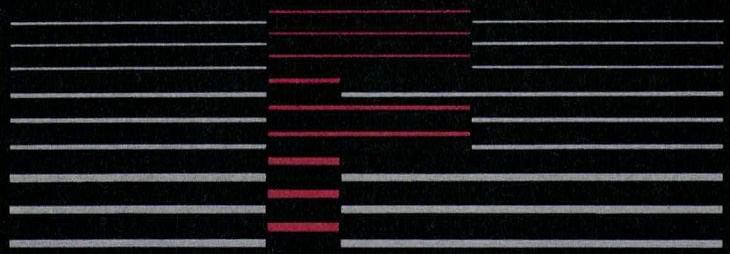

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## RAIMA'S MULTIUSER db_VISTA

Raima Corp. has introduced Version 2.0 of db_Vista, its database management system (DBMS) for software development in the C programming language for Unix system MS-DOS machines.

The new version features multiuser capability, transaction processing, an interactive database access utility, and the ability to import and export dBase II/III and ASCII files.

The new multiuser db_Vista costs $990 with source and $495 without source. The single-user version is available for $495 with source and $195 without source. A demo version with manual is available for $50.

For more information, contact Raima Corp., 11717 Rainier Ave. South, Seattle, WA 98178; 206/772-1515.

*Please circle Reader Service Number 160.*

## ICM GMS PACKAGE FROM SUN

Sun Microsystems has introduced the Interactive Computer Modelling's Geometrical Modelling System (ICM GMS) on the Sun-2/160 Color SunStation. Previously available on the monochrome Sun-2/120 workstation, ICM GMS now also fully utilizes the color-graphics capabilities of the Sun-2/160.

ICM GMS uses both Boundary Representation (B-Rep) and Constructive Solid Geometry (CGS) as its basic internal representation and secondary data structure. Its applications include the design and layout of mechanical parts and assemblies and displays.

ICM GMS is available immediately.

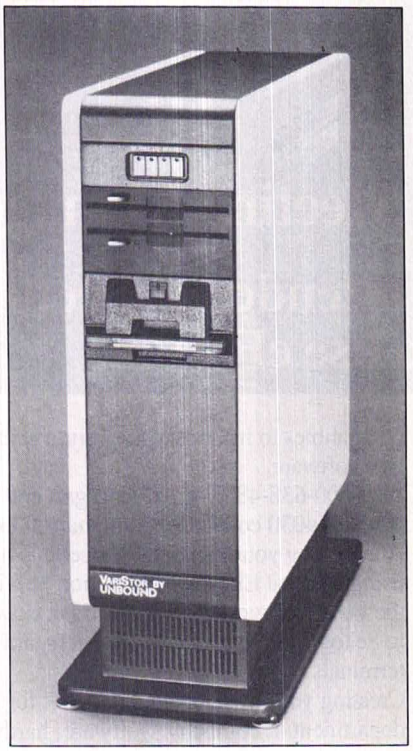
For more information, contact Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, CA 94043; 415/960-1300.

*Please circle Reader Service Number 161.*

## UNBOUND'S DEC-COMPATIBLE

Unbound Inc. introduced a modular computer system compatible with the Digital Equipment Corp. Micro-PDP-11/73 offering.

The new VariStor (Variable Storage Architecture) accommodates four 5.25 inch full-height peripherals and one half-height peripheral.




*The VariStor by Unbound.*

VariStor's processor is the DEC KDJ11-AA (PDP-11-73), making the VariStor compatible with all DEC PDP operating systems.

VariStor, configured with an eight slot backplane, 300 watt power supply, PDP-11/73 processor, 512K byte memory, dual channel serial interface, dual RX50 floppy, 5-Mbyte removable cartridge disk, and a 47-Mbyte to 123-Mbyte Winchester is priced from $11,500 to $16,600.

For more information, contact Unbound Inc., 15239 Springdale St., Huntington Beach, CA 92649; 1-800/UNBOUND.

*Please circle Reader Service Number 162.*

## MICRO CRAFT'S DIMENSION 68000

Micro Craft Corp. has come out with a complete four-user Unix system featuring dual 68000s in a proprietary architecture. A Dimension 68000 Unix system with 50-Mbyte hard disk and four terminals with 25-foot cables is now available for $15,995.

Systems are also available with four terminals and a 20-Mbyte hard disk for $14,995; less terminals with a 50-Mbyte for $12,895; or less terminals with a 20-Mbyte hard disk for $9995.

For more information, contact Micro Craft Corp., 4747 Irving Blvd., Suite 214, Dallas, TX 75247; 214/630-2562.

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## MOLECULAR SYSTEM 16 FAMILY

Molecular Computer has introduced the System 16 family of multiuser business systems. They support all

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industry standard operating systems, including Xenix, MS-DOS, PC-DOS, and CP/M-86, and from 2 to 64 users.

The System 16 family includes the System 16/200, a 2- to 10-user shared-processor computer featuring a dual 80286/80186 architecture. Disk storage options range from 20 Mbyte to 120 Mbyte, with integral tape back-up. Prices on the System 16/200 begin at $6995.

The Molecular System 16/300 is a network server for 8 to more than 64 PC's or PC lookalikes. Entry level prices begin at $11,995.

The System 16/400 and 16/600 feature a 16-bit, 80186 processor with 1 Mbyte of RAM per user in configurations for 4 to 64 users. Hard disk storage options ranging from 40 Mbytes to 360 Mbytes are also available. Pricing for the 16/400 begins at $14,995 and $41,995 for the 16/600.

For more information, contact Molecular Computer, 251 River Oaks Pkwy., San Jose, CA 95134-1986; 408/262-2122.

*Please circle Reader Service Number 164.*

## RIDGE OFFERS RISC STATIONS

Ridge Computers has introduced a new family of four computers designed for computationally intensive tasks. The new computers are based on reduced instruction set computer (RISC) architecture.

Ridge's 32/110 compute station features a 78-Mbyte disk drive, a 1-Mbyte floppy disk, Ridge's standard central processing unit (CPU), 4 Mbytes of main memory, and four expansion slots.

The 32/130 compute station comes in the same frame, but includes a 150-Mbyte disk drive and a 1-Mbyte floppy disk. It also contains a new high-performance CPU that features enhanced floating-point operation, a 4-Mbyte main memory, and four expansion slots.

The 32/310 compute station includes a 150-Mbyte hard disk, a 1-Mbyte floppy disk, the standard CPU, 4 Mbytes of main memory, and nine expansion slots.

Ridge's high-end offering, the 32/330 compute station, includes a 150-Mbyte hard disk, a 1-Mbyte floppy disk, the high-performance CPU, 8-Mbytes of main memory, and eight expansion slots.

Ridge has priced its 32/110 compute station at $39,000, the 32/130 sells for $47,000, the 32/310 costs $56,000, and the 32/330 is priced at $69,000.

For more information, contact Ridge Computers, 2451 Mission College Blvd., Santa Clara, CA 95054; 408/986-8500.

*Please circle Reader Service Number 165.*

## CAE SYSTEMS' PC AT WORKSTATION

The CAE Systems Division of Tektronix Inc., through its wholly owned subsidiary CAE Systems Inc., has introduced a high-performance computer-aided-engineering (CAE) system based on the IBM Personal Computer AT.

Called the TekStation AT, it incorporates a VAX 750-class 32-bit coprocessor, Berkeley Unix 4.2, and CAE 2000 design software. It can concurrently support PC-DOS and compatible application software available from IBM and third-party suppliers.

TekStation AT prices start at $25,000. A file server configuration is available for about $40,000, and an Ethernet interface is $1400.

For more information, contact CAE Systems Inc., 1333 Bordeaux Dr., Sunnyvale, CA 94089; 408/745-1440.

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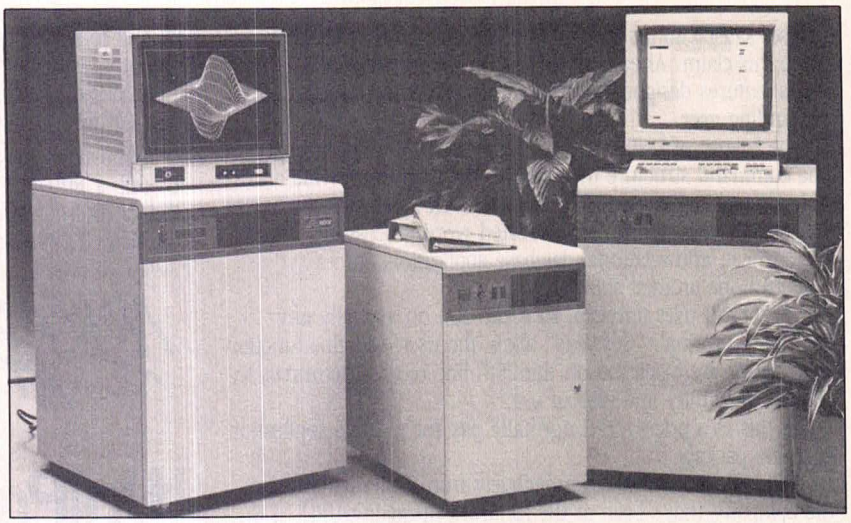

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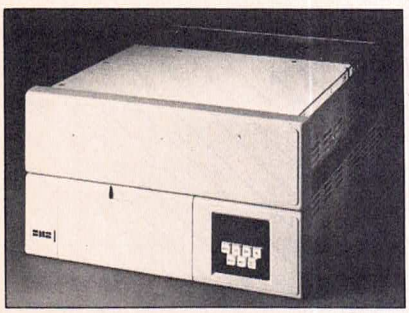
## SMS ADDS MODEL 50

Scientific Micro Systems (SMS) introduced the SMS 8000 Model 50, a higher capacity version of the SMS Model 40.

All versions are based on an advanced SMS Foundation Architecture and include system enclosure, a



*SMS 8000 Model 50.*

choice of fixed and removable peripherals, 8086/80286 processors, and up to 16 Mbytes of main memory.

U.S. list price for the SMS 8000 Model 50 starts at $6800 in quantity, complete with Foundation Module and one serial port, 12-Mbyte Winchester, 5¼" 700K-byte floppy, 8086 CPU, and 512K bytes of main memory.

For more information, contact SMS Inc., 339 N. Bernardo Ave., Mountain View, CA 94043; 415/964-5700.

*Please circle Reader Service Number 167.*

## INCREASED MEMORY, DISKS FROM APOLLO

Apollo Computer Inc. has introduced memory and storage capacity increases for its Domain systems, a new model of its high-end system, and a field-upgrade memory expansion program.

The company doubled the memory capacity of its top-of-the-line color workstation, the DN660 to 8 Mbytes, and quadrupled memory on two other Domain system nodes, the DN460 and the DSP160 computational server to 16 Mbytes.

Apollo increased main memory threefold (from 1 to 3 Mbytes) on the Domain File Server series and doubled the maximum disk capacity per file server from 1 to 2 gigabytes.

For more information, contact Apollo Computer Inc., 330 Billerica Rd., Chelmsford, MA 01824; 617/256-6600.

*Please circle Reader Service Number 168.*

## PYRAMID'S NEW 98X

Pyramid Technology Corp. has introduced the Pyramid 98x Isoprocessor, the new high-end member of Pyramid's 90x series product line.

The 98x Isoprocessor uses two fully symmetrical RISC-based processors. The new system is designed for commercial, scientific/technical, and university applications that require heavy multiuser Unix operating system and development requirements. The 98x runs OSx, Pyramid's dual port of the Unix operating system that incorporates both 4.2BSD and AT&T's System V.

The Pyramid 98x Isoprocessor System supports up to 256 users, 32 Mbytes memory, and over 5 gigabytes of disk storage. A typical configuration, priced at $307,000, includes an 8-Mbyte main memory, two 470-Mbyte disk drives, a 6250-bpi magnetic tape drive, 32 RS232 ports, a color console, and the OSx operating system with license for 32 users.

For more information, contact Pyramid Technology Corp., 1295 Charleston Rd., Mountain View, CA 94043; 415/965-7200.

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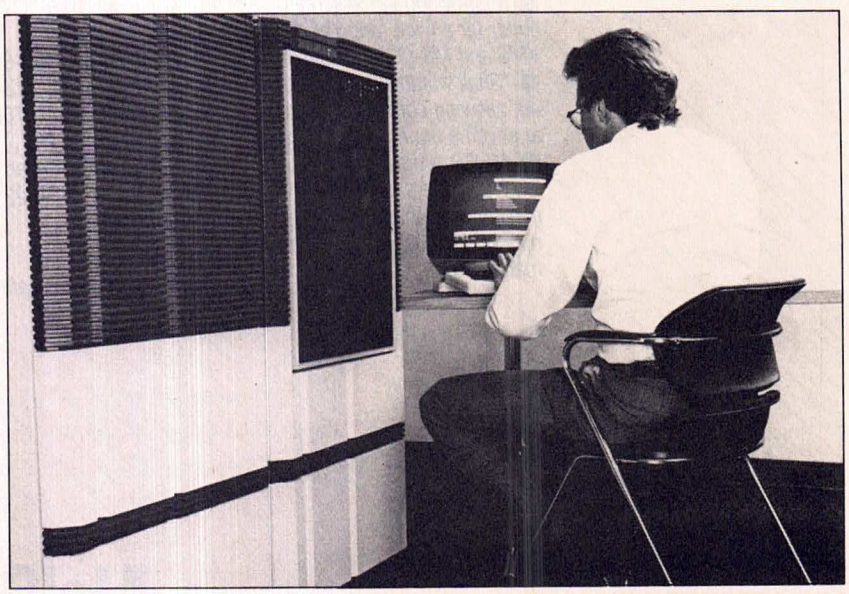

*Pyramid's new high-end member of the 90x series: 98x Isoprocessor.*

## RTI'S INGRES/PCLINK

Relational Technology Inc. (RTI) has introduced Ingres/PClink, which connects RTI's Ingres database management software to the most popular personal computer productivity software.

Combining Ingres Visual Query Language, ASCII terminal emulation, and file transfer capabilities, Ingres/PClink automatically reformats data in remote Ingres databases for processing by software packages such as Lotus 1-2-3, dBase II, WordStar and Multiplan.

The price of Ingres/PClink for a single host system, including the right to make an unlimited number of copies of the PC-resident components, ranges from $1500 to $12,500, depending on the host processor.

For more information, contact RTI, 1080 Marina Village Pkwy., Alameda, CA 94501; 415/769-1400.

*Please circle Reader Service Number 170.*

## R SYSTEMS' OFFICE

Systems has introduced R Office, an office automation package for multi- and single-user applications. It runs on Unix, Xenix, and RM/COS multiuser systems and single or networked DOS-based machines.

As a full-featured word processor, spreadsheet, database, and desk organizer, the integrated features of R Office perform the functions of several stand-alone programs in these areas. Moreover, data can be combined and transferred from one application to another.

R Office requires 320K bytes of memory in a single-user environment. In a multiuser environment,

the program requires the initial 320K bytes for the first terminal and 32K bytes per additional terminal. Multiuser RM/COS requires 35K bytes per terminal.

The price of the DOS version (US) is $495. The Unix, Xenix, and RM/COS versions sell for $1295.

For more information, contact R Systems Inc., 11450 Pagemill Rd., Dallas, TX 75243; 214/343-9188.

*Please circle Reader Service Number 171.*



## CCI ADDS FLOATING POINT

Computer Consoles Inc. (CCI) has introduced the Floating Point/Math Accelerator to its Power6 family of products.

The Floating Point/Math Accelerator is a high speed co-processor that provides execution rates of 7500 Whetstone KIPS for single precision functions. In addition, the performance of FORTRAN and C applications is enhanced by the Floating Point/Math Accelerator.

The Floating Point/Math Accelerator option is $16,500 and is available immediately.

For more information, contact Computer Consoles Inc., 97 Humboldt St., Rochester, NY 14609; 716/482-5000.

*Please circle Reader Service Number 172.*

## FACET FOR PC'S

Structured Software Solutions Inc. has introduced FACET, a software package that turns a PC into a multifunction windowed terminal when linked to a Unix or Xenix system host computer.

FACET makes it possible for IBM and compatible PC users to "pop up" to 10 individual session windows on their PC screens, even while running another program.

For more information, contact Structured Software Solutions Inc., 4031 West Plano Pkwy., Suite 205, Plano, TX 75075; 214/985-9901.

*Please circle Reader Service Number 173.*

## ISLAND'S PAINT SYSTEMS

Island Graphics Corp. has designed two powerful full-featured paint systems which will be marketed by Salt Lake City-based Quanta Corp.

EVP-800 is designed to enhance Quanta's Q8 character generator. EVP-500 will support Quanta's recently released QCG500 character generator. Either combination of paint system and character generator provides the professional user unlimited graphics opportunities.

Also new from Island is the paint/image manipulation software board (ICB). The ICB provides owners of AT&T and IBM computers an affordable way to integrate video images and high-resolution graphics.

Island has also released Paint 160, a paint system designed to take advantage of Sun Microsystem's new 2/160 color workstation. Paint 160's picture manipulation features include object rotation, scaling and windowing. Paint capabilities include 256 out of 16 million on-screen colors, brush and pattern editing, air brush, anti-aliasing, color spreads, and color cycle animation. The system utilizes the Sun 2/160's 1160 X 900 high-resolution monitor. Paint 160 is priced at $5995.

For more information, contact Island Graphics Corp., One Harbor Dr., Sausalito, CA 94965; 415/332-5400. □

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UNIX/WORLD'S "New Products"" section is provided as a service to our readers, and our selection criteria are based solely on the needs of our readership. If you would like to have your product news considered for publication, please address your correspondence to UNIX/WORLD Magazine, New Products Editor, Castro St., Suite 1220, Mountain View, CA 94041. Because of the large number of press releases we receive, UNIX/WORLD cannot verify the accuracy of claims made by a product's manufacturer. We advise that you thoroughly test any product before buying.


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# SYSTEMS ADMINISTRATION: CURES FOR BUSINESS ILLS

## PART 6, ADDING AND REMOVING ACCOUNTS

BY DR. REBECCA THOMAS

As a multiuser system, more than one user can access the Unix system at the same time. Generally, all system users have their own personal accounts. In addition, certain accounts are created to perform system related functions, such as the superuser account for system management duties. In this month's installment, you will learn how to add or remove user and system-related accounts.

In both cases, you need to update the password and perhaps the group file as well. Thus, you need to know the layout of these important data files before you can modify them for adding or removing system accounts.

### THE PASSWORD AND GROUP FILES

The password file is the database that describes the accounts on your Unix system. This file has the pathname `/etc/passwd` and is readable by all system users, but usually only the superuser can write to it. The entry for each account consists of a single line that has seven colon-separated fields. Figure 1A lists the fields and their contents; a typical password file entry is depicted in Figure 1B.

The password file must be readable by all users in order for several of the Unix system utilities, such as `ls` and `find`, to relate the user account name to the user identification number (UID). Thus, for security, an encrypted form of the password is stored, instead of the password itself. The password file is usually only writable by its owner (the superuser) to prevent ordinary users from altering this important system file and gaining unauthorized access to system accounts. The superuser must be able

a. The fields of the password file:

- The user name, consisting of up to 8 characters.
- The encrypted password, which consists of 13 characters from the character set (.), (/), 0 to 9, A to Z, and a to z. If blank, no password is requested when signing on to the account. Only `passwd` should be used to install a password, although you can remove a password completely with an editor.
- The user identification number (UID), a unique number that is assigned to the account. This number ranges from zero (reserved for `root`) to 65,535.
- The group identification number (GID), a number shared by accounts belonging to the same group. This number ranges from 0 to 65,535.
- A comment field. The usage of this field is implementation dependent, but usually is used for a comment or identifying information. Frequently, the full name of the account user is placed here.
- The home directory, which will become the initial working directory location after logging in.
- The log-in program pathname. This is the program executed by `login` during the log-in sequence. Usually a general-purpose shell, such as the Bourne or C shell, is specified here. When no log-in program is specified, a default program, usually the Bourne shell, is used. If a Unix utility is specified after signing on, the utility is executed, and when the program is finished, the user is logged out. A few common examples for such utilities would be `who`, `sync`, `ps`, or an editor.

b. A typical password file:

```
$ cat /etc/passwd
root:fsvR4s7nd/iDQ:0:1:The System Doctor:/:/bin/csh
daemon::1:1:The Devil Himself:/:
bin:ExGVBv/LEWC.1:2:2:Command Maintenance:/bin:/bin/csh
adm:y.EC0sQ.j0fEw:3:3:Administrative Functions:/usr/adm:
manual:jCWxOA51GCYuo:4:4:Manual Pages:/usr/man:
uucp:P0CHBwE/mB51k:5:5::/usr/spool/uucppublic:/usr/lib/uucp/uucico
games::6:7:Play Games:/usr/games:/bin/rsh
sync::7:7:Synchronize File System:/:/bin/sync
username:OB/ZkzYYKMP8fw:100:10:Test Account:/usr/username:/bin/csh
friend:XdJAg131HzUk:101:10:Test Account:/usr/friend:/bin/sh
rik:NO-LOGIN:102:20:Rik Farrow:/usr/rik:/bin/csh
becca:k8xOE1tQsk6jc:103:20:Becca Thomas:/usr/becca:/bin/csh
$ □
```

FIGURE 1: THE PASSWORD FILE, `/etc/passwd`

to write to the password file in order to add or remove an account from the Unix system.

If you examine Figure 1B, you'll notice some accounts with "strange" user names; these are generally located near the beginning of the file. Accounts with names such as `root`, `daemon`, `adm`, `bin`, `uucp`, and so on, are employed for system-related functions; that is, for running and maintaining your Unix system.

The `games` account is a restricted account in that it uses a restricted shell `/bin/rsh` (available with Bell Systems III and V) that doesn't allow users to change directories, reset their command search path, use pathnames when specifying command programs, or redirect output to a disk file. These restrictions effectively limit the users who log in as `games` to run the game programs (located in `/usr/games`, their home directory).

The `sync` account is also a limited access account. When a user logs into this account, the `sync` command is executed and the user is logged off. This account is useful for updating file systems in an emergency, when logging in to the system and specifying the `sync` command would take too much time.

You should familiarize yourself with the password file on your system. Simply enter `cat /etc/passwd` to view the contents of this important data file.

The accounts for the ordinary system users are listed after the system-related accounts. When you are examining the entries for the ordinary users, note that more than one user may share the same group identification number (GID), which is the fourth field from the left. Each user with the same group identification number belongs to the same group, which we call the *default group*.

Each group member can share another member's files if the group access permission is enabled for these files. In our sample password file, we depict accounts `username` and `friend` to be in group 10 and the `rik` and `becca` accounts to be in group 20. So if user `rik` enables group permission for a file, then user `becca` can access that file (and vice versa). This feature provides a simple way for several people working on a common project to access one another's files.

In addition to the default group, users may be assigned to one or more other group associations by means of the group file, `/etc/group`. This file contains entries similar to `/etc/passwd`; however, it only has four fields of information. Figure 2A lists these fields and their contents, and Figure 2B shows an example of a typical group file.

Another use for the group file is to associate a name with a GID. Although not essential, names are easier to remember than numbers; in

a. The fields of the group file:

- The group name, consisting of up to 8 characters.
- The encrypted group password, which usually is not present since most Unix systems do not provide an easy way to install a password in the group file.
- The group identification number (or GID).
- An optional list of comma-separated user account names that are authorized to access files as a group.

b. A typical group file:

```
$ cat /etc/group
other::1:
bin::2:
adm::3:
manual::4:
uucp::5:
restrict::7:
test::10:becca,rik
docum::20:username,friend
$ □
```

FIGURE 2: THE GROUP FILE, `/etc/group`

a. General command line format for Bourne shell:

```
$ newgrp [ - ] [ groupname ]
```

b. General command line format for C shell:

```
% exec newgrp [ - ] [ groupname ]
```

c. Changing from default to `test` group:

```
$ newgrp test
$ □
```

FIGURE 3: USING THE `newgrp` COMMAND

this example, `/etc/group` defines names for group numbers 1 through 5 and 7.

More important, additional group associations between accounts are defined using `/etc/group`. In the example shown, the groups named `test` and `docum` are used for this purpose. The `test` group, with GID 10, already has accounts `username` and `friend` as members by default. That is, both of these accounts were assigned GID 10 in the password file. The `test` entry in `/etc/group` defines two additional accounts as members—namely `becca` and `rik`. Likewise the `docum` group has default members `becca` and `rik` (defined in `/etc/passwd`), and the members, `username` and `friend`, are defined by `/etc/group`.

As we have seen, accounts can belong to the same group by default. Accounts can *potentially* belong to the same group by definition in the group file. The `newgrp` command, however, must be used to change group association from one group to another before file accesses to the new group are allowed.

The command line syntax for changing to *groupname* from the Bourne shell is shown in Figure 3A and for the C shell in Figure 3B. The `newgrp` function is built into the Bourne shell but not the C shell. Therefore, you must specify the `exec` directive from the C shell so the new C shell (with the *groupname* ownership) will overwrite the old one. Otherwise, you will create an extra C shell process.

The group association is changed back to the original default group by omitting the *groupname* argument. Indicate the dash argument (`-`) with either shell if you wish the shell startup files to be executed to change your environment to be the same as if you had actually logged in again. We discuss using shell startup files to change your environment later in this article.

As an example, let's say that account `becca` wishes to access files owned by account `username`. These accounts don't belong to the same default group, so account `becca` cannot automatically access files owned by user `username` (or vice versa) even if the group permissions for the files were enabled. The `/etc/group` file, however, allows user `becca` to change group association temporarily to the group that `username` belongs to—namely `test`. Figure 3C shows how to accomplish this task from the Bourne shell. When user `becca` wishes to return to the default group, only `newgrp` need be entered after the shell prompt.

Now that you've learned about the layout and function of the password and group files, you're ready to add or remove system accounts.

## ADDING A USER ACCOUNT

Several steps are involved in adding a new account to a Unix system: *one,* updating the password and perhaps the group file; *two,* creating a new home directory; and *three*, optionally providing a working environment for the new account.

Actually, the first step is to have the user decide on an account name. You may use up to eight letters, digits, and punctuation charac-

a. Updating the password file, /etc/passwd:

```
# cd /etc
# cp passwd passwd.bak
# ed passwd
641
$p
becca:k8xOEltQsk6jc:103:20:Becca Thomas:/usr/becca:/bin/csh
a
philipg::104:20:Philip Gill:/usr/philipg:/bin/sh
.
$p
philipg::104:20:Philip Gill:/usr/philipg:/bin/sh
w
690
q
# □
```

b. Updating the group file, /etc/group:

```
# cp group group.bak
# ed group
104
/test/
test::10:becca,rik
s/$/,philipg/p
test::10:becca,rik,philipg
w
112
q
# □
```

FIGURE 4: EDITING THE PASSWORD AND GROUP FILES

a. Creating the directory:

```
# cd /usr
# mkdir philipg
# chown philipg philipg
# chgrp docum philipg
# ls -ld philipg
drwxrwxrwx  2    philipg   docum          32 Nov   1 12:36 philipg
# □
```

b. General command syntax for using chown and chgrp:

chown *owner file . . .*
chgrp *group file . . .*

FIGURE 5: CREATING A NEW HOME DIRECTORY

ters that don't have special meaning to your shell. Generally people use some form of their personal name for their personal account and a functionally descriptive name for other accounts.

To add a new account entry to the password file, first log in as root, since only the superuser should have the ability to edit the password file. Then change to the /etc directory to avoid typing full pathnames. Make a copy of the password file before you edit it, say by typing cp passwd passwd.bak.

If your system has the vipw (or similar) shell script command, use this for updating the password file. If all users agree on using vipw for changing /etc/passwd, then the script ensures that only one user can update the password file at any one time. If you don't have vipw or a similar command, use your favorite editor. As an example, Figure 4A shows adding a new account, user name philipg, using the universally available ed editor.

The password field (second field from left) for philipg was left blank because the passwd command will fill it later. We increased the UID by 1 over the last entry (from 103 to 104), but we left the GID the same. Thus, both the accounts becca and philipg will be in the same default group (GID of 20). The next field to the right can contain a comment, so we placed the full name of the account user here. The home directory field (second from the right) was patterned after the entry for becca since both accounts have the same parent directory (/usr). Finally, the Bourne shell (pathname, /bin/sh) was indicated to be the log-in program.

Figure 4B shows adding philipg to the docum group by updating the group file. We left the second field blank because any password must be installed with a group password command. The Bell and Berkeley Unix systems *do not* have such a command, but some commercial vendors have added one to their system. As long as /etc/group can't be written to by any user other than root, however, a group password is superfluous.

## CREATING A HOME DIRECTORY

The directory entry in the password file (field number 6) that we created earlier simply names the home directory. Now we need to create it. Figure 5A shows one approach. First we changed to the /usr directory and then created the new directory

a. Commands appropriate for `/etc/profile`, `.profile`, or `.login`:

- Changing the terminal modes with `stty`.
- Resetting the command search path.
- Resetting the shell prompt.
- Setting shell variables and perhaps placing them in the environment.
- Display the current values of shell and environment variables.
- Display and record your log-in time.
- Display system status information, such as the number of users, who is on the system, the amount of free disk space, all processes currently executing (to see how loaded the system is), and so on.

b. Additional commands appropriate for `.login` or `.cshrc`:

- Defining command aliases.
- Enabling the history function.

c. Duplicating the startup file:

```
# cd /usr
# cp startup-file philipg
# chown philipg philipg/startup-file
# chgrp docum philipg/startup-file
# □
```

d. Linking the startup file:

```
# cd /usr
# ln startup-file philipg
# chmod a-w,a+r philipg/startup-file
# □
```

FIGURE 6: USING THE SHELL STARTUP FILES

`philipg` with the `mkdir` command. Notice that the home directory base name is the same as the account name—this is a convenience not a necessity.

This new directory is owned by the user who created it—namely the superuser. You have to change the ownership of the directory to the account user so he or she can change access permissions and do other operations that require file ownership.

You can use two commands for changing ownership. The `chown` command changes individual ownership of a file and `chgrp` changes the group ownership. The syntax of both commands is similar, as can be seen in Figure 5B. You may specify either *owner* or *group* by name or by number.

## PROVIDING A WORKING ENVIRONMENT

You can provide an environment for the account user by placing the appropriate shell commands in a file, known as a *shell startup* file. When a user logs on to the system, this file is executed automatically by the log-in shell program.

Shell startup files have a reserved name that is recognized by the log-in shell. With the Bell System III and V Bourne shell, the systemwide startup file, `/etc/profile`, is executed first. You would place commands in this file to provide a common working environment for *all* system accounts.

All versions of the Bourne shell recognize a file named `.profile` in the user's home directory. You would place commands that provide the new account with its own particular working environment in this file.

The C shell recognizes two shell startup files—`.login` and `.cshrc`. During the log-in procedure, the C shell first reads `.cshrc` and then `.login`. Furthermore, whenever a new C shell is started up, say by specifying a *shell escape* from inside certain Unix programs, the new instance of the C shell reads and executes commands in `.cshrc` (but not those in `.login`).

Figure 6A lists some types of commands that you might include in your Bourne shell startup files (`/etc/profile` or `.profile`) or C shell `.login` startup file. Additional commands you might place in the C shell's `.login` or `.cshrc` file are listed in Figure 6B. Note that any command that is executed in the `.login` startup file, whose effects carry over to a subshell, need not be included in the `.cshrc` file.

Figures 6C and D show two different scenarios for installing these individual account startup files. In both cases, we assume that sample startup files are present in the `/usr` directory.

Use the approach shown in Figure 6C if you want new account users to be able to modify their startup files. Make a duplicate of the startup files (using `cp`) in the home directory for the new account. Then change the individual and group ownership of these files to the new account as well.

On the other hand, use the approach shown in Figure 6D if you don't want the new account user to be able to change the startup file. Link it (using `ln`) to the new home directory and remove any write permission, but leave read permission for the user. Also, retain the original ownership of these files. In this way the shell program of the new account

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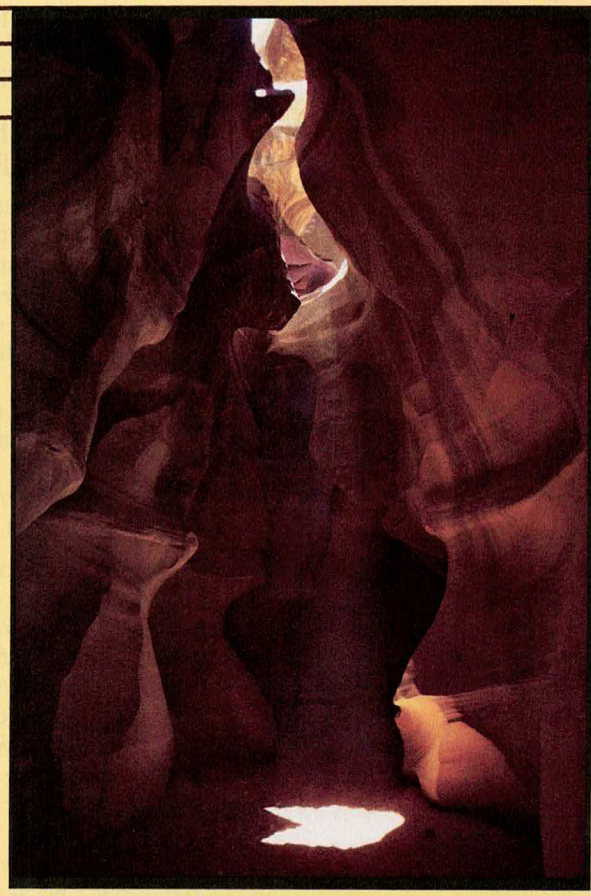

## A WORKPLACE SHAPED BY LISTENING.

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SPERRY

a. Editing the password file, /etc/passwd:

```
# cd /etc
# cp passwd passwd.bak
# ed passwd
703
$p
philipg:06JqPzZDBVUuw:104:20:Philip Gill:/usr/philipg:/bin/sh
s/:.....:/:NO-LOGIN:/p
philipg:NO-LOGIN:104:20:Philip Gill:/usr/philipg:/bin/sh
w
702
q
# □
```

b. Updating the group file, /etc/group:

```
# cp group group.bak
# ed group
112
/,philipg/
test::10:becca,rik,philipg
s///p
test::10:becca,rik
w
104
q
# □
```

c. Removing the user's files:

```
# cd /usr
# tar cv philipg
# rm -r philipg
# find / -user philipg -print >philipg.files
# tar rv `cat philipg.files`
# rm `cat philipg.files`
# rm philipg.files
# □
```

FIGURE 7: REMOVING A USER ACCOUNT

is able to execute the startup files, but the user cannot alter them. Another plus to this approach is that the linked file doesn't take up any extra disk space.

## DELETING A USER ACCOUNT

The user account should not be deleted from the system but rather inactivated. This is so that any files created by that account will not pass their ownership to a new account that happened to be assigned the same number UID. This problem could occur, for instance, when files from a backup tape are restored.

## UPDATING THE PASSWORD AND GROUP FILES

One of the simplest ways to inactivate an account involves logging in as `root` and editing the password file entry, placing an "impossible" password in the password field. This procedure is illustrated in Figure 7A.

We chose to substitute the string "`NO-LOGIN`" for the password; however, you may use any other string that could not be a valid password. Another idea would be to place the date the account was inactivated in this field.

Also, you should move the inactivated entries to the end of the password file. Because Unix utilities, such as `passwd`, search the password file from the beginning to the end, the system wouldn't spend extra time searching through inactive accounts to locate active ones.

You can completely erase the old account name from any entry in the `/etc/group` file. Unlike the UID, the GID is not unique, so a placeholder doesn't have to be maintained on the system. Figure 7B shows the group file being edited to remove the `philipg` entry from the `test` group.

## REMOVING THE HOME DIRECTORY

Archive any files that are worth saving, and then delete the original files on the system disk. You can use `find` to locate files elsewhere on the system owned by the old account. Finally, remove the home directory for the inactivated account, which frees up the disk space for other users. These steps are depicted in Figure 7C. □

---

*Dr. Rebecca Thomas, UNIX/WORLD's Technical Editor, is an author of* A User Guide to the Unix System, *the second edition of which is now available. She is currently writing a book on Unix system administration.*

**Acknowledgement**

I wish to thank Rik Farrow for reviewing this month's installment.

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# POTPOURRI: JUMBLES, A BUG FIX, AND `write`

BY DR. REBECCA THOMAS

This month I have lined up an assortment of *Wizard's Grabbag* contributions—one for fun, two serious, but all three useful. First off this month is a shell script to help you solve Jumbles, the syndicated newspaper word game. This is followed by a reader's correction to a bug he discovered in the `spellproofer` shellscript we published in our June issue. Last, a reader prescribes a possible solution to a common dilemma encountered with the `write` command.

**Dear Dr. Thomas:**

Enclosed is a listing of a recursive program that should help you solve Jumbles—a word game syndicated in many newspapers. I've also enclosed a shell script front-end for driving the C program. (Figure 1A lists the Bourne version and 1B the C shell version of the author's shell script, `jumble`. Figure 2 lists the C program, `jum.c`.)

The `jum` program accepts a character string as an argument and sends all permutations of that string to its standard output. This program works as follows: The first letter of the string is skipped and all permutations of the remaining letters are obtained. Then the first letter is traded with one of the remaining letters, and the process repeated until all letters in the input have been processed. Recursion is used to jumble the remaining letters, while the letter in the first position is held constant. The jumbling routine is called over and over until a residual string of length 1 is passed, and then a word is printed on the standard output.

The `jumble` shell script sorts the list of strings from `jum`, deleting duplications, and stores the result in a temporary file. All strings not considered words correctly spelt (by the Unix `spell` utility) are piped into `comm`, which is invoked to output all words present in the temporary file that aren't misspelled. The resulting list of words are good candidates for solving the Jumbles puzzle.

*Contributed by Barton A. Pricola*
*Alexandria, VA*

## SOME IMPROVEMENTS TO `spellproofer`

**Dear Dr. Thomas:**

I have enclosed a corrected copy of the `spellproofer` script published in your June issue. A problem

a. The Bourne shell version:

```
if test $# -lt 1; then
        echo "Usage: jumble string"
        exit
fi
jum $1 | sort -u >temp
spell temp | comm -23 temp -
rm temp
```

b. The C shell version:

```
if ($#argv != 1) then
        echo "Usage: jumble string"
        exit
endif
jum $argv | sort -u >temp
spell temp | comm -23 temp -
rm temp
```

FIGURE 1: THE `jumble` SHELL SCRIPT

```
$ pr -n -t jum.c
   1  #include<stdio.h>
   2  #define MAXLEN 6        /* Change as necessary */
   3  #define void int
   4  main(argc, argv)
   5  int argc; char argv;
   6  {
   7          char *ptr;
   8          if (argc != 2) /* One word at a time */
   9                puts("nUsage: jumble string'n");
  10                exit(-1);
  11          }
  12          ptr = argv[1]; /* Point to first character of word */
  13          jumble(argv[1], ptr); /* Output all permutations */
  14  }
  15  void
  16  jumble(word, real_word)
  17  char *word, *real_word;
  18  {
```

continued

FIGURE 2: THE `jum.c` PROGRAM LISTING

```
 19  char    *chr,                   /* Pointer to substring */
 20          *ptr,                   /* Traverses the input string */
 21          temp,                   /* For character storage */
 22          *next_word,             /* Next string for jumbling */
 23          original[MAXLEN],       /* The original string */
 24          *strcpy();              /* Must declare return type */
 25  if (strlen(word) == 1) { /* Done */
 26          printf("%s\n", real_word); /* So output it */
 27          return
 28  }
 29  strcpy(original, word); /* Make a copy of input string */
 30  next_word = word + 1; /* Point to substring to jumble */
 31  for (ptr = original + 1; *ptr != '\0'; ptr++) {
 32          jumble(next_word, real_word);
 33          temp = *(word + 1); /* Switch characters */
 34          *(word + 1) = *word;
 35          *word = *ptr; /* Change first character */
 36          for (chr = word + 1; *chr != '\0'; chr++) /* Search */
 37                  if (*chr == *ptr) { /* for same letter */
 38                          *chr = temp; /* change to saved value */
 39                          break; /* to eliminate duplicates */
 40                  }
 41          if (*(ptr + 1) == '\0')
 42                  jumble(next_word, real_word);
 43          }
 44  }
$  □
```

FIGURE 2: continued

a. Changes to specify a local dictionary by default:

```
echo "Do you want to use a local dictionary? If so enter the name"
echo -n "or press RETURN for the default dictionary \"dict\": "
read localfile
if test -z "$localfile"; then
        localfile=dict
        echo "Using local dictionary file $localfile."
fi
touch $localfile
```

b. Changes to see the incorrect word in context:

```
echo "The word \"$word"\ appears to be misspelled."
echo -n "Do you want to see it in context (y or n)? "
read context
        if test "$context" = y; then
                echo
                grep $word $filelist
        fi
echo
```

c. Changes to prevent overwriting original file with empty temporary:

```
if test -s /tmp/$file; then
        mv /tmp/$file $file
fi
```

FIGURE 3: SUGGESTED IMPROVEMENTS TO `spellproofer`.

```
#!/bin/sh
# System-dependent mailer (change as necessary):
MAILER='Mail'
cmd=`basename $0`
if test $# -lt 2; then
        echo 1>&2 "Usage: $cmd login_name Your message"; exit 1
else
        you=$1; shift
fi
# For each terminal logged into write a message.
# If not logged in mail the message.
terminals=`who | sed -n '/ ^'$you' /s/ ^'$you' *`(tty[^]*`) .*/`1/p'`
if test -z ``$terminals''; then
        echo 1>&2 ``$cmd: $you not logged in; mailing your message."
        echo "$@" | $MAILER -s "Hey, $you!" $you
else
        for tty in $terminals
        do
                echo "Hey, $you: $@" | write $you $tty
        done
fi
```

FIGURE 4: LISTING OF THE hey SHELL SCRIPT

a. Command line format for using hey:

```
hey login-name message
```

b. Some examples for using hey:

```
$ (cc massive.c; a.out; hey me All done.)&
$ hey camille Please call when your meeting is over.
$ hey root "Help, we're out of printer paper."
$ □
```

c. Multiline message using the Bourne shell:

```
$ hey you 'This is
  a rather long message\
  continued
  over many lines.'
$ □
```

d. Multiline message using the C shell:

```
% hey you 'This is\
  a rather long message\
  continued\
  over many lines.'
% □
```

FIGURE 5: USING THE hey COMMAND

with the original script caused it to delete my source file if I made a correction that included a space, such as correcting "feltthat" to "felt that." In such a case, the sed program informs you "sed: command garbled: s/felt that/felt." Then, if you answer affirmative to the next query "Save corrections in "*input-file*" file (y or n)?", sed produces an empty file in /tmp. This is then copied back over the original—destroying it!

I made several other changes

that I found useful, including defaulting to using a local dictionary, allowing you to view suspected errors in context before making changes, and making the dialogue a little friendlier. Since you're sending a lot of garbage to the screen, you might as well make it readable.

Thanks for publishing the script. I'm surprised no one caught the bug. It lost me a few hours work—which I wasn't too happy about.

*Contributed by Tim O'Reilly*
*O'Reilly & Associates, Inc.*
*Newton, MA*

[*Doctor's notes*: Thank you for your suggestions. I'm sorry the "design bug" caused you problems. Your problem brings up a good point. We try to catch as many errors as possible, but time doesn't allow us to test every submission exhaustively. Basically, the programs and scripts are published "as is," so take due precautions. It's always a good idea, especially when testing new software, to back up your important file(s) before using the software.

I've reproduced portions of Mr. O'Reilly's improved `spellproofer` script in Figures 3A, 3B, and 3C. Substitute the code in Figure 3A for lines 9 and 10 in the original version to use a default local dictionary `dict`; append the code fragment in Figure 3B after line 17 to see the incorrect word in context; and to prevent overwriting the original file by an empty temporary file, replace line 40 in the original script by the code in Figure 3C.]

HEY(LOCAL) UNIX Programmer's Manual HEY(LOCAL)

**NAME**

hey - write to all terminals a given user is logged in to

**SYNOPSIS**

**hey** *person message*

**DESCRIPTION**

`Hey` writes the specified one-line *message* to all terminals that a given *person* is logged into. The message is sent via a one-line `write`(1) for ease of identification. If the specified recipient isn't logged in, the message is mailed.

Permission to write to a terminal is granted or denied by the `mesg`(1) command.

**EXAMPLES**

Assuming the sender's login name is `me` and the recipient's login name is `you`:

```
tar cv *; hey me Your tar is finished.
(incredibly-long-running-command; hey me all done)&
hey you Call home
hey root The line printer is out of paper.
```

Note that multi-line messages can be sent via newlines within quotes (from `/bin/sh`) as in:

```
hey you 'This
is spread across
a few lines.'
```

The same effect is possible from `csh` by typing a backslash (escaped newline) at the end of the message lines.

**DIAGNOSTICS**

"Permission denied" as printed by `write`(1) when the recipient's terminal is write-protected.

**SEE ALSO**

mesg(1), talk(1), wall(1), write(1)

**BUGS**

This command makes it easy for some people to be obnoxious.

FIGURE 6: MANUAL PAGE ENTRY FOR THE `hey` COMMAND.

## HEY YOU . . .

**Dear Dr. Thomas:**

It's not easy to send a message to a particular user if he/she is logged in to several terminals at once. The `wall`(1) command broadcasts the message to everyone on the system, which is like standing on your desk and shouting. The `write`(1) command is fine if you know which terminal the person is currently staring at, but that's not easy to figure out when the person is listed many times in the `who`(1) command output. (The same problem plagues the Berkeley `talk`(1) command.) You

want to get your message to the person no matter which terminal they're logged in to.

The `hey` Bourne shell script (listed in Figure 4) sends a message to every terminal that a specified user is logged in to. Typing "hey" with no arguments produces a command summary (see Figure 5A). Typical uses for `hey` are to announce when that long compiler job is finished, leave a reminder, or to grab someone's attention when there are problems (see Figure 5B).

The `hey` command sends its message via a selective one-line `write` to all terminals that the indicated user is logged in to. If the user isn't logged in, your message is dropped in the mail. Users can block messages mail. Users can block messages from `hey` just as they do with `write`(1) by using the `mesg`(1) command. Simply type "mesg n" to block any messages and "mesg y" to grant access again.

Multiline messages can be sent because the shell allows it. If you use the Bourne shell, a single quote at the beginning and end of the message will protect the embedded newlines. (Figure 5C shows an example.) If you use the C shell, you must precede the newlines by a backslash (\) *and* quote the message, as with the Bourne shell (see Figure 5D).

The script runs "as is" on a system that has Berkeley `Mail`. For other systems, initialize the `MAILER` variable to the name of the particular mail program.

[*Doctor's notes:* The Berkeley mailer recognizes the `-s` command line argument for indicating a subject. For versions that don't, omit the `-s "Hey, $you!"` argument. If terminal names on your system don't begin with `tty` then substitute `awk '{print $2}'` for the `sed` command.]

If any readers are interested in

a version of `hey` that can hunt a user down over a network of machines running 4.2BSD, send mail to my network address [see below] for a free copy of the network-version script and manual page. □

---

*Contributed by Bob Designer*
(ucbvax!hpda!bd)
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*Hewlett-Packard Co.*
*Cupertino, CA*

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"Wizard's Grabbag" is a regular feature of UNIX/WORLD. Submit your shell scripts, C programs, or tips and techniques that ease the burdens of system administrators and programmers to "Wizard's Grabbag," UNIX/WORLD, 444 Castro St., Suite 1220, Mountain View, CA 94041. Authors of published entries receive $50 for shell scripts, `awk` scripts, `sed` scripts, `lex`, `yacc`, and C programs, or tips.

Please follow these guidelines for reader contributions: Write your shell scripts, C programs, and other code so that it is portable across different versions of the Unix system. If possible, it should run without change on Bell Version 7, Systems III and V, and Berkeley 4.x. Thus, you should use "universal" Unix utilities such as `who am i` (all systems) in lieu of `whoami` (Berkeley only), and the Bourne shell, if possible, when coding shell scripts. However, C shell scripts are also welcome because most of our readers now have access to this popular command interpreter. Use the standard I/O library when writing C code.

In addition, use the lint syntax checker to eliminate nonportable constructions and compile the code with a portable C compiler such as `pcc` to help ensure portability. Hardware dependencies, such as terminal control sequences, should be eliminated or at least minimized and isolated to one code region or to a separate module. Keep your example as short as possible, say under 100 lines of code. □

# SIX MORE COMMON PROBLEMS

BY BILL TUTHILL

This is the second article of a two-part series intended to help new users solve problems they are likely to encounter on the Unix system. This month, I concentrate on system-related difficulties. On small computers, most users are system administrators as well, so this material applies to almost everyone.

## CORE DUMPS

The Unix system was designed for program development. As an engine to run applications, it sometimes falls short. For example, there is no easy way to disable the dumping of memory. When a program fails, the system writes an image of memory to disk. By looking at this file, programmers can determine why their programs failed. Before the days of metal-oxide semiconductor (MOS) memory, computers had large iron core memories; thus, the system refers to this process as a *core dump*.

Figure 1 indicates that the `dbedit` program failed because of a memory fault—probably the result of a wild pointer, or a subscript going off the end of an array. High-quality software should never core dump. Nonetheless, this kind of thing does happen because vendors don't always deliver high-quality software, so be prepared. This kind of behavior should be reported to the vendor of your Unix system. Table 1 gives a list of the most common reasons why a core dump appears.

On some systems, a memory fault is called a segmentation violation. If you see a core file lying around, but you didn't create it yourself, try to determine what program left it there. You can do this by running the debugger `adb` as shown in Figure 2.

More advanced versions of the debugger tell you which program dumped core; earlier versions have to be coaxed by giving cryptic incantations too esoteric to reproduce here.

## NO SPACE LEFT ON DEVICE

This message means that a disk partition is full. A physical disk drive is usually partitioned into separate file systems; if one file system fills up, the others still have free space, even though they may be on the same physical disk drive. Suppose you're writing an output file as shown in Figure 3. This means that the database report has filled up the `/tmp` file system. When this happens, the message in Figure 4 also should appear on the console.

The proper thing to do is list the `/tmp` directory, and remove unnecessary files, starting with the one you just created. Then there may be enough room to store your output file. If not, you'll need to use another file system with more space.

It is amazing that some software (such as the Version 7 `sort` program) fails to report when a file system is full. High-quality software should check frequently for read and write errors, and issue meaningful error messages whenever they occur.

| | |
|---|---|
| Quit | User typed a quit character (control-' is the default) |
| Illegal instruction | Attempt to execute non-existent machine instruction |
| Floating exception | Floating point: divide by zero, overflow, underflow |
| Bus error | Output to, or input from, non-existent device |
| Memory fault | Writing to, or reading from, protected area of memory |

TABLE 1: COMMON CAUSES OF CORE DUMPS

```
% dbedit -p attis
Memory fault (core dumped)
% □
```

FIGURE 1: NOTIFICATION THAT `dbedit` PROGRAM HAS FAILED

```
% adb core
core file = "core" / program = "dbedit"
```

FIGURE 2: RUNNING THE DEBUGGER `adb`

```
% repgen database > /tmp/report
/tmp: No space left on device
% □
```

FIGURE 3: SAMPLE OUTPUT FILE

```
/tmp: file system full
```

FIGURE 4: RESPONSE FROM FILESYSTEM

## SYSTEM CRASHES

Electrical glitches, such as power surges and dips, are the most common cause of Unix system crashes. Another common problem is the failure of disk drives, which are a weak link in today's computer technology. You can minimize hardware crashes by buying good hardware from reputable vendors. Software crashes, however, are almost a thing of the past, and well-maintained 4.2BSD and System V.2 machines seldom experience them.

After a system crash, many Unix systems automatically reboot (or restart) themselves. Those that don't must be given some simple instruction, such as `b` for `boot`. During rebooting, the system reads the `/etc/rc` file to initialize everything. Generally, one of the lines in this file calls the `fsck` program to check file system consistency, since after a system crash, some files may have become damaged. If a file system was damaged during a crash, `fsck` repairs the problems and starts over again. On well-

```
% freq chapter*
freq: Not enough core
%
```

FIGURE 5: NOTIFICATION OF PROGRAM FAILURE

```
% lemma dict.[a-z]
lemma: Too many open files
%
```

FIGURE 6: NOTIFICATION FROM `lemma` PROGRAM OF TOO MANY OPEN FILES.

```
% edit memo7734
:a
...
:w
edit: I/O error
:
```

FIGURE 7: I/O ERROR MESSAGE

established Unix systems, you shouldn't have to do anything but wait until `fsck` is finished.

## NOT ENOUGH MEMORY

Machines with 16-bit architectures, such as the IBM PC (based on the Intel 8088 chip), the Altos 586 (based on the Intel 8086 chip), or the Zilog (based on the Z8000 chip), impose a per-process limit of 64K (or in some cases 128K). Machines with 32-bit architectures, such as the VAX, or MC68000-based computers, also limit process size, but the limits are much higher. When a program runs out of memory, it fails, and the user will see on the screen something similar to Figure 5.

One solution is to run the program on smaller chunks of data, and then combine the results, but a better solution is to buy a machine with a 32-bit architecture.

Note that a single process running out of memory is different from having too little memory on your computer. Unix systems are typically configured with between half a megabyte and four megabytes of memory. Unless you have virtual memory (as does 4.2BSD), per-process memory never exceeds the machine's memory. However, with many users on the system, performance degrades when all users together take up all available memory. Then, processes have to be swapped between memory and disk. You can recognize this situation when the system behaves sluggishly and programs freeze in mid-stream. Buying more memory is the easiest way to solve this problem.

## MANY OPEN FILES

Some programs need to open lots of files for reading and writing. Most Unix systems impose a per-process limit of 20 simultaneously open files. Some vendors of 4.2BSD systems have raised this limit to 30. Suppose you are trying to lemmatize a dictionary organized into 26 separate files; unfortunately, the `lemma` program complains because you give it more than 20 files (Figure 6).

On systems with the higher limit of 30 open files, this program would succeed. Otherwise, you have to collapse letters such as WXYZ into a single file, until you fall below the limit of 20.

## I/O ERROR

An I/O (input/output) error is one of the most serious problems you can have: It means that a disk or tape is bad. If you are writing a tape, just change tapes and hope the new one works better. If you are reading a tape, try using a different tape drive, if you can find one. Sometimes tapes are totally unreadable, in which case you have to throw them away and ask whoever sent the first one to send another tape.

With physical disk I/O errors, things are worse. Suppose you are composing a memo, but when you write it to disk, the system gives you an I/O error message. This means your disk drive is failing. Before you panic, write the file to a file system on another disk drive, if you have one. The disk may simply be too warm—if so, point the air conditioner at it. Some dust may have gotten inside—try blowing it out with a fan.

The very first I/O error is a sign that you should replace a disk. You may not be able to afford a new one right now; but in the long run, a new disk saves both time and money.

---

*Bill Tuthill, a member of the technical staff at Sun Microsystems (Mountain View, Calif.), was previously a systems analyst at Imagen Corp, and a programmer at UC Berkeley.*

# CALENDAR

**C Programming Language** September 30–October 11, Cincinnati, Ohio. Contact Information Technology Development Corporation, 513/741-8968.

**CSI's Fall SNA Seminar** October 1–3, St. Louis, Mo. Contact Bob Walsh, 408/725-1568.

**Computer Graphics** October 1–4, Los Angeles, Calif. Contact Ruth Dordick, ICS, 800/421-8166 (outside Calif.), 800/352-8251 (inside Calif.), 800/267-7014 (from Canada).

**Software Requirements, Specifications & Tests** October 1–4, Los Angeles, Calif. Contact Ruth Dordick, ICS, 800/421-8166 (outside Calif.), 800/352-8251 (inside Calif.), 800/267-7014 (from Canada).

**Evaluation of Unix and the Unix Marketplace:** October 2–3, Boston, Mass. Contact Center for Advanced Professional Education, 714/261-0240.

**Unix Systems Expo '85** October 2–5, Boston, Mass. Contact Bill Littlefield, 800/826-2680.

**Evaluation of Unix and the Unix Marketplace:** October 7–8, Atlanta, Ga. Contact Center for Advanced Professional Education, 714/261-0240.

**Office Automation:** October 7–9, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

**C Programming Workshop:** October 21–25, New York, N.Y. Contact Suzanne B. Battista, Plum Hall Inc., 609/927-3770.

**Real Time Software Design:** October 8–11, Los Angeles, Calif. Contact Ruth Dordick, ICS, 800/421-8166 (outside Calif.), 800/352-8251 (inside Calif.), 800/267-7014 (from Canada).

**Introduction to C for Programmers:** October 10, Palo Alto, Calif. Contact Ray Swartz, Berkeley Decision/Systems, 408/458-0500.

**Advanced C Topics Seminar:** October 14–18, Absecon, N.J. Contact Suzanne B. Battista, Plum Hall Inc., 609/927-3770.

**Unix for End Users:** October 14–18, Cincinnati, Ohio. Contact Information Technology Development Corp., 513/741-8968.

**C Language Fundamentals:** October 15–17, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

**Great Southern Computer & Electronics Show:** October 18–20, Orlando, Fla. Contact Great Southern Shows, 904/743-8000.

**Unix System Concepts and Facilities:** October 21–24, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

**Informix:** Relational Data Base October 21–25, Cincinnati, Ohio. Contact ITDC, 513/741-8968.

**Semicon/Southwest:** October 22–24, Dallas, T.X. Contact Cindy Seramy, 415/964-511.

**Unix: A Comprehensive Introduction:** October 22–25, Boston, Mass. Contact Ruth Dordick, ICS, 800/421-8166 (outside Calif.), 800/

*Continued on page 106*

# AT&T's SYSTEM V INTERFACE DEFINITION

*AT&T System V Interface Definition*
Issue 1 by D. E. Kevorkian

AVAILABLE THROUGH AT&T,
343 PAGES, $37.00

REVIEWED BY
IRENE PASTERNACK

The *AT&T System V Interface Definition* is written for applications programmers writing in C. There are many ports of Unix System V on the market, each of which has slight variations in the interface between the C language and the operating system. This book begins the process of defining a standard interface for Unix System V services, error conditions, signals, library routines, header files, utilities, environment variables, data files, directory structure, and device files, so that new applications can be moved to any System V port.

One issue can't cover all the details: The Unix system is just too big, and is continuously evolving. The *AT&T System V Interface Definition* is designed to be a series. The next issue should be out by the end of 1985, and will contain all of Issue 1, as well as corrections and details on the extensions. AT&T intends to publish new issues as new releases of System V are made available.

## HOW THE BOOK IS ORGANIZED

The first issue of the interface definition contains five sections: An introduction to the interface definition, the basic System V interface for applications programs, extensions to the kernel, other planned extensions, and future directions. The appendices form the meat of the book, providing the details for each of the five main sections. They begin on page 43 of a 343 page book.

The main portion of the appendices describes the source code interface and run-time behavior of each component of the base interface definition, including operating system services and other library routines. Other appendices include a detailed comparison of the System V interface standard to the 1984 /usr/group standard, lists of implementation specific constants, signals, and error return conditions, a short glossary, an index of routines, syntax and error message standards, and details on each header file and its impact on the base standard and the kernel extensions.

The appendix on how System V differs from the /usr/group standard covers all the details, including the steps that are being taken to bring the two closer together. Differences are divided into three categories: those which will not be changed by AT&T, those that will be changed to come closer to or meet the /usr/group standard, and functions that are part of the /usr/group standard but will never be part of AT&T's standard.

## WHAT IS THE STANDARD?

The System V interface standard is divided into two parts, a base standard which covers services provided by all System V environments, and a standard for optional extensions.

**REVIEW HIGHLIGHTS**

- **Reference manual rather than a book.**
- **Highly recommended for programmers writing in C.**
- **Not recommended for the Unix system beginners.**

AT&T has divided the extensions into nine categories: Basic Utilities: (includes `cat`, `date`, `echo`, `ed`, `ls`, `pwd`, `rm...`); Software Development: (includes `cc`, `lint`, `sdb`, `time...`); Network Services: (not yet defined); Large Machine: (`cron`, `init`, `fsck`, `mount`, `sync`, accounting programs `...`); Graphics: (`ged`, `graph`, `sin`, `tplot..`); and Data Base Manager: (not yet defined).

These extensions are not required to meet the base definition of standard System V, but if they are used, a standard is provided. Issue 1 covers the base standard in detail, and covers the extensions in seven pages. The extensions will be covered in detail in future issues.

The *System V Interface Definition* is definitely a reference manual, rather than a book. The details on each component of the interface are presented in a similar format to the typical *Unix Reference Manual:* one command per page, with the "Name," "Synopsis," "Description," and "See Also" sections.

AT&T made some minor modifications to the titles of the sections, however. The old "Bugs" and "Warnings" have been combined into a new expanded category called "Applications Usage," which is a more practical list of things to watch out for, along with the preferred usages. The information on errors and return values have been listed under "Errors" and "Return Value", making them easier to pick out.

The last category, "Level" documents which items may change in the future and which are guaranteed to stay the same. AT&T's "commitment" level is specified as a "1" or a "2." If it is level 1, the item will always remain in the definition; if level 2, the item will remain in the definition for at least three years.

The "Applications Usage" category does a good job of pointing out the subtler differences between the

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Readers who have computer merchandise or services to sell, buy, or trade and want to be included as a classified Advertiser in UNIX/WORLD Magazine should write to: Advertising Department, Tech Valley Publishing, 444 Castro Street. Suite 1220, Mountain View, CA 94041. 415/940-1500. The rate for the classified section is $12 per line. The deadline for ads is the 20th of the 2nd month prior to publication. Please include complete name and address in every ad.

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# TRAINING CALENDAR

*Continued from page 104*

352-8251 (inside Calif.), 800/267-7014 (from Canada).

**Mini/Micro Northwest—'85:** October 22–24, Portland, Ore. Contact Roberta Hansen, 213/772-2965.

**C Programming Workshop:** October 7–11, Absecon, N.J. Contact Suzanne B. Battista, Plum Hall Inc., 609/927-3770.

**Unix for Users, Including Shell Programming:** October 21–23, Palo Alto, Calif. Contact AIQR, Computer Software Division, 408/978-2911.

**Evaluation of Unix and the Unix Marketplace:** October 23–24, San Jose, Calif. Contact Center for Advanced Professional Education, 714/261-0240.

**Programming the Unix Shell:** October 24, Palo Alto, Calif. Contact Ray Swartz, Berkeley Decision/Systems, 408/458-0500.

**Advanced C Programming:** October 28–31, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

**Advanced Shell Programming and AWK:** October 31, Palo Alto, Calif. Contact Ray Swartz, Berkeley Decision/Systems, 408/458-0500.

**Office Automation** October 7–9, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

**Real Time Software Design** October 8–11, Los Angeles, Calif. Contact Ruth Dordick, ICS, 800/421-8166 (outside Calif.), 800/352-8251 (inside Calif.), 800/267-7014 (from Canada).

**Unix for End Users** October 14–18, Cincinnati, Ohio. Contact Information Technology Development Corp., 513/741-8968.

*Continued on page 108*

standard and what a System V programmer might be used to. It directs programmers to preferred functions, such as standard input/output `stdio` routines rather than `open, close, creat...`

You may think from the description that the *System Interface Definition* is little more than Volumes 2 and 3 of the standard *Programmer's Reference Manual,* but don't be fooled by the similar format. The information on portability and future directions of System V cannot be found anywhere else.

This book reflects AT&T's commitment to standardize System V, and, most importantly, to making the information easily available to programmers. As the Unix system usage continues to increase, the role of AT&T in standardization becomes even more important.

My only complaints are cosmetic:Though the book was typeset on the Autologic, Inc. APS-5 typesetter, it looks more like it was done on a laser printer. You will find the usual amount of typos expected in the first publication of a major reference manual.

The book would be more usable if a permuted index were included in addition to the table of contents. A brief index to system calls and library routines is buried in the middle of the book, but until you have used the book for a while, it is hard to know where to look. The authors have received so much feedback about this, that a new and more complete index is planned for the next issue.

So if you're writing programs you want to be portable to other System V implementations, this book and the upcoming issues are indispensable. If not, it will just be another unused manual on your shelf. □

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*Irene Pasternack is the director of Specialized System Consultants, Inc. She teaches seminars, writes Unix system pocket references, and is chairman of the Seattle Unix system user group board.*

*Continued from page 106*

**C Language Fundamentals** October 15–17, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

**Great Southern Computer & Electronics Show** October 18–20, Orlando, Fla. Contact Great Southern Shows, 904/743-8000.

**Unix System Concepts and Facilities** October 21–24, New York, N.Y. Contact Alice Moss, Lucid, 212/807-9444.

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**Semicon/Southwest** October 22–24, Dallas, T.X. Contact Cindy Seramy, 415/964-511.

**Unix: A Comprehensive Introduction** October 22–25, Boston, Mass. Contact Ruth Dordick, ICS, 800/421-8166 (outside Calif.), 800/352-8251 (inside Calif.), 800/267-7014 (from Canada).

**Mini/Micro Northwest—'85** October 22–24, Portland, Ore. Contact Roberta Hansen, 213/772-2965.

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To further the education of Unix systems users and professionals, Unix/World each month provides a calendar of events as a service to our readers. Please send information about your seminar, trade show, or course to Calendar Editor, Unix/World Magazine, 444 Castro St., Suite 1220, Mountain View, CA 94041. All items should include a title, a brief description of the course, seminar, or trade show, the date of the event, the city and state where it will be held, the name of the sponsoring company or organization, and an address and phone number for further information. Please submit all items at least four months in advance. □

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*Continued from page 110*

Given that some computer lingo can be confusing even to our co-workers, it doesn't take too much imagination to realize what such terms must sound like when they're used without explanation to people outside our field! Avoiding the use of lingo in certain situations may seem cumbersome and time-consuming, but sometimes it's the best course. Part of the reason that the "outside" world sees computer professionals as being largely a confusing and at best unapproachable "technical priesthood" is our sometimes extreme reliance on acronyms and other lingo—which is perceived (with some justification) more widespread than in many other professions.

So gang, though the temptation to use lingo here, there, and everywhere may be ever-present, we should resist it—and try instead to limit our use of jargon to "appropriate" situations. If it's *really* necessary to use lingo in conversations with laymen, special effort should be made to explain our terminology for their benefit. True, in some situations it can be a hassle to avoid using our favorite lingo, but in the long run it's an effort that can be well worthwhile. □

```
--Lauren--
UUCP: {ihnp4, decvax,
       seismo, clyde,
       bonnie}
       !vortex!lauren
```

*Lauren Weinstein is a computer/telecommunications consultant living in Los Angeles. He has been involved in an array of projects that range from the mundane to the bizarre. He has particular expertise in the fields of computer networking, the Unix system, microcomputer technology, and telecommunications systems.*

# LOST IN LINGO?

BY LAUREN WEINSTEIN


Lingo. We see and hear it everyday. Most every technical field, from plumbing to medicine, has its own. While the "layman" may dislike wading through the unknown vocabulary that professionals in a given field may use, lingo can serve a useful purpose by allowing workers in a particular profession to streamline their communications through the use of linguistic shortcuts.

But as with almost anything else, it's possible to take things too far. Lingo can sometimes become an impediment, rather than an aid, to the accomplishment of particular tasks. One field that certainly has more than its own share of lingo is computer science/business—we create new jargon at the drop of the proverbial hat. And of course, those of us who work with Unix and Unix-like systems have our own set of lingo that we've added to the fray. Let's look at just a few of the more popular computer-oriented terms with which we frequently deal, in no particular order . . .

***boot*** —One of the many more "fundamental" descriptive terms we've borrowed for our own use. "Booting" the system, of course, is to get it started. The image of a good swift kick is quite apt, and sometimes helps with miscellaneous hardware problems as well.

***kernel***—Not to be confused with "kernal" or "colonel." Frequently misspelled. The kernel is that part of the overall system that provides the fundamental hardware and software management services to user applications programs. It is often used somewhat interchangeably with the term "operating system."

***foo***—Wouldn't you like to have a nickel for every time you've heard someone ask where this term comes from? "Foo" is short for "foobar," of course! Which explains the popular query/response "foo? . . . bar." The term "Foobar" itself is a "sanitized" spelling of the acronym "FUBAR," made popular during World War II. It stood for "F**ked Up Beyond All Recognition," though some persons use the phrase "Fouled Up" to explain the first two words of the acronym, rather than the other, more correct (historically at least) "F" word.

***core***—A popular term still often used to describe the main memory of a computer. Today, as we all know, most computer memory is semiconductor ("solid state") in nature. "Core" refers to the little magnetic doughnuts that were used as a primary storage medium before semiconductor chip-based memory was developed and became both practical and affordable. I still remember the classes where they taught about the "X," "Y," and "sense" lines of real core memory and how they worked, knowledge that's now about as obsolete as slide rules. Anyway, the term "core" is still heavily used, particularly by "old timers" in the computer world. One of its most common appearances continues to be the popular and frequently seen phrase "Core dumped."

***dump***—In general, it means just what it sounds like—to get data out of the computer in some manner. One common operation associated with this term is the "dumping" of data for visual inspection by a human (as in "octal dump"). Another typical usage is in the "dumping" of a system for backup purposes to tape—known, logically enough, as "taking a dump" of the system. OK, settle down out there. I didn't invent these terms, so don't blame me!

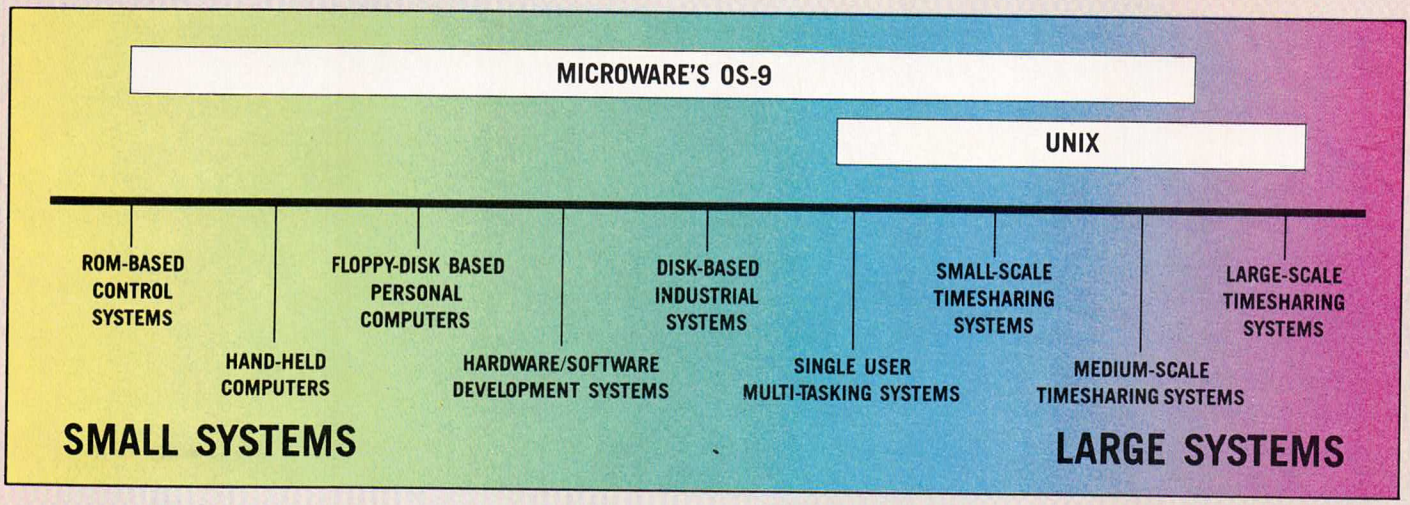
Obviously, we could go on almost indefinitely with more terms . . . our field has got a million of 'em. The important thing to keep in mind is that though these terms have a definite meaning for most of us working in this area, people outside our field cannot be expected to understand what we're talking about if we let such vocabulary creep into our conversations. I've heard computer people respond to bad news with a loud "FOO!"—completely confusing the poor person at the other end of the phone, who wasn't sure whether or not they had just been insulted!

The "moral" here is pretty clear. It's usually OK to throw around some jargon when talking to people in our own field whom we know already are familiar with such terms. But we can easily overdo it, especially when we get into the very specialized terminology of, say, computer hardware or other rather comparatively "esoteric" aspects of our work.

For example, overusing lingo while discussing the technical specifics of computer networking with someone who works with computers but who is not a networking specialist can cause obvious problems. Terms such as RS-232 and TCP (their definitions are left as an exercise for the reader) are totally clear to many of us, but we can't expect that everyone working with computers will have been exposed to the same level of acronym and vocabulary madness that pervades some areas of our community.

*Continued on page 109*

# Only Microware's OS-9 Operating System Covers the Entire 68000 Spectrum




**Is complicated software and expensive hardware keeping you back from Unix?** Look into OS-9, the operating system from Microware that gives 68000 systems a Unix-style environment with much less overhead and complexity.

OS-9 is versatile, inexpensive, and delivers outstanding performance on any size system. The OS-9 executive is much smaller and far more efficient than Unix because it's written in fast, compact assembly language, making it ideal for critical real-time applications. OS-9 can run on a broad range of 8 to 32 bit systems based on the 68000 or 6809 family MPUs from ROM-based industrial controllers up to large multiuser systems.

### OS-9'S OUTSTANDING C COMPILER IS YOUR BRIDGE TO UNIX

Microware's C compiler technology is another OS-9 advantage. The compiler produces extremely fast, compact, and ROMable code. You can easily develop and port system or application software back and forth to standard Unix systems. Cross-compiler versions for VAX and PDP-11 make coordinated Unix/OS-9 software development a pleasure.

### SUPPORT FOR MODULAR SOFTWARE — AN OS-9 EXCLUSIVE

Comprehensive support for modular software puts OS-9 a generation ahead of other operating systems. It multiplies programmer productivity and memory efficiency. Application software can be built from individually testable software modules including standard "library" modules. The modular structure lets you customize and reconfigure OS-9 for specific hardware easily and quickly.

### A SYSTEM WITH A PROVEN TRACK RECORD

Once an underground classic, OS-9 is now a solid hit. Since 1980 OS-9 has been ported to over a hundred 6809 and 68000 systems under license to some of the biggest names in the business. OS-9 has been imbedded in numerous consumer, industrial, and OEM products, and is supported by many independent software suppliers.

### Key OS-9 Features At A Glance

- Compact (16K) ROMable executive written in assembly language
- User "shell" and complete utility set written in C
- C-source code level compatibility with Unix
- Full Multitasking/multiuser capabilities
- Modular design - extremely easy to adapt, modify, or expand
- Unix-type tree structured file system
- Rugged "crash-proof" file structure with record locking
- Works well with floppy disk or ROM-based systems
- Uses hardware or software memory management
- High performance C, Pascal, Basic and Cobol compilers

microware®

OS-9™

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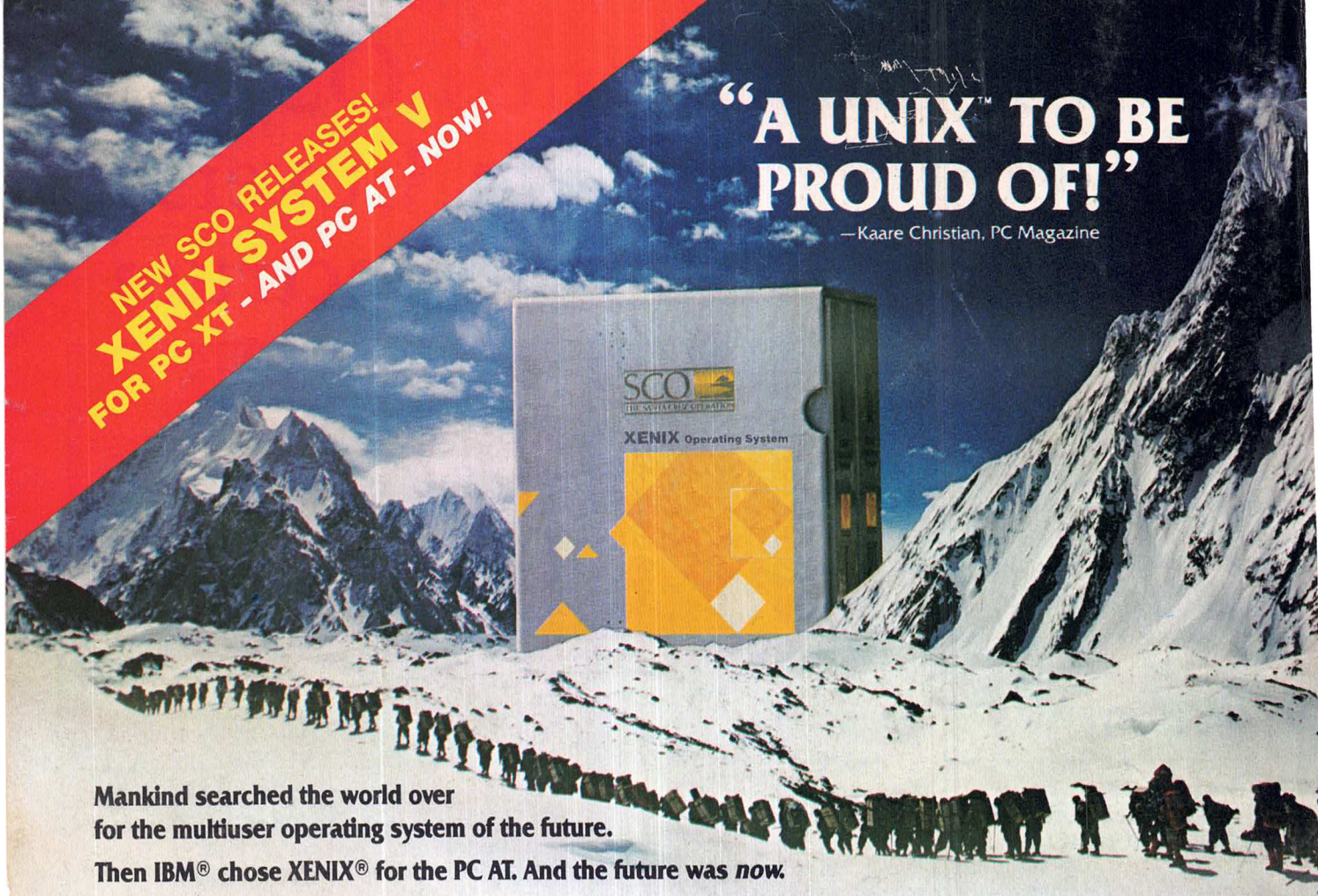


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