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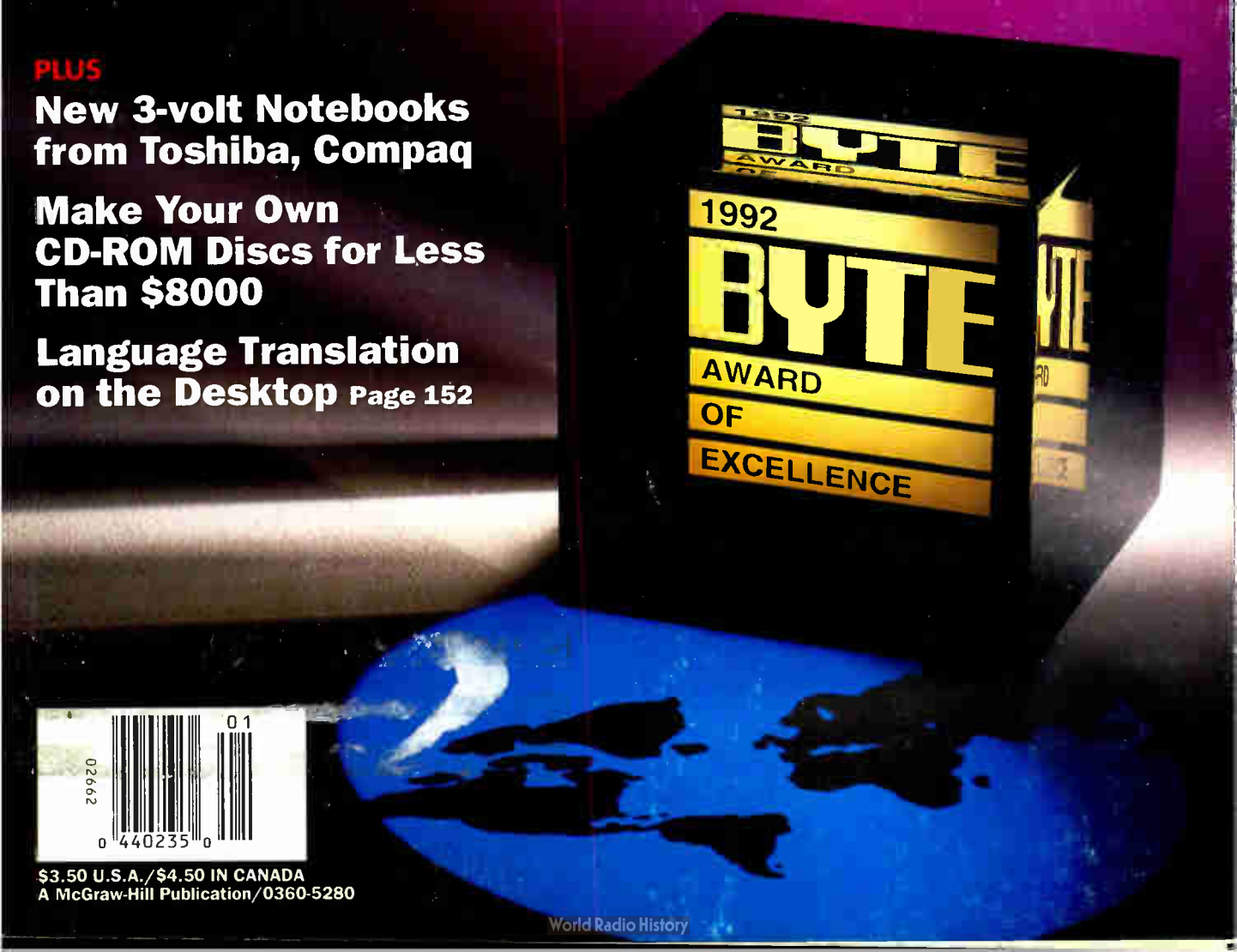

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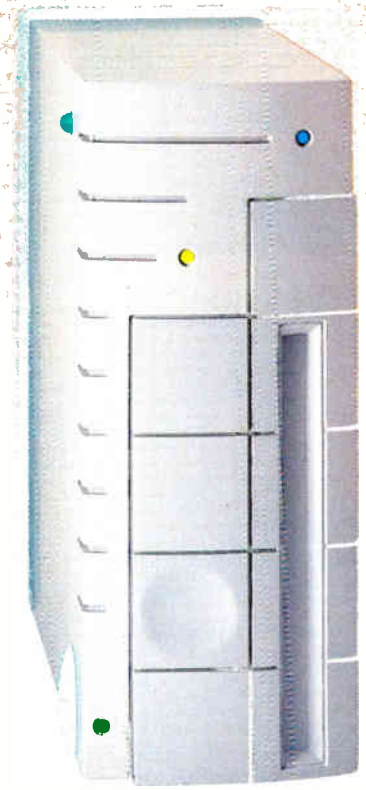

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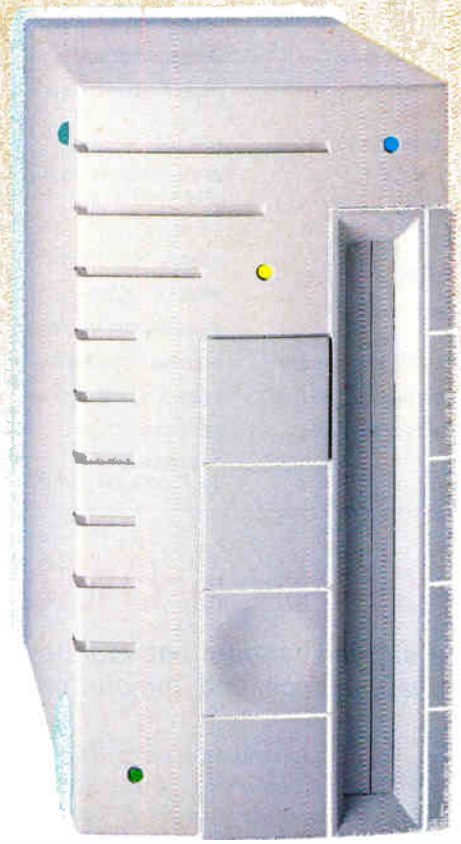

Type: 5.25" Optical
Capacity: 650 MB
Size: 7.3" (H) x [illegible] x [illegible]
Weight: 7 lbs
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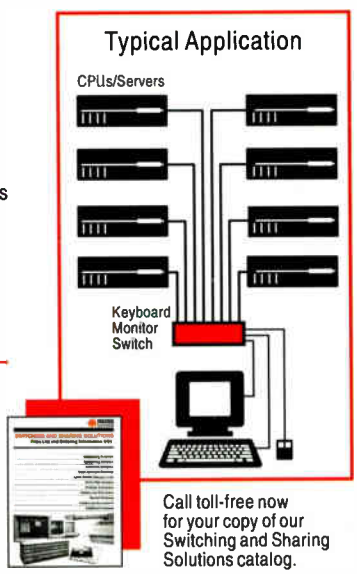

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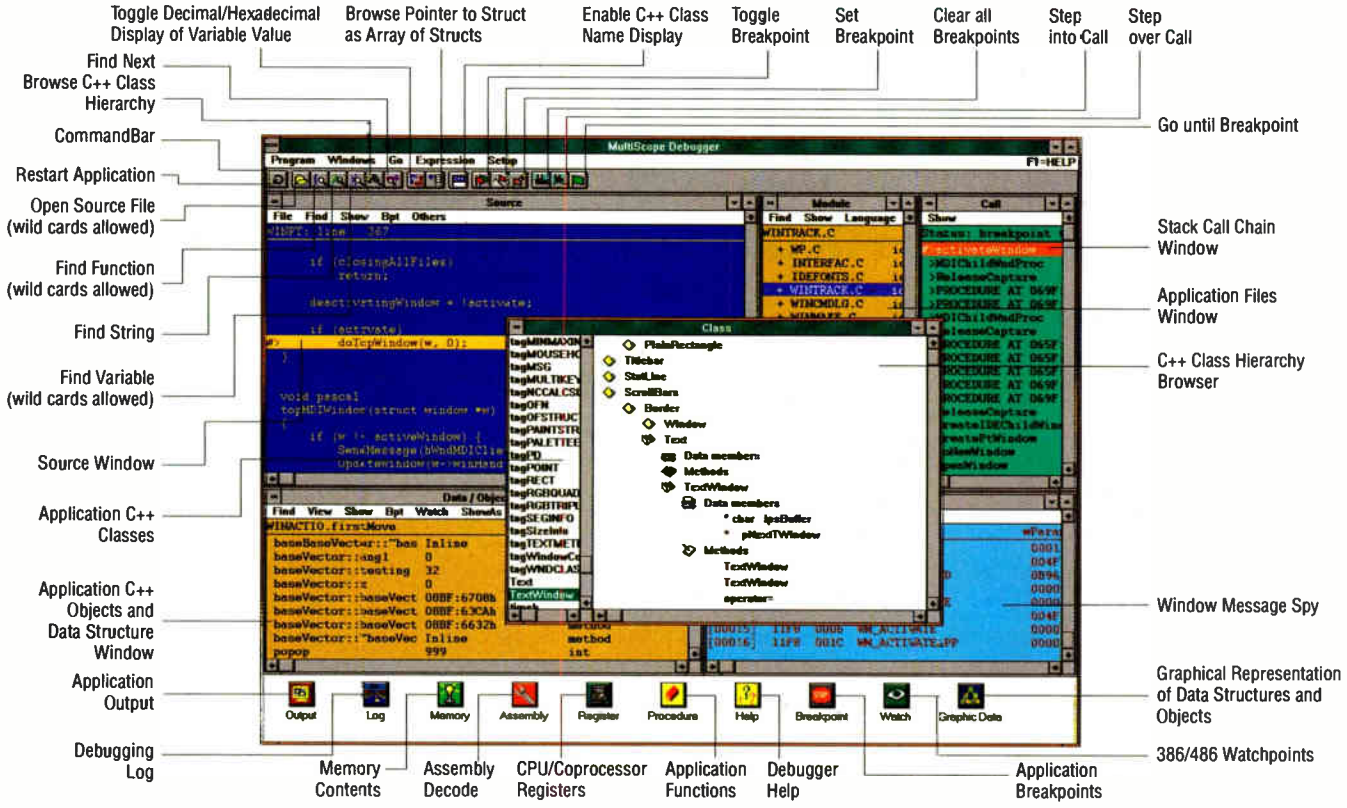
WINDOWS DEBUGGERS DOC/C++.



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EDITORIAL

DENNIS ALLEN

1993

While this issue of BYTE officially names the best products and technologies of 1992, I'd like to look ahead at what 1993 holds in store.

Two hot technology areas in which we'll see a lot of activity are local-bus adapters and PCMCIA cards. By mid-1993, nearly all high-end systems will include fast local-bus video, and by the end of the year, non-local-bus video cards will virtually be things of the past. Soon afterward, we'll see a sizable number of local-bus adapters speeding up tasks other than fast video.

1993's hot technologies will include local-bus adapters and credit-card-size hard disks

In the meantime, PCMCIA cards—those little credit-card-size devices that you may have seen on notebook computers—will make their way to mainstream desktop systems. Already IBM has shown its Energy Desktop PC, which accepts four PCMCIA cards. Because of their convenient size, which makes them easy to insert into an external slot, PCMCIA cards may spell the beginning of the end of traditional internal expansion boards. For 1993, though, the biggest thing in PCMCIA cards will be tiny, removable hard disks. Expect to see several notebook computers with 60- to 120-MB hard disks on removable PCMCIA cards by March.

Another exciting area for hardware will be mobile computing. In 1993, a notebook computer with an active-matrix color display may actually become affordable. Or, if you're willing to forgo the color, you'll be able to buy an easy-to-carry 486-based subnotebook for $2000 (and maybe less). If you're into exotic systems, PDAs (Personal Digital Assistants) will make their debut. Apple may have raised expectations too high with the promise of its Newton, but check out the Personal Communicator from EO and AT&T—it's very clever. Moreover, the EO Personal Communicator raises the bar for other pen-input systems.

Also important will be the Intel Pentium microprocessor (previously known as the P5 or 586). You can expect to see some fast—and expensive—desktop systems using the Pentium in 1993, but that's not where it will have the greatest impact: Where this new CPU will really make its mark is in the file-server arena. For the desktop, expect to see more clock-doubling technology in the form of very high-speed 486 chips.

You'll hear more about non-Intel CPUs, too. The ongoing hardware price war is forcing several PC makers to look for alternative CPUs whose price/performance ratios can beat those of Intel's chips. Cyrix, AMD, and other Intel rivals will take advantage of this window of opportunity, so you should see some new and interesting non-Intel CPU offerings that will compete directly with the Intel 486.

As the hardware price war rages, the applications software industry will join the battle. At the end of 1992, we witnessed Microsoft offering its Access database program at an introductory price of $99. Well, there'll be plenty more bargains like that one. As many software makers reach the limit of what they can add to existing products to justify high prices in a competitive market (consider the latest CorelDraw, for example), they will have no choice but to lower prices (as Corel did). Remember all that money you put into the budget for applications software this year? You'll be able to buy a lot more applications with it.

Operating systems, on the other hand, may be just as confusing as ever. Yes, you can expect to see Windows NT sometime in 1993, but once it's available we'll have to answer the bigger questions of where it fits and whether it was worth the wait. There will be a lot of talk and a lot of coverage of NT, Unix, OS/2, Mac OS, Windows, and Desqview, to name a few. By year's end, however, we will consider most of the debate as strategic planning for 1994. When 1993 is done, the only real change in operating systems will be in continued migration from plain DOS to Windows.

Finally, I see 1993 as the year of the document. With Adobe's recent introduction of Acrobat, a portable document-encoding format, we at last have a sensible way to exchange electronic documents. Adobe's Acrobat will have as profound an impact on documents as PostScript had on desktop publishing. If rumors hold true, though, Acrobat may have some stiff competition from as-yet-undisclosed features of Xerox's PaperWorks. Either way, add in low-cost CD-ROM drives and affordable (less than $8000) CD-ROM recorders, and you can see how in 1993 we may move pretty close to the ideal of the electronic office.

—Dennis Allen
Editor in Chief

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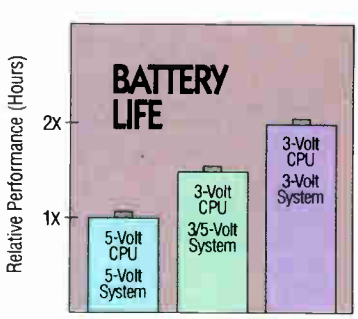

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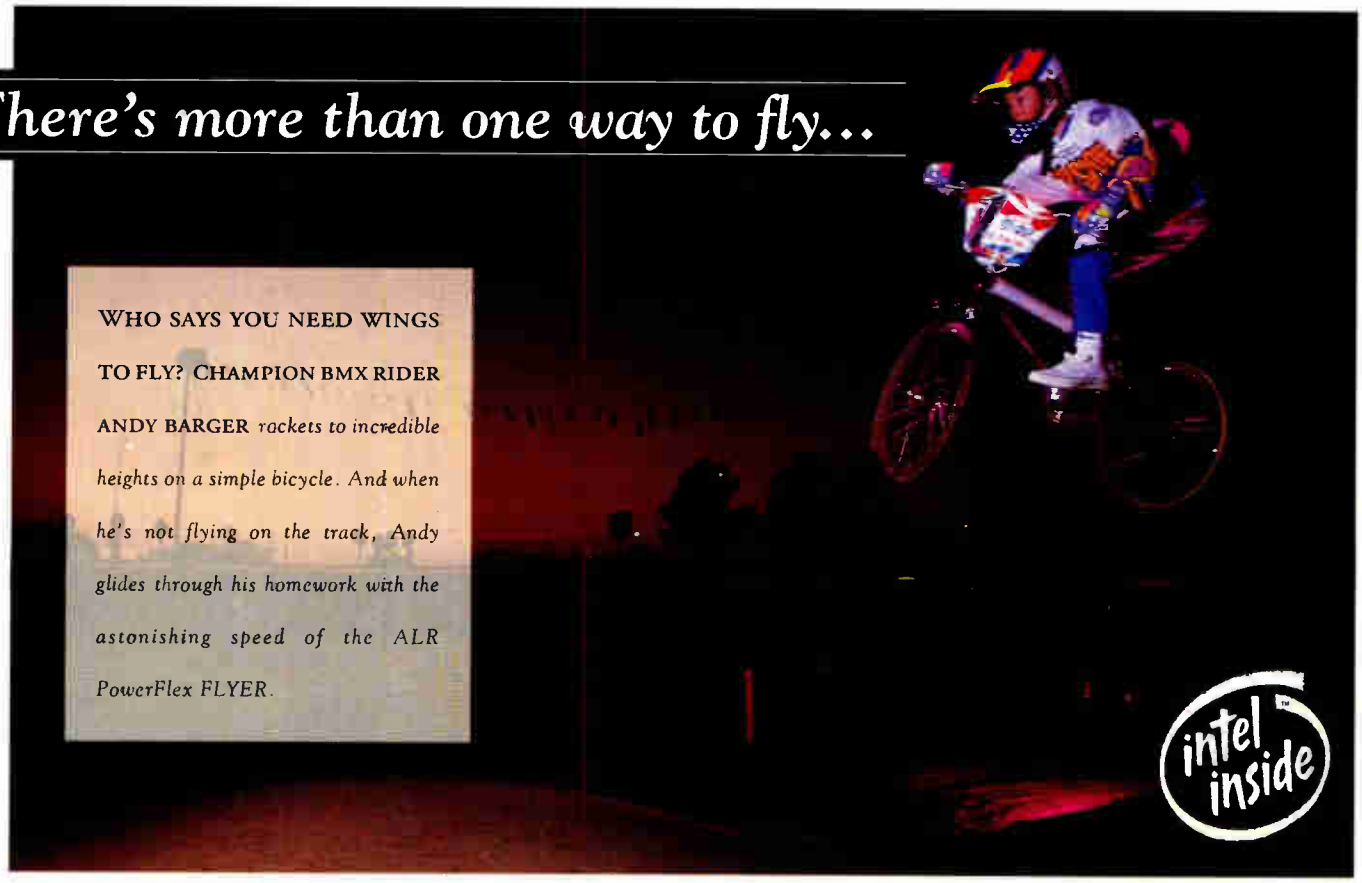

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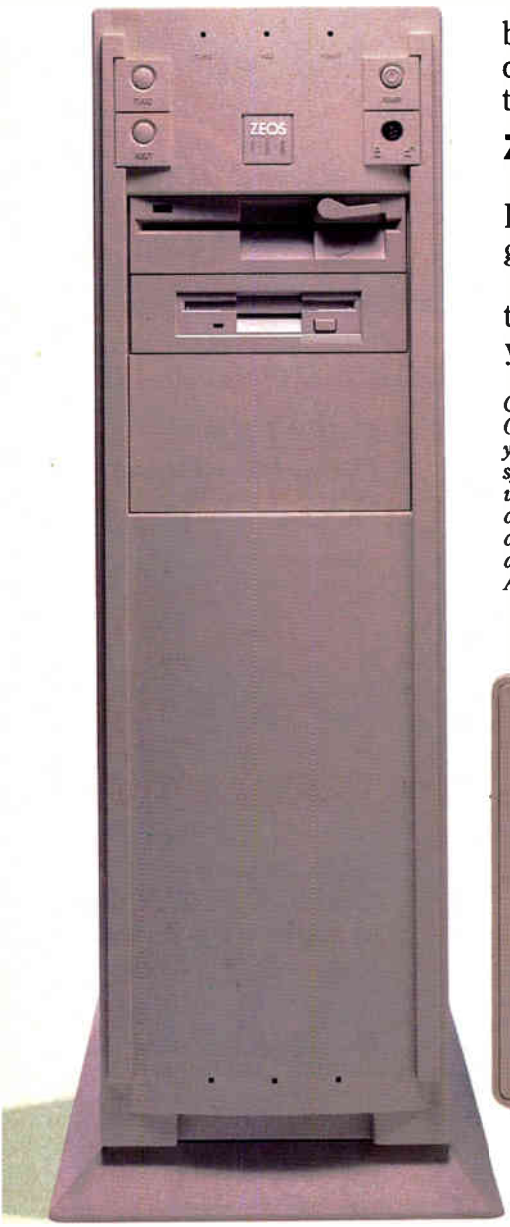

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LETTERS

Parshall Credit

I found James Parshall's Some Assembly Required article ("Mac OOP Explained," October 1992) quite helpful. I have been using the Think C version of the Think Class Library for a few months, and I'm just starting to feel comfortable with it. I particularly liked the emphasis on data (instance variables) and how it is manipulated within a class.

John Kordybac
Calgary, Canada

Land of the Double Byte

T. R. Reid's observations on the Japanese computer environment in the Report from Tokyo ("In the Land of the Double Byte," October 1992) are basically correct, but the comment from his Japanese friend who said using a computer to write a story is too slow is unbelievable. His comment was valid when NEC's 8088-based PC-9801 appeared in 1982, but not today, when most Japanese PCs are equipped with a 386SX or faster processor.

It is true that most Japanese journalists don't use a laptop computer or even a Wah-Puro. (The name is an abbreviation of the phrase "wah-doe purosessah," the Japanese pronunciation of "word processor.") However, this is because a mental barrier prevents reporters from using a computer. Many friends of mine testify that writing by computer has accelerated their writing speed by two or three times.

Also, the most common operating system in Japan is not DOS/V, but NEC's MS-DOS, which runs on the PC-9801 series (and is incompatible with the IBM PC). American software houses don't bother to spend much money to analyze such closed architectures. The language barrier matters to some extent, but the difference in computer architecture is a far more serious obstacle for foreign software houses.

Enomoto Makoto
Saitama, Japan

Presidential Brouhaha

I am disturbed by Dennis Allen's endorsement of George Bush in the October editorial titled "Open Markets, Better Computers." Allen's remarks can be faulted on a number of grounds. If he is so concerned about R&D budgets, why does he say nothing about the drastic decline in both private-sector and total R&D expenditures during the Bush administration?

But more important, this kind of politicking has no place in BYTE. Allen may believe sincerely that reelecting Bush will be the best thing for computer users and for the country and that one-sentence descriptions of the candidates' positions on world markets are all we need to know to decide how to vote. But I read BYTE for information about computers, not for Allen's political views, and I find their intrusion into the magazine offensive.

I will seek advice about how to cast my vote from other sources that take a broader and more informed view, and I will certainly cancel my subscription to BYTE if it continues to endorse political candidates.

George Avrunin
Amherst, MA

Gee, nice timing...a little commercial message, "Vote for George Bush," appeared in the October editorial. By the time there can be any balancing response, say the printing of this letter, the election will be over.

Robert Lynch
Berkeley, CA

It is ironic that I read Dennis Allen's October editorial on the day after hearing an announcement that the leaders of numerous high-technology companies, including John Sculley of Apple, support Governor Clinton for president. Would Allen have us believe that Sculley hopes to see the computer industry take a nosedive during the next five years? I think not.

Robert M. Luzenski
Haslett, MI

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Internet Plug

Daniel Dern's "Plugging Into the Internet" (October 1992) is very timely, and I hope that you expand your coverage of the Internet. We can use all the Internet information we can get our hands on.

My compliments to Dern for his excellent article.

T. Pat Kelly
Atlanta, GA

Hidden Requirement

Othar Hansson's review of Microsoft C/C++ 7.0 (or C7) ("Microsoft's Lucky Number," September 1992) failed to mention a significant drawback: the requirement for a DPMI (DOS Protected Mode Interface) manager. This isn't mentioned in Microsoft's ads, nor in the company's upgrade information. Microsoft bundles 386Max with C7 as a partial remedy for those programmers who don't choose to run under Windows.

When I substituted 386Max for QEMM386, some of my Desqview windows stopped working, and some of Microsoft's own programs, such as Profile, wouldn't work either.

It's bad for any product to require a total revamping of a user's system. It's worse for Microsoft to try to rope users into running Windows just to get C7 going. It's still worse for the company to provide a less-than-adequate product as a workaround.

Robert L. Wears
Jacksonville, FL

World Radio History

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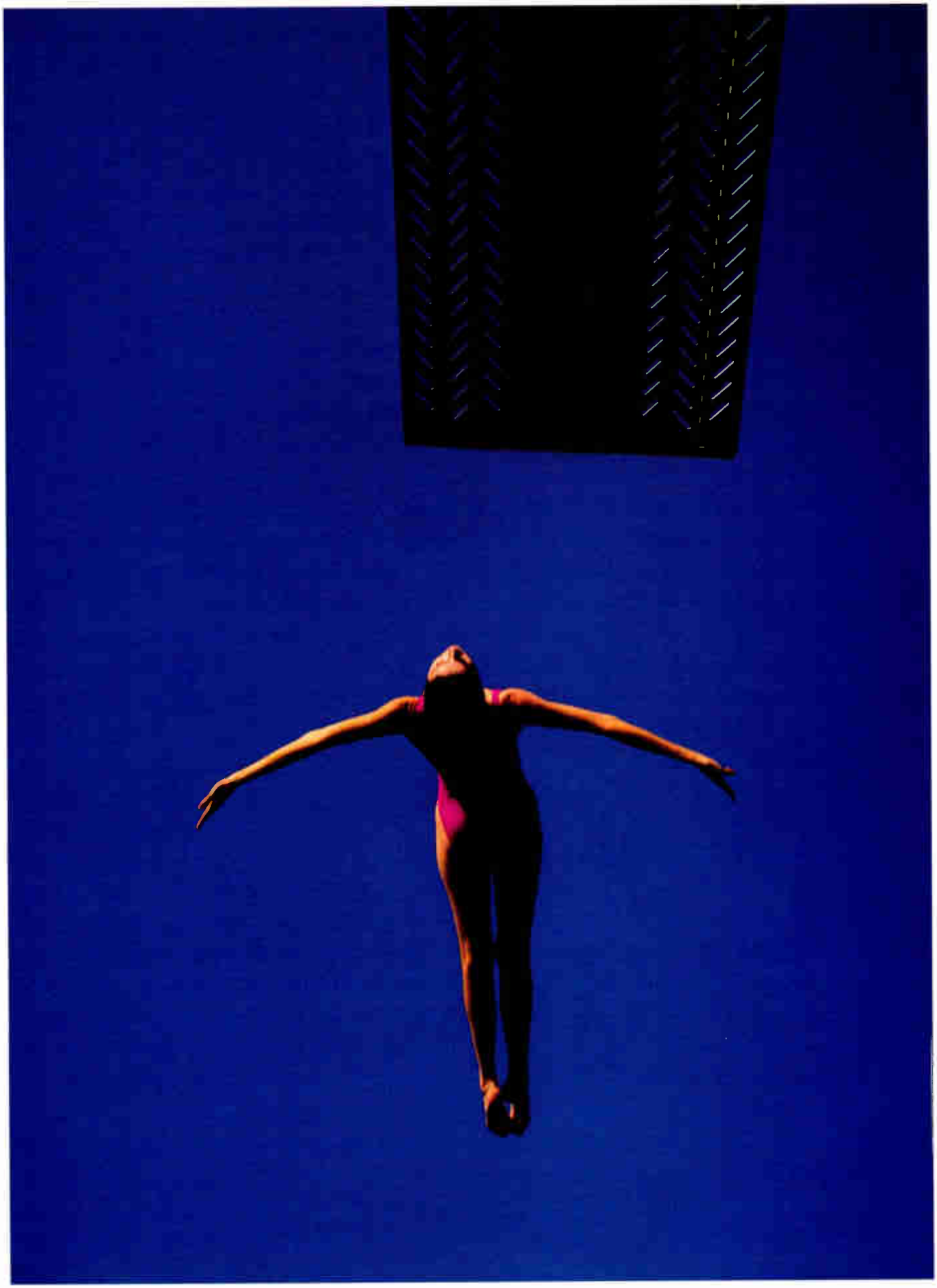

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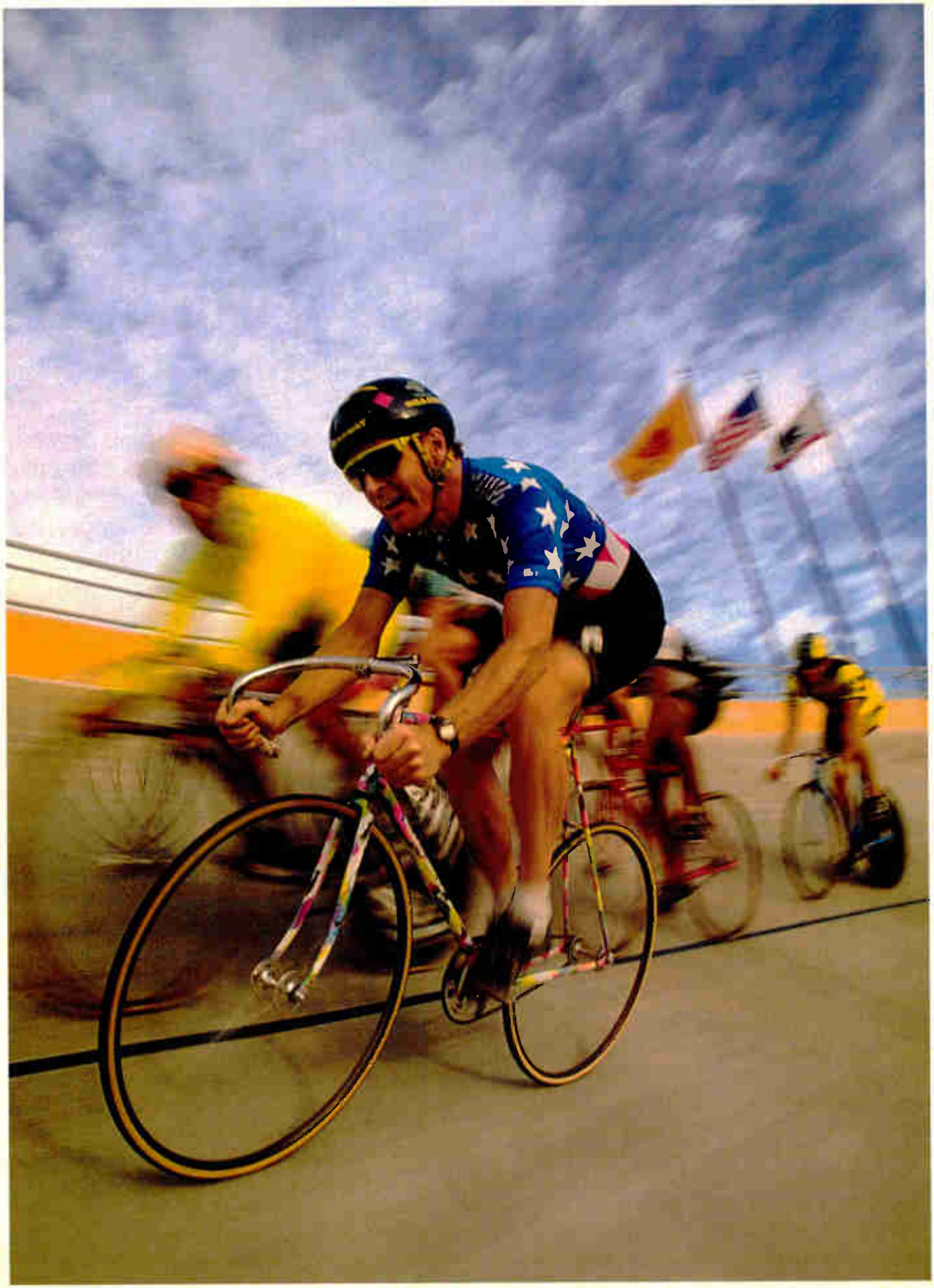

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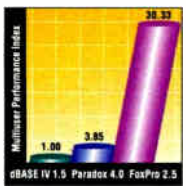
Since the beginning of time, people have been obsessed with reaching ever increasing rates of speed. So what else is new with Microsoft FoxPro 2.5?



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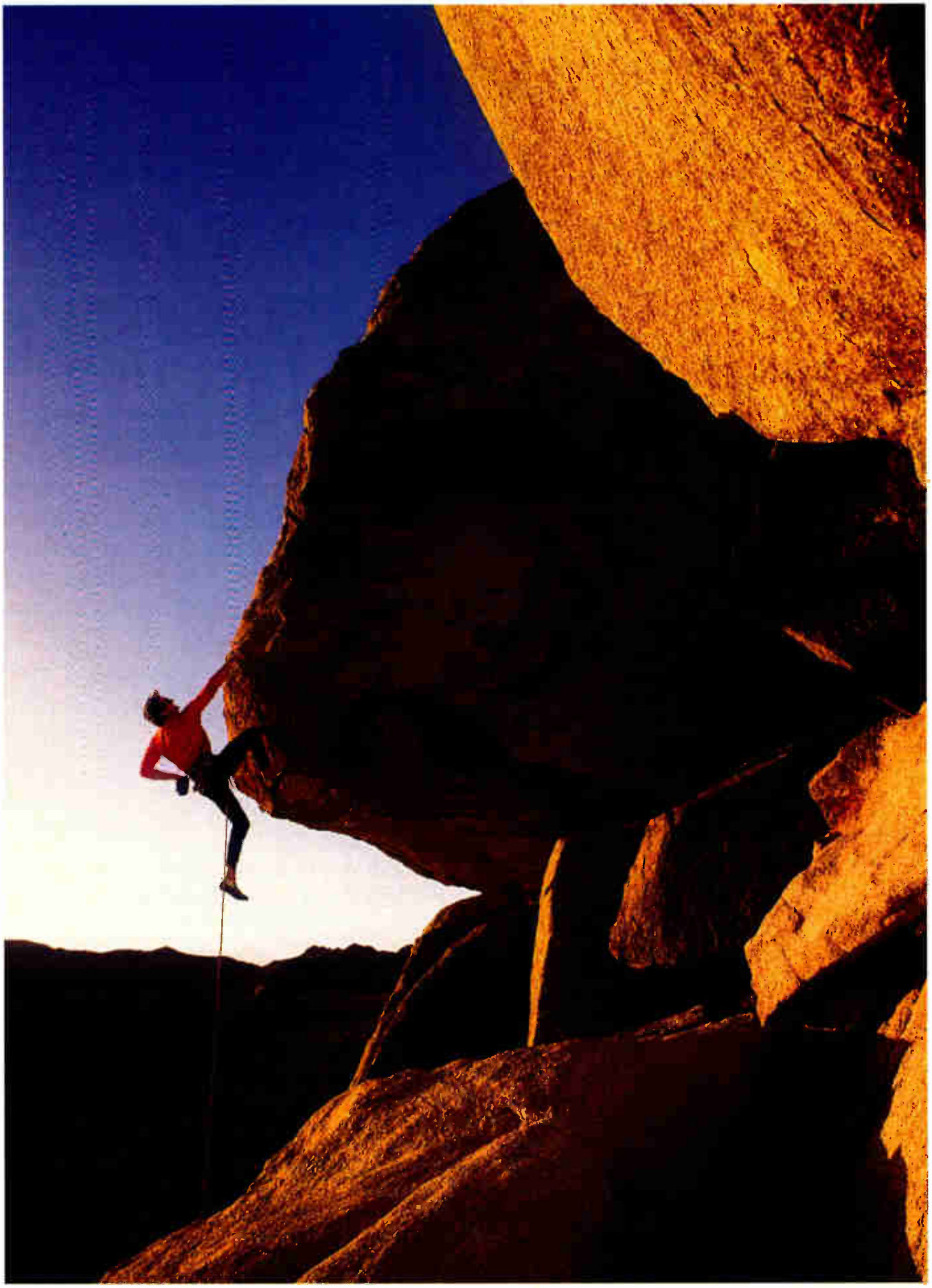

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With AccessWizards, you have a guide to walk you through complex tasks, one step at a time.

If you're a database user or programmer, we'd like to show you a great shortcut. It's called Microsoft Access.™ It's a new database management system for Windows™ that can give you something no other database can. Easy access to the powerful features you need to do your job.

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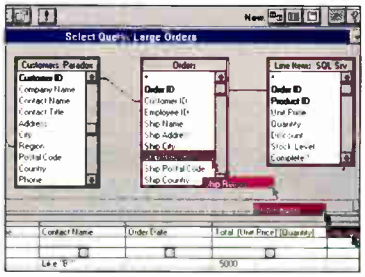

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LETTERS

Inmark Responds

The article "Code on the Move" (July 1992), which covered portable libraries, contained several significant errors regarding zApp. The most troubling was the general theme that zApp was designed to work only with the Windows API. Statements in the article position zApp as a nonportable user interface. Nothing could be further from the truth. Our current support of OS/2 clearly demonstrates zApp's portability beyond the Windows API.

The article also stated that zApp achieves its portability by distributing Magma Software Systems' Mewell interface for DOS. This is true for the DOS version, but not for the Windows, Windows NT, OS/2, or planned X/Motif versions, which all use native-mode calls. Also, although the screens from zApp were labeled as DOS and Windows screens, they were actually the same DOS screen.

The article classifies zApp as a shell-style library. While it is true that zApp encapsulates the breadth of the Windows API (and most GUIs, for that matter), it is not a shell library. zApp's advanced, portable design is not a wrapper of the Windows API as are Microsoft's Foundation Classes. In fact, zApp includes many advanced classes that have no analogy in the Windows API. Many of zApp's customers have moved away from real shell-style libraries (e.g., MFC and OWL) because they wanted the more powerful constructs that zApp provides.

Howard M. Love Jr.
President and Chairman of the Board
Inmark Development Corp.
Mountain View, CA

LabView in Review

I have been using LabView for years and disagree with some of Andy Reinhardt's comments regarding LabView programming ("Acquiring Data Through Windows," September 1992). In my experience, structuring and debugging a sophisticated application is far easier with LabView than with any of the conventional languages I've used.

Some of Reinhardt's comments refer to LabView's layers of modules as a source of difficulty when creating and modifying LabView programs. I find this puzzling. I consider LabView's ability to encapsulate program details in discrete modules to be one of its strengths. I would hate to have to develop a sophisticated system using a language that does not support structured programming.

Jeffrey M. Parker
Round Rock, TX

Andy Reinhardt's first impressions of LabView for Windows appear to be just that—impressions. His sentiments are favorable, but I can't help thinking that the purported difficulty of structuring and debugging LabView programs stems from only a superficial exposure to this excellent programming environment. LabView represents a new paradigm in programming. Reinhardt's comments indicate that he couldn't quite shake the dogma of procedural programming.

Had he spent more time with LabView, Reinhardt would have come to the same conclusion I did four years ago: I will never type another line of code again!

David A. Moschella
Boston, MA

I agree that object-oriented software may boost programming productivity in data acquisition, and I don't dispute that LabView's visual nature can aid application development. In fact, my article was quite favorable to LabView, which I found extremely powerful. The point I was trying to make in my critique was that for some users, especially those automating simple test procedures, the software may be overkill. Not all BYTE readers have made the paradigm shift from procedural to event-driven programming, and for them, I sought to highlight that LabView will open up new vistas only after a period of adjustment. After all, there are still a lot of users out there who prefer command-line interfaces to GUIs!—Andy Reinhardt

Iomega Pricing

In "The New Wave of Removable Mass Storage" (October 1992), the cost per megabyte for the Bernoulli device was miscalculated. The cost, given at $12.04/MB, should have read $2.54/MB. At today's street prices, the cost comes down to $1.50/MB.

Also, the interface adapter for the Bernoulli Transportable 90 Pro drive is a $239 option, but it is included with the Bernoulli PC Powered 90 Pro drive.

Iomega's drives are now price competitive with hard drives. And when you consider cost per megabyte over time, the Bernoulli is less expensive.

Mike Joseph
Vice President of Marketing
Iomega Corp.
Roy, UT

BYTE apologizes for this typographical error.—Eds.

FIXES

- In "BYTE's Guide to 128 Top Windows Products" (BYTE Special Issue: Essential Guide to Windows), the latest release date for Smalltalk/V 2.0 for Windows is incorrect. The current version was introduced in June 1992.
- The two photo captions in the text box "Putting VL-Bus to the Test" (October 1992, page 124) were inadvertently switched. Photo A is the UltraStor hard drive controller; photo B is the Micronics VL-Bus motherboard.
- In "FileMaker Pro 2.0 Unites the PC and Mac" (October 1992), we stated that both versions of FileMaker are network-ready out of the box and include a license for up to 25 users. In fact, the network licensing is an option.
- The CPU benchmark graph in "Compaq's Newest Notebooks" (October 1992) inaccurately shows a very low score for the Dell NL25 notebook computer. The NL25 fell between the slower Compaq LTE/Lite and the faster Compaq LTE/Lite 25C.
- In "Operating-System Trends" (October 1992), an editing error resulted in our identifying Mike Nash as a product manager at Intel. Nash is Microsoft's product manager for Windows NT. The error carried into a subsequent passage which refers to "Intel's Windows NT." The idea stirs the imagination, but NT is still a Microsoft product.

BYTE regrets these errors. ■

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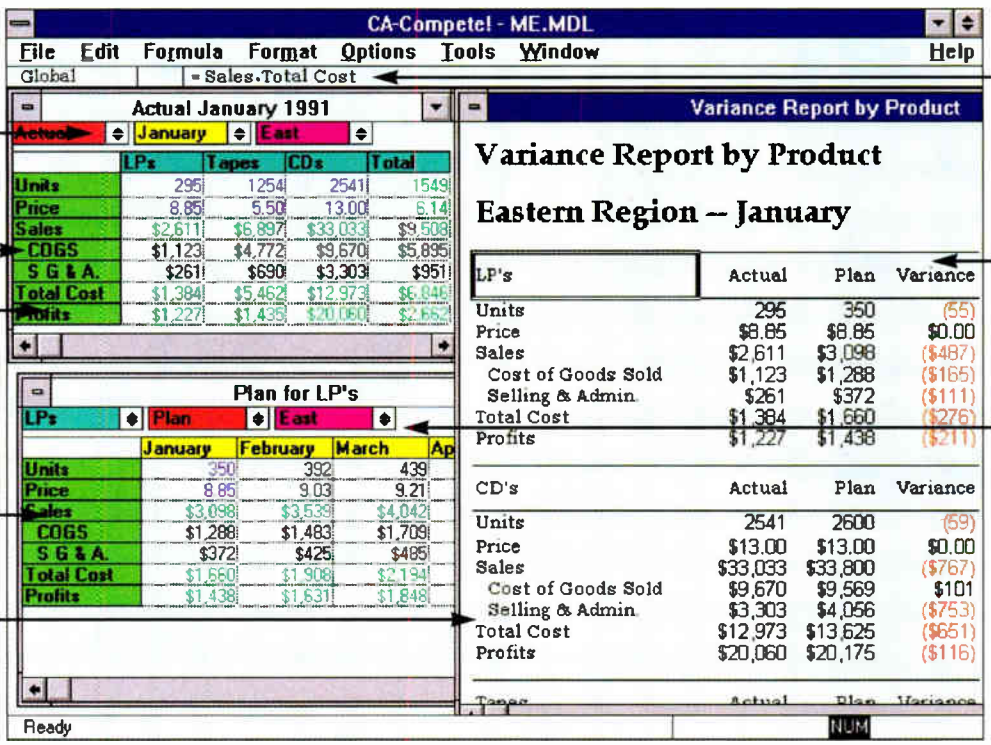

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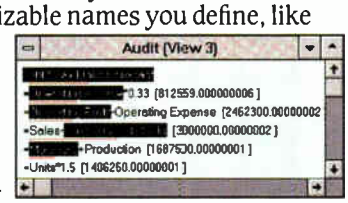

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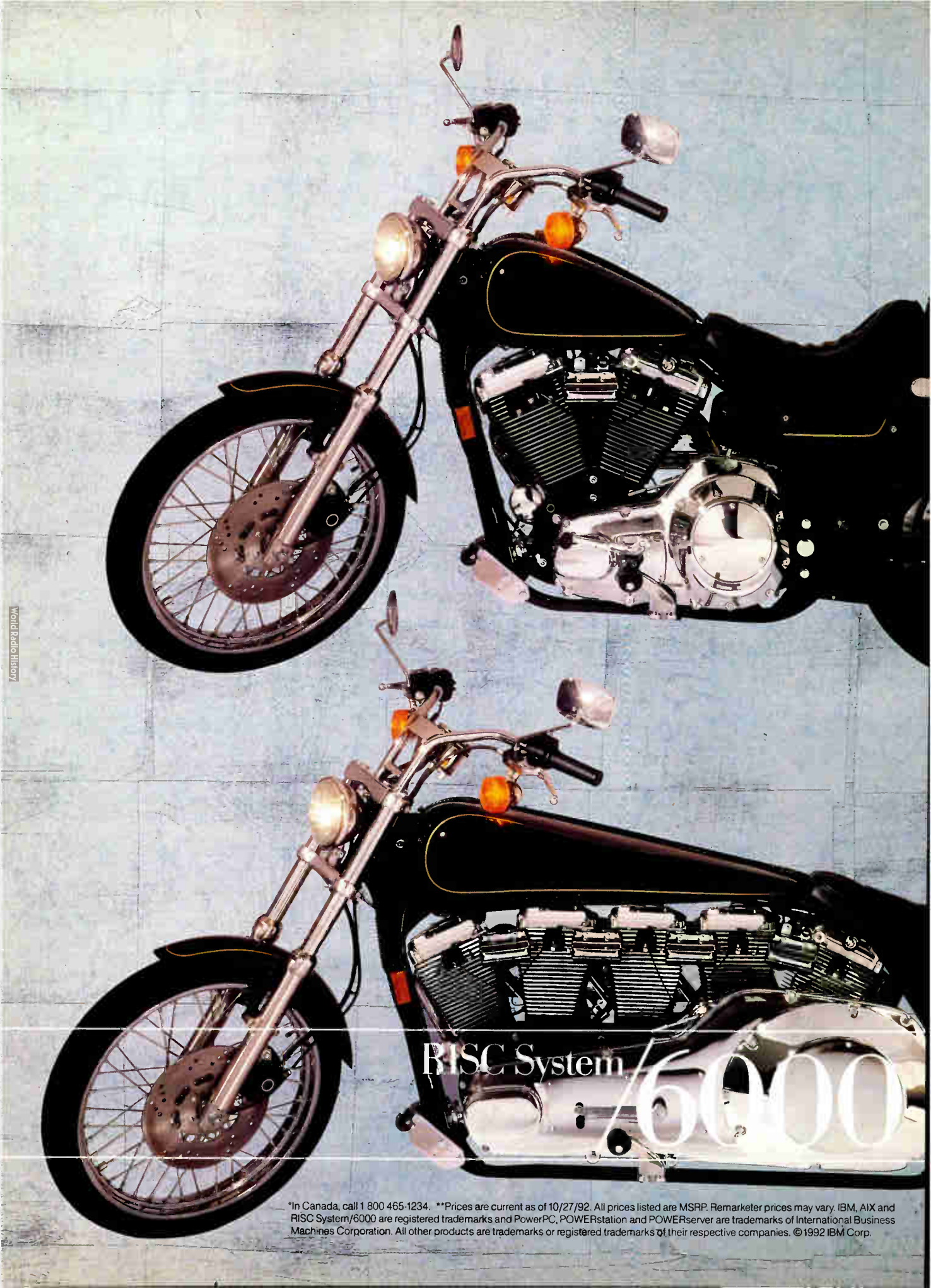

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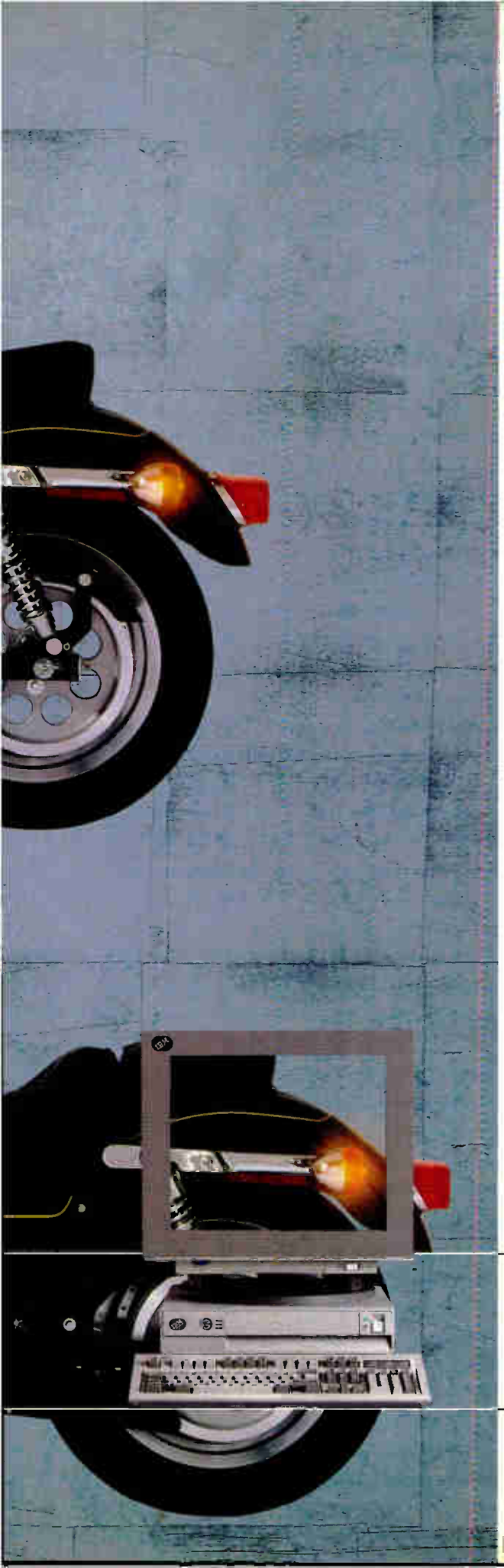

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NEWS

MICROBYTES

Motorola Skips a Generation with the 68060

Like Intel's Pentium (formerly known as the P5), Motorola's next-generation microprocessor will use superscalar architecture, parallel pipelines, branch prediction, and a common instruction pipe that the integer and FPUs share. It will also maintain full software compatibility with earlier members of its chip family. But by the time Motorola's 68060 begins to ship in production quantities, Intel's Pentium will likely have been in production for over a year: Motorola expects to begin manufacturing the 68060 in the first half of 1994.

At Michael Slater's Microprocessor Forum last October in Burlingame, California, Motorola (Austin, TX) said that the 68060 will run about 3½ times faster than a 25-MHz 68040, delivering about 77 MIPS at its initial clock rate of 50 MHz. That's not quite as fast as the Pentium, which Intel says will deliver about 100 MIPS at its initial frequency of 66 MHz. Motorola says it hopes to eventually drive the 68060 at 66 MHz; that version of the chip could achieve a performance of 100 MIPS.

However, the 68060 contains about 2 million transistors with a minimum transistor size of 0.5 micron, compared to the Pentium's 3 million transistors in 0.8-micron technology. Also, the 68060 is a static CMOS chip that operates at 3.3 V as well as at 5 V; the first Pentium is expected to be strictly a 5-V device.

Architecturally, both chips take advantage of similar techniques to wring more performance from their traditional CISC designs. In the 68060, a four-stage fetch unit dispatches integer instructions along a pair of four-stage execution pipelines. At the same time, the chip stores the instructions in a 256-entry cache and predicts upcoming branches based on past patterns.

When the chip correctly predicts a branch that is taken, it effectively jumps to the new address in 0 clock cycles. When the processor correctly predicts that a branch in a program will not be taken, it jumps to the correct address in 1 clock cycle.

How efficient are the parallel pipelines? Motorola says the 68060 executes 50 percent to 60 percent of the instructions in pairs. That's with integer code generated by existing compilers. Presumably, more instructions could be generated in parallel by generating code with an optimized compiler.

The 68060's FPU has three arithmetic units—an adder, a multiplier, and a divider—and it shares the execution stages of the primary integer pipeline. Floating-point instructions can be dispatched along this pipeline, while integer instructions flow through the secondary pipeline; both instructions' execution cycles can overlap. Floating-point loads and stores take 1 cycle, addition takes 3 cycles, multiplication takes 4 cycles, and division takes 24 cycles. Other features of the 68060 include a pair of 8-KB caches for instructions and data, as well as a 32-bit data/address bus similar to the 68040's.

If you're wondering why the new chip is called the 68060 instead of the 68050, Motorola has an explanation. Traditionally, odd-numbered chips in the 68000 family offer incremental improvements, while even-numbered chips are considered major leaps. Motorola says its customers wanted more than the small gain implied by the step from 68040 to 68050.

Competition was surely a factor as well. Intel's Pentium significantly raises the stakes for CISC processors. With the 68060 expected to ship about a year after the Pentium, it's no wonder that Apple, one of Motorola's biggest customers, is adopting a new family of RISC chips for its next-generation machines. Motorola and IBM are jointly developing those chips, the PowerPC series.

—Tom R. Halfhill

NANOBYTES

Intel says the official new name of its next-generation processor—previously known as the P5—will be the **Pentium**. Speaking to the New York PC Users Group, Intel president and CEO Andrew Grove said the forthcoming Pentium will have an FPU that will be five to 10 times faster than the FPU on a 486DX/33. Intel hopes to introduce the chip, which Grove said will have 3.2 million transistors and a 32-bit external bus, around the end of the first quarter of this year. Grove said that other suggested names for the chip included Memory Lane, Chip IQ, Suetable Chip, Quintel, Big New Chip, and Imitraitor. Grove applauded the semiconductor trade agreements, which he said have doubled the number of U.S. semiconductors sold in Japan—from 8 percent to 16 percent of the total Japanese market. □

The early word from Microsoft is that its new operating system, called MS-DOS 6.0, will include integrated compression, networking, and improved ease of use. **Rich Freedman**, Microsoft's product manager for MS-DOS, said that businesses still have a large number of vertical applications that for various reasons will not be ported to Windows. Microsoft wants to improve the usability of MS-DOS for these non-Windows users, he said. "Memory management was the key feature that sold and continues to sell MS-DOS 5.0," Freedman said. So you can expect improvements in that area as well. □

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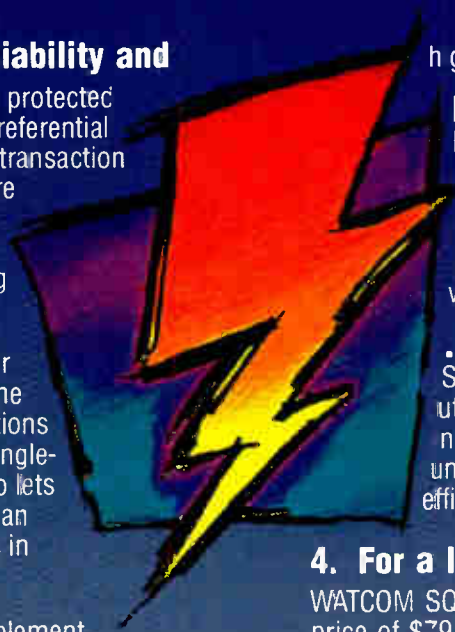

2. Royalty-free run-time For just $99 you get royalty-free run-time support. It lets you distribute applications for standalone PCs and include our single-user run-time database server. It also lets you distribute your applications on an unlimited number of client machines in network environments.

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From entry level PCs... You can use DOS PCs with just 640K memory as database server machines for small networks. For single-user standalone environments, the SQL database server together with an application can run on DOS PCs equipped with a minimum of 640K memory.

...to high end servers. The WATCOM SQL database server automatically adapts to utilize the available memory on your system for increased performance. The 32-bit version unleashes the power of 386/486 PC's to efficiently serve many clients in large networks.

4. For a limited time it's yours for just $395

WATCOM SQL Developer's Edition has a suggested retail price of $795 but for a limited time you can get it at the introductory price of only $395. Even better, as a registered user of the Developer's Edition you'll be able to get a copy of the 6-user Network Server Edition for only $99 (Suggested retail price: $795).

Developer's Edition

Complete Client/Server Development Tools Package Including Standalone Single-user SQL Database Engine

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Package components include: Single-user standalone database server (both 16 and 32-bit versions) • Interactive SQL • ACME front-end application development system • Embedded SQL/C preprocessor • SQL libraries for use with WATCOM C, WATCOM C/386, Microsoft C/C++, and Borland C/C++.

System Requirements:
Hardware: IBM PC compatible with hard disk, 640K minimum memory
Software: DOS, Windows DOS box, or OS/2 DOS box

Special Introductory Offer: $395 (Suggested retail price: $795)

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Package components include: Multi-user network database server (both 16 and 32-bit versions) • Interactive SQL • Network requestor and request manager.

Client System Requirements:
Hardware: IBM PC compatibles, 640K minimum memory
Software: DOS, Windows DOS box, or OS/2 DOS box

Database Server System Requirements:
Hardware: IBM PC compatible with hard disk, 640K minimum memory
Software: DOS

Network Requirements: NetBIOS or Novell Netware (IPX)

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NEWS

MICROBYTES

PowerPC 601: Ahead of Schedule

IBM and Motorola are ahead of schedule with the development of their PowerPC 601, the first in a series of RISC microprocessors on which IBM and Apple will base their next generation of personal computers. The first-pass silicon was ready last October, less than a year after a joint team began work in Austin, Texas.

If development continues apace, IBM and Apple expect to introduce their first PowerPC systems by late 1993. The 601-based systems will be relatively inexpensive and will rival the performance of low-end workstations. As reported last month in Microbytes, future chips in the PowerPC family will include the 603, for portable systems; the 604, for mainstream desktop computers; and the 620, for high-end systems and servers.

The 601 is a streamlined derivative of the single-chip RISC engine found in IBM's RISC System/6000 Model 220 workstation. Evolutionary rather than revolutionary, the 601 combines the basic architecture of the RS/6000 with an enhanced version of the bus interface from Motorola's 88110 RISC processor.

Even though the 601 improves on the RS/6000's architecture, it's considerably less integrated than the single-chip RS/6000. Gone are on-chip controllers for DMA, interrupts, and memory, along with some automatic timers. IBM says it has scaled down the integration to keep the 601 from becoming too system-specific—an important design goal for a CPU that's intended to be used in machines from IBM, Apple, Groupe Bull, Thomson-CSF, and others.

The superscalar architecture of the 601 has three execution units that separately handle integer operations, floating-point operations, and branches. By routing these types of instructions to the appropriate pipelines, the chip can dispatch up to 3 instructions per cycle. The branch pipeline has two stages, and the integer pipeline has four. The six-stage floating-point pipeline is tuned for single-precision math, and double-precision operations are double-pumped through the pipeline's two execution stages.

Most integer instructions execute in only 1 cycle, thanks to hardware support for multiply, divide, and other special operations. The FPU achieves 1- or 2-cycle throughput, depending on the type of operation and the level of precision. The chip includes a 32-KB data/instruction cache, an MMU (memory management unit) with 52-bit virtual addressing, and support for symmetric multiprocessing. Using 0.6-micron static CMOS technology, it packs 2.8 million transistors into a 304-pin package less than 11 mm square. It operates at 3.6 V and consumes 9 W at 50 MHz.

Performance benchmarks aren't available, but IBM offers the following "conservative estimates based on simulations.": SPEC Integer '89 benchmark: 40 at 50 MHz, 50 at 66 MHz; SPEC Floating-Point '89 benchmark: 60 at 50 MHz, 80 at 66 MHz. That's more than twice as fast as the RS/6000 Model 220 chip, which runs at 33 MHz. IBM says the PowerPC 601 will be "aggressively priced." The chip could cost as little as $50. Systems could sell for $1000 to $2000.

—Tom R. Halfhill

Incompatible APIs Call for Mail Bonding

When it comes to sending electronic messages across different operating systems, LANs, and WANs, companies such as Microsoft, Lotus, and Apple want to make the act of sending E-mail as simple as dropping off a letter in an old-fashioned mailbox. An obstacle to this vision is the variety of competing—and sometimes incompatible—messaging APIs, including Microsoft's MAPI (Messaging API), Apple's OCE (Open Collaboration Environment), the VIM (Vendor-Independent Messaging) API, and the XAPIA (X.400 Applications Programming Interface Association) mail specification.

"We want to take the issue of competing messaging technologies off the table for our customers," says Lotus chairman and CEO Jim Manzi. Manzi says Lotus will release a program this year that will allow mail-enabled applications written to the VIM API to work with Microsoft's MAPI. Tim Dempsey, manager of developer relations in Lotus's Communications Products division, says Lotus's software subsystem will reside between the application and the messaging system.

When Microsoft releases its full MAPI specification, Lotus says it will release the MAPI-VIM subsystem to public networks at no charge. Microsoft says that the full MAPI SDK (Software Development Kit), which will include Simple MAPI, extended MAPI, and service providers, will be

NANOBYTES

PC manufacturers, mindful of the challenges inherent in designing new motherboards for full-scaled Pentium-based systems, are taking an intermediate step by shipping computers with Overdrive sockets for a scaled-down version of Intel's next-generation Pentium processor. Manufacturers such as DEC, Compaq, Hewlett-Packard, NCR, and Hyundai Electronics America are shipping systems with a 238-pin upgrade socket that lets users replace their current 486DX processors with a **Pentium-variant Overdrive.** □

EliteGroup Computer Systems, a Taipei-based company with U.S. headquarters in Fremont, California, plans on releasing a motherboard with a 486 ZIF (zero-insertion-force) socket that will accept the P24T, Intel's code name for the unreleased Pentium Overdrive. EliteGroup Computer Systems' director of marketing Darwin Chang said, "A motherboard that can run a full-blown [Pentium] will be an extremely expensive motherboard." The cost differential between full Pentium-based and Pentium Overdrive–based boards will be about $400, he said. □

IBM Technology Products, an IBM independent business unit, recently outlined its plans to begin selling chips on the open market. The main message: We're for real, we mean business, and you can trust us. Until 1992, IBM-TP was a nearly invisible cog in the world's largest computer company (IBM), and it sold virtually all its products to IBM. Now, under IBM's vast restructuring plan, IBM-TP is an autonomous company that must compete in the outside world and show a profit. IBM-TP is already providing 16-Mb DRAMs to Siemens Nixdorf and Toshiba, making IBM-TP one of the rare U.S. domestic suppliers of DRAMs. IBM-TP is also pushing its Intel-compatible 386SLC and 486SLC microprocessors, as well as the upcoming PowerPC RISC chips. □

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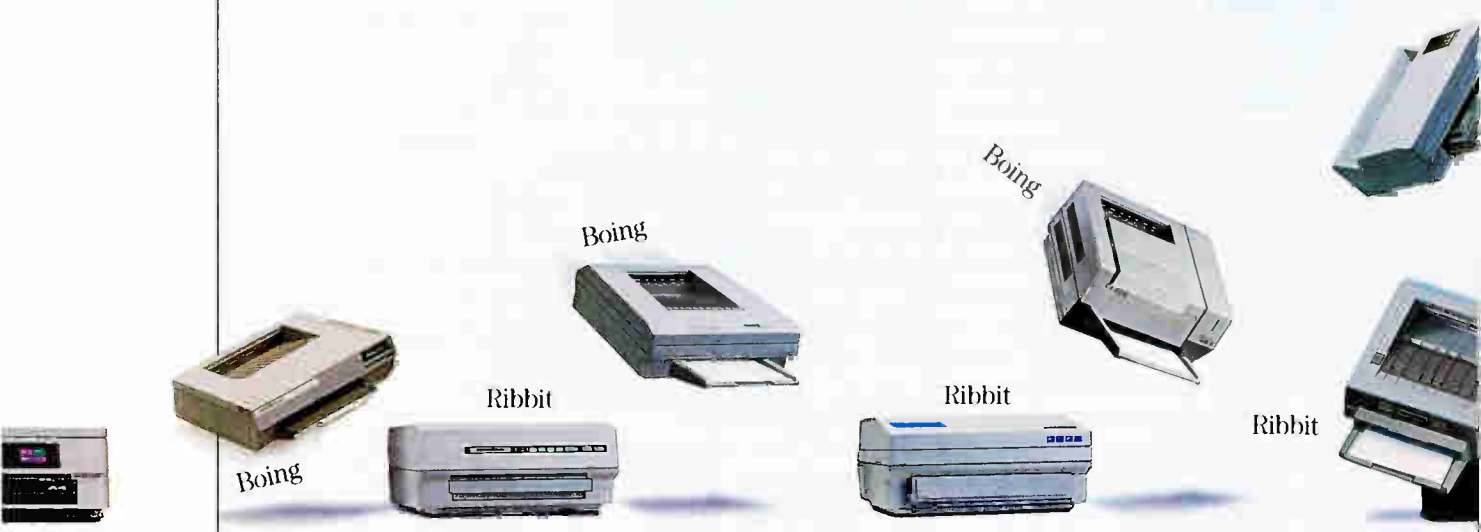
Other laser printers play leapfrog trying to catch up with the HP LaserJet.



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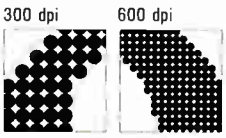

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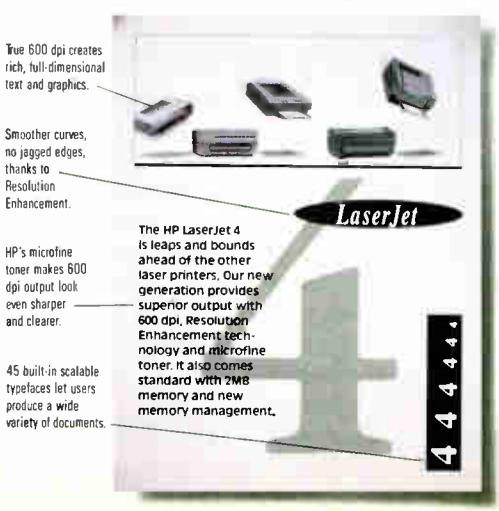

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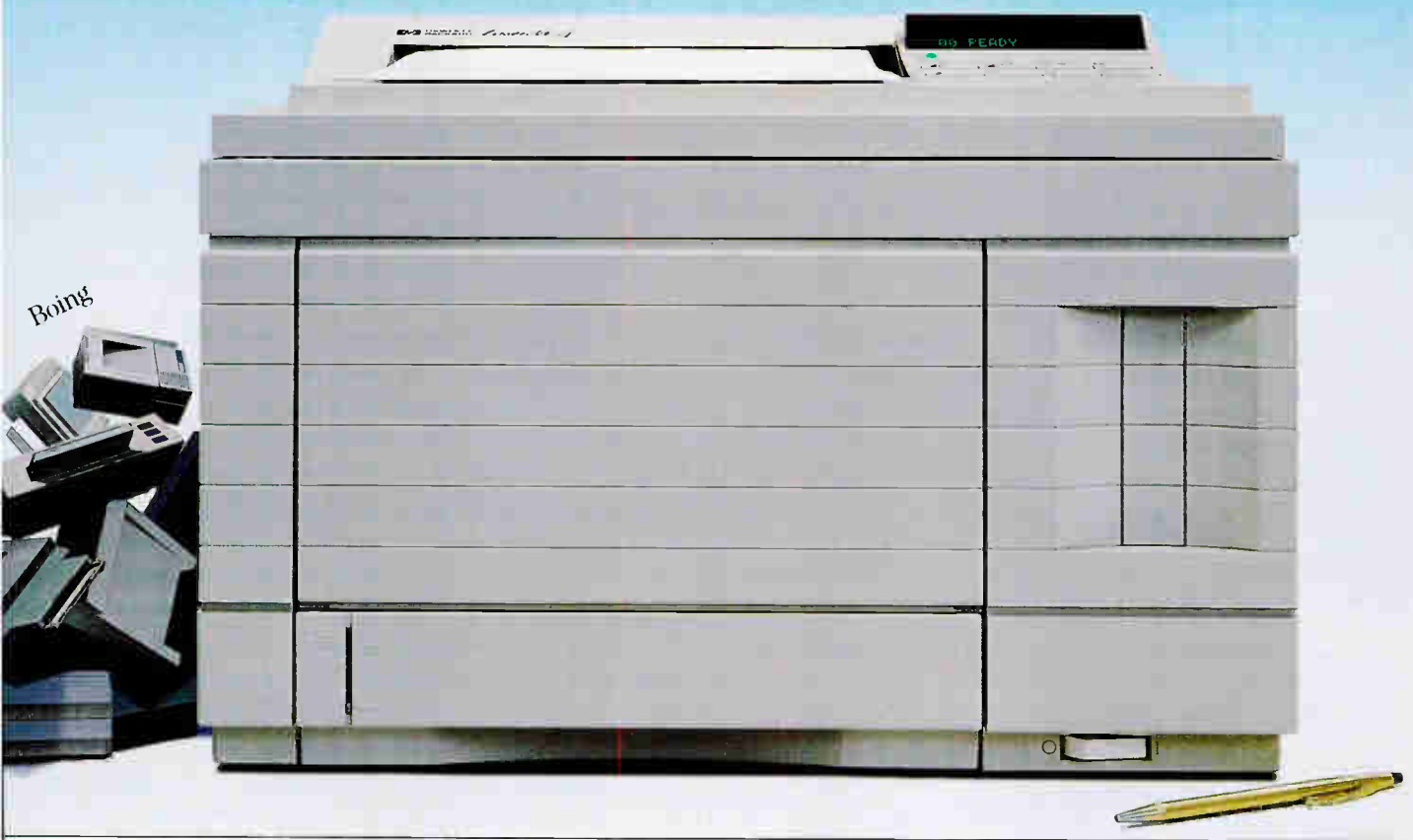

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released in the first quarter. Full MAPI specification will eventually be integrated into Microsoft operating systems.

Simple MAPI, which supports common messaging calls (e.g., log-on and read), offers compatibility between Mac and Windows programs. When it is released, the full MAPI specification (which is a Windows-only API) will likely have more than 100 messaging calls to support complex workgroup functions. For a more robust multiplatform messaging API, Microsoft so far has eschewed VIM in favor of endorsing the XAPIA consortium efforts begun last summer to define a common multiplatform messaging API.

Lotus says it, too, will comply with messaging calls as they are defined by the XAPIA. But VIM proponents argue that XAPIA calls have been slow in coming, with the first XAPIA calls not expected to be released for industry comment until January or February. Dempsey says the XAPIA's first five calls—send, list, read, act, and directory lookup—probably won't be ready for developers until mid-1993. "If it took them this long to come out with the basic send call, you can figure how long it will take them to publish the other calls," Dempsey says. Lotus has already released a VIM developer's kit, and Dempsey says that more than 40 products are available that support VIM. He adds that Lotus Notes 3.0, expected to ship in the first half of 1993, will also support VIM.

Suzan Fine, MAPI product manager at Microsoft, says that Microsoft's messaging strategy is that not everything can be done in a common, multiplatform API. "We don't necessarily believe that a lot of calls should be in the cross-platform [messaging] API," she says. "A lot of what people want in cross-platform development tools is being turned over to the cross-platform messaging API," Fine adds.

Fine says that Microsoft's position is to endorse a multiplatform API that offers full functionality and not to have developers invest resources in supporting calls that are multiplatform but offer minimal functionality. "That's why Microsoft is encouraging developers to exploit OCE on the Mac platform, MAPI on Windows, or with OS/2, its API," she says. What about DOS? Fine says that a combination of Simple MAPI and XAPIA common mail calls on top of DOS will provide the basis for an upcoming DOS mail client.

In another development, Phoenix Systems (Arlington, VA) is developing an electronic-messaging gateway between Microsoft Mail for PC Networks 3.0 and Lotus Notes. With the gateway, expected to ship in March or April, Microsoft Mail users can exchange messages with text, graphics, and sound with Lotus Notes through Windows' OLE. So, despite Microsoft's and Lotus's continuing disagreement about which common-messaging API to support, the E-mail bridges are slowly being built, one way or another.

—Dave Andrews

Pacific Bell Lets You Get There from Here

The refrain "I live in E-mail" is heard more and more in business these days. The problem is that not everyone lives in the same E-mail package, and several E-mail programs are incompatible with each other. For LAN administrators who can't wait for software vendors to resolve this E-mail incompatibility issue, Pacific Bell (San Francisco, CA, (510) 823-5880) has introduced a new service, called LANmail Connection.

LANmail Connection lets LAN-based users send and receive messages from within their familiar E-mail program with users on other dissimilar E-mail systems. LANmail Connection supports Lotus cc:Mail-, Microsoft Mail–, and MHS (message-handling-service)-compatible mail systems like Da Vinci eMail.

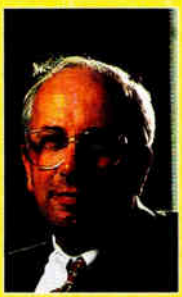
Other services include X.400 InterConnection for host-based systems and Mailbox Connection for stand-alone PCs and Macs. Also, Pacific Bell Connection provides an E-mail directory to all connection subscribers. Companies send their E-mail directory to Pacific Bell, which places them in a centralized X.400 directory. The updated directories that you send to Pacific Bell are reflected in its systemwide database. You can then dial the service and send mail. Pacific Bell Connection identifies the recipient and forwards the message.

LANmail Connection also provides a link to X.400-compliant systems worldwide, public E-mail providers such as AT&T and Sprint, private mail systems such as DEC VMS Mail, and SoftSwitch and Retix Open servers. LANmail Connection includes a $25-per-LAN installation charge, a $10-per-LAN monthly service charge, a 15-cent charge for messages containing from 1000 to 2000 characters, and a 5-cent fee for an extra 1000 characters thereafter. International per-character charges are higher.

—Steve Apiki

NANOBYTES

IBM is showing the first signs of being as nimble as its competitors in the low-end PC battleground.



Where actions like price reductions once required endless approval through several levels in the IBM hierarchy, the new IBM PC Co. operating unit responded in just one day when Compaq attempted to preempt Big Blue's ValuePoint announcement (see "New Systems...New IBM?," November 1992 BYTE) by cutting prices on low-end Compaq systems. In turn, IBM reduced its prices on its PS/ValuePoint systems. IBM PC president **Bob Corrigan** told BYTE that one of the operating unit's goals is to prove to itself, as well as to the competition, that IBM can make it in today's market, which he described as "more analogous to clothes buying than PC buying." □

Things have changed in the computer industry in a big way, as evidenced by the recent Microsoft announcement of **Windows for Workgroups** last fall. Microsoft's cofounder, chairman, and CEO Bill Gates unveiled Windows for Workgroups to about 50,000 people assembled in New York's Gershwin Theatre and connected via satellite in 17 cities across the U.S. The extravaganza, called "How to Succeed in Business with Workgroup Computing," included seven scenes played by professional actors, singers, and dancers, along with three Microsoft people, including Gates playing himself. But following the debut, Microsoft officials acknowledged that some of the dazzling features, such as message routing, won't be ready until mid-1993. Simple MAPI, on which Windows for Workgroups is based, doesn't support routing. □

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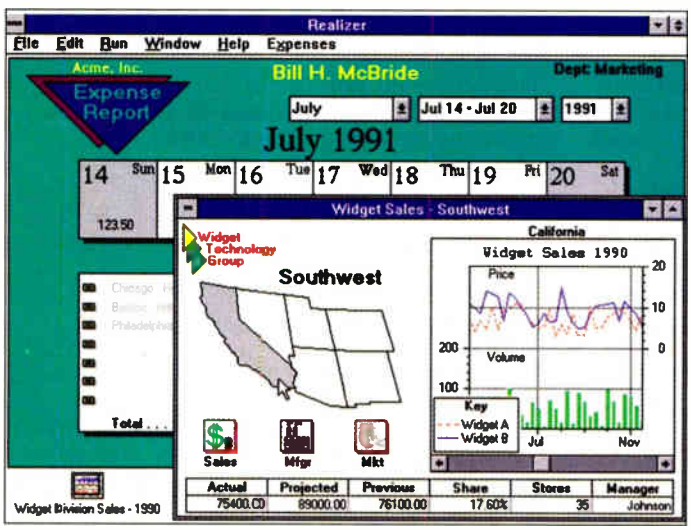

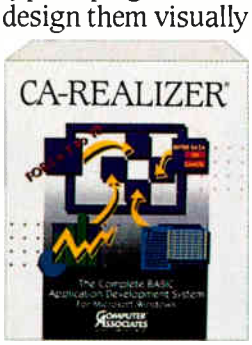

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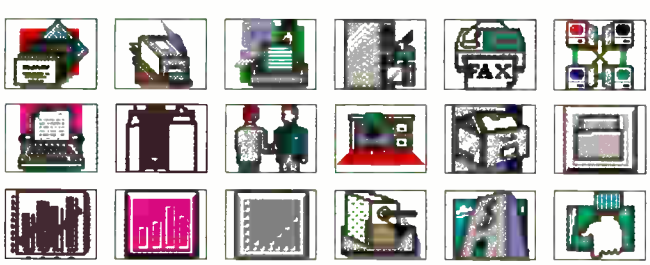

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CA-REALIZER Release 1.0 and Visual BASIC Release 1.0 compared 10/92. Cost comparison based on Visual BASIC Release 1.0 Suggested Retail Price. *PC Computing* quote appeared 10/91, pg. 90.

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NEWS

MICROBYTES

IBM, Others Vie for Japanese PC Market

TOKYO—The battle of the PC prices is shifting to Japan, where U.S.-based vendors like IBM, Apple, and Compaq have pitted themselves against a myriad of Japanese operating standards that are incompatible with the ISA-bus standard—not to mention each other. Additionally, companies based here (e.g., Canon) are introducing low-cost (under 200,000 yen, or US$1650), Taiwan-built PCs based on Intel's 486 processor.

Five major bus standards compete in the Far East market. They are offered by NEC, Epson, Fujitsu, Toshiba, and AX, a consortium that includes Hitachi and Sony. But NEC, which commands more than half the Japanese market with unit sales of nearly 2 million a year, is the clear leader. NEC recently added new models (including several multimedia systems) to its popular 9800 series to fend off challenges from the ISA-bus and Apple community. One of the new models is a 486SX/20-based color notebook that sells for about 498,000 yen (US$4000). It is prices like this, still high by U.S. standards but typical for Japan, that companies such as IBM and Compaq hope to exploit.

The NEC PC-H98T desktop PC sports a 12-inch color LCD that supports 1120- by 750-pixel resolutions in addition to NEC's sub-VGA 640- by 400-pixel standard. The PC-H98T costs 1.75 million yen (about US$14,000). "You can buy a good car for [the price of] this machine," said Asao Ishizuka, a senior writer for Nikkei Business Publications. "This is what they call a symbolic machine, to show NEC is a leader in this technology. It's symbolic—they don't have to sell it."

Last fall, IBM Japan announced desktops and notebooks that are in varying degrees based on the PS/ValuePoint (but come with XGA-2 instead of Super VGA graphics) and ThinkPad products. With the IBM systems, Japanese-speaking users can run U.S.-developed software on IBM-standard machines fitted with a kanji keyboard and DOS/V. The 3½-inch 1.44-MB floppy drives accept disks formatted for NEC's proprietary 1.2-MB standard. So far, however, IBM's machines are not priced sufficiently below those of NEC to make a big difference.

Of a bevy of invaders that include Apple, Dell, and DEC, Compaq may be the vendor most responsible for escalating the pitch of the Japanese price wars to that of the U.S. market's. The company recently began shipping its Deskpro/I and Prolinea lines here at prices barely above what they cost in the U.S. But Compaq did so months after introducing them in the U.S. "Low cost is perceived as poor quality in Japan," said Compaq spokeswoman Yvonne Donaldson. Compaq, to be safe, built a foundation of trust with a year of Systempro and Deskpro/M promotions before making its low-cost systems announcements.

What eventually may weigh against NEC is that Windows and OS/2 need more power than NEC's architecture can offer. "The NEC 9800 is not sufficient to run Windows," said Ishizuka. "The I/O bus structure is very inefficient." NEC technicians, he added, have said it themselves. "They have revealed to me that they think OS/2-J kanji will not run nicely on 9800 architecture."

—Ed Perratore

A Bad Exchange Causes U.K. Price Increases

LONDON—Fluctuations in European exchange rates are pushing PC prices up in Europe, particularly at the low end of the market. Many manufacturers are holding prices steady, and many more have already passed increases, halting the two-year European price-reduction trend.

The hardest hit by the increases is the U.K. market, following a 25 percent devaluation of sterling against the U.S. dollar and even greater instability against the German deutsche mark. "If the pound keeps falling, then everyone will have to raise prices," said Steve McCall, U.K. managing director of Dutch company Tulip Computers. Most other European currencies have not suffered as badly.

U.K. supplier Dan Technology increased prices last November, and technical manager Chris Bakolas predicted unavoidable price hikes for future months as well. "Even if you can resist the pressure of the pound, there is a temporary shortage of 486s, which makes them more expensive. There is a shortage of chip sets from Taiwan, and there is an embargo on Korean memory within the EC [European Community]. It almost looks like a conspiracy to push prices up," he said.

CompuAdd's U.K. subsidiary is expected to raise prices by 10 percent, alongside price hikes from Viglen (7 percent) and Elonex in the U.K. ■

—Louise Cole

NANOBYTES

Last fall, at the NetWorld show in Dallas, Texas, Novell previewed NetWare 4.0 but downplayed its upcoming release. The company instead focused on SFT (System Fault Tolerant) Level III and existing NetWare 3.11 features. SFT III promises reliable fault-tolerant LAN operation, a feature designed to appeal to companies moving their mission-critical operations from mainframes to LANs. The NetWare 4.0 SDK (Software Development Kit) is available and the operating system itself is in solid beta, Novell says. One important feature of NetWare 4.0 is the NDS (NetWare Directory Services) component that replaces the file-server-based NetWare bindery with a single, network-wide, distributed database. □

With Borland's Paradox for Windows not expected to ship until sometime in the first quarter, Microsoft hopes to make inroads into the Windows database market by selling its Access database at just $99 until January 31, when the price will go up to $695. But at least one database developer believes that, in 1993, most of the PC database action will remain in DOS. "Our feeling is at least in the database market, [DOS database programs] will account for 80 percent of the programs sold in 1993," said **Richard Rabins**, cochairman of PC database vendor Alpha Software (Burlington, MA). Rabins said products like Access and Paradox for Windows "show flashes of brilliance, but they are not products to run your business on yet." Still, Rabins said, "People will be evaluating Windows databases like crazy in 1993." Alpha is developing a Windows version of its Alpha database, said Rabins. ■

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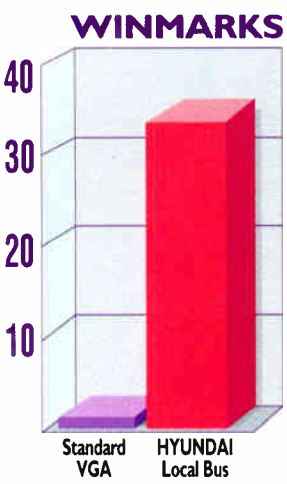
486 STAMPEDE

That thunder you hear on the PC prairie is the New Breed Hyundai 486 stampede. The hardest-charging, price-lean, MIPS-mean herd of computers you'll ever see. We're bringing everything from powerful 66MHz 486DX2 machines to Overdrive-Upgradable 486SX-25 computers. And with our 50MHz 486DX2 desktop PC and 486DX-33 blasters, you can handle today's demanding applications.



Do something "Longhorn" Local Bus.

That flash you see on the graphics horizon is the image of our Windows processing power triggering the Hyundai 486 stampede.

Your 486 processor was meant to run today's applications. So why rein in all that power? That out-to-pasture, 16-bit VGA card can only deliver 2 Megapixels at best. That's already dated technology. Let her rip with 32-no-blink-bits of "Longhorn" *Local Bus video acceleration.* And with up to 32 Megapixels *standard*, believe it, you'll see an incredible difference in Windows performance.

Do something thunderbolt.

Lightning-fast *"warpspeed" L2 caching* is another max-performance feature that's designed into every Hyundai 486. Thunderbolt write-back operations blast your DOS, Windows, or OS/2 data into a box canyon of ultra-fast SRAM. Start out with 128KB standard (more than the cow computers), then expand to 256KB to handle today's big applications. Cache hit for cache hit, the Hyundai 486 Family, with 128KB standard caching, delivers twice the MIPS of non-cached cows.

Do something upgradable.

The Hyundai 486 New Breed Family is designed in Silicon Valley, U.S.A., to out-perform the herd.

All of our systems are *CPU-upgradable* through a single chip via a *ZIF or Overdrive socket*, so the New Breed lets you double your speed. We won't let tomorrow's 32-bit operating systems blast a hole in your productivity. Just upgrade your Hyundai 486 to any higher-speed Intel 486 CPU in the future.

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486SX/33—$1999

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Compare our *standard 128KB of zero-wait state cache* with non-cached cows. And don't forget, the Hyundai 433S flexes its processing muscle up to 256KB of cache expansion. This system runs at the head of the stampede!

And we don't just drive the Hyundai stampede, we overdrive it! Double your speed by simply snapping in the *Intel Overdrive™ Processor*. And our advanced "warpspeed" L2 cache and "Longhorn" Local Bus graphics engine give your upgraded system the 32-bit video and fast SRAM you'll need for your higher-speed 486 CPU.

Hyundai 433S

- 33MHz 486SX w/ 8KB integrated cache
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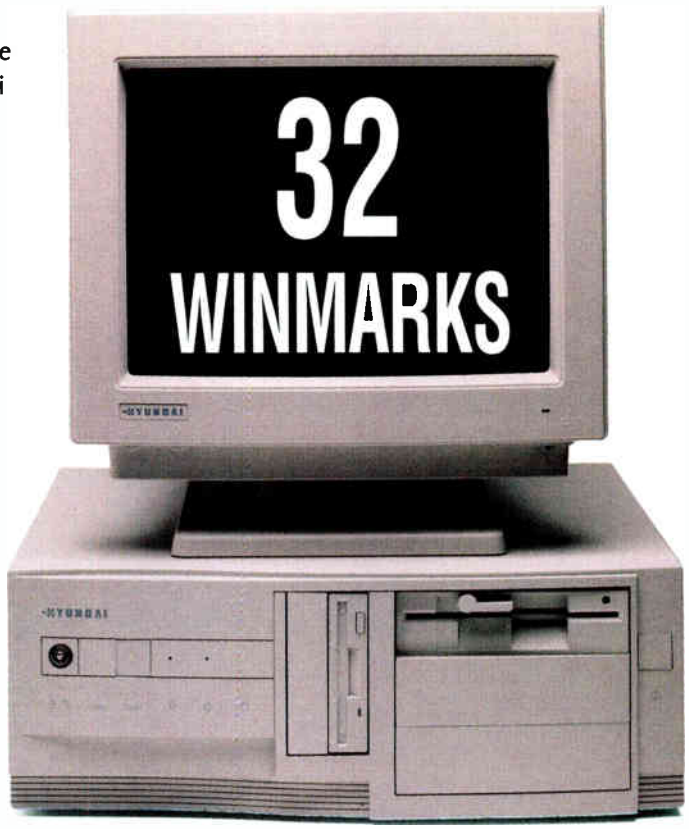
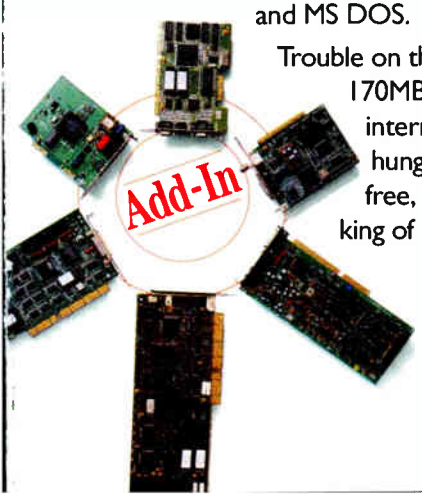
- 128KB "warpspeed" write-back 20ns SRAM L2 cache (expandable to 256KB)
- Upgradable to 486DX power via Intel "Overdrive" socket
- 4MB system memory expandable to 64MB on system board
- 170MB 19ms IDE HDD, 32KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs, (2.88MB-ready FDD interface)
- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt and swivel base
- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 expansion slots, including 1 VESA local bus slot
- 200 watt power supply
- 101 keyboard, 2 button mouse
- Built-in virus protection, front keylock, 2 level password
- MS DOS 5.0 and MS Windows 3.1



Hyundai 433S

Want to talk add-ins? We test our 486 systems with literally hundreds of industry-standard cards and software applications. We test software compatibility on Novell (we're fully certified and a Novell Alliance Program member), Banyan Vines, OS/2 2.0, LAN Manager, and SCO UNIX, plus hundreds of programs running under Windows and MS DOS.



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Number of PCs installed 486_____ 386_____ 386SX_____ 286_____

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Architecture	❑ ISA	❑ EISA				
Memory	____MB installed	Cache Memory	❑ 128 KB	❑ 256KB		
Floppies	❑ 1.44MB 3-1/2"	❑ 1.2MB 5-1/4"				
Hard Disks (IDE)	❑ 100MB	❑ 120MB	❑ 200MB	❑ 250MB	❑ 330MB	❑ 500MB
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- 2S/1P, integrated PS/2 mouse port
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- 4MB system memory expandable to 64MB on board
- 200MB 12ms IDE HDD, 256KB disk buffer
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- 7 slots incl. 1 VESA Local Bus slot
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- Processor upgradable via ZIF socket
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- 200MB 12ms IDE HDD, 256KB disk buffer
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- 2S/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 slots incl. 1 VESA Local Bus slot
- 200 watt power supply
- 101 keyboard, 2-button mouse
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- Processor upgradable via ZIF socket
- 8MB system memory expandable to 64MB on board
- 360MB 12ms IDE HDD, 256KB disk buffer
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- 14" non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt-and-swivel base
- 2S/1P, integrated PS/2 mouse port
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- 7 slots incl. 1 VESA Local Bus slot
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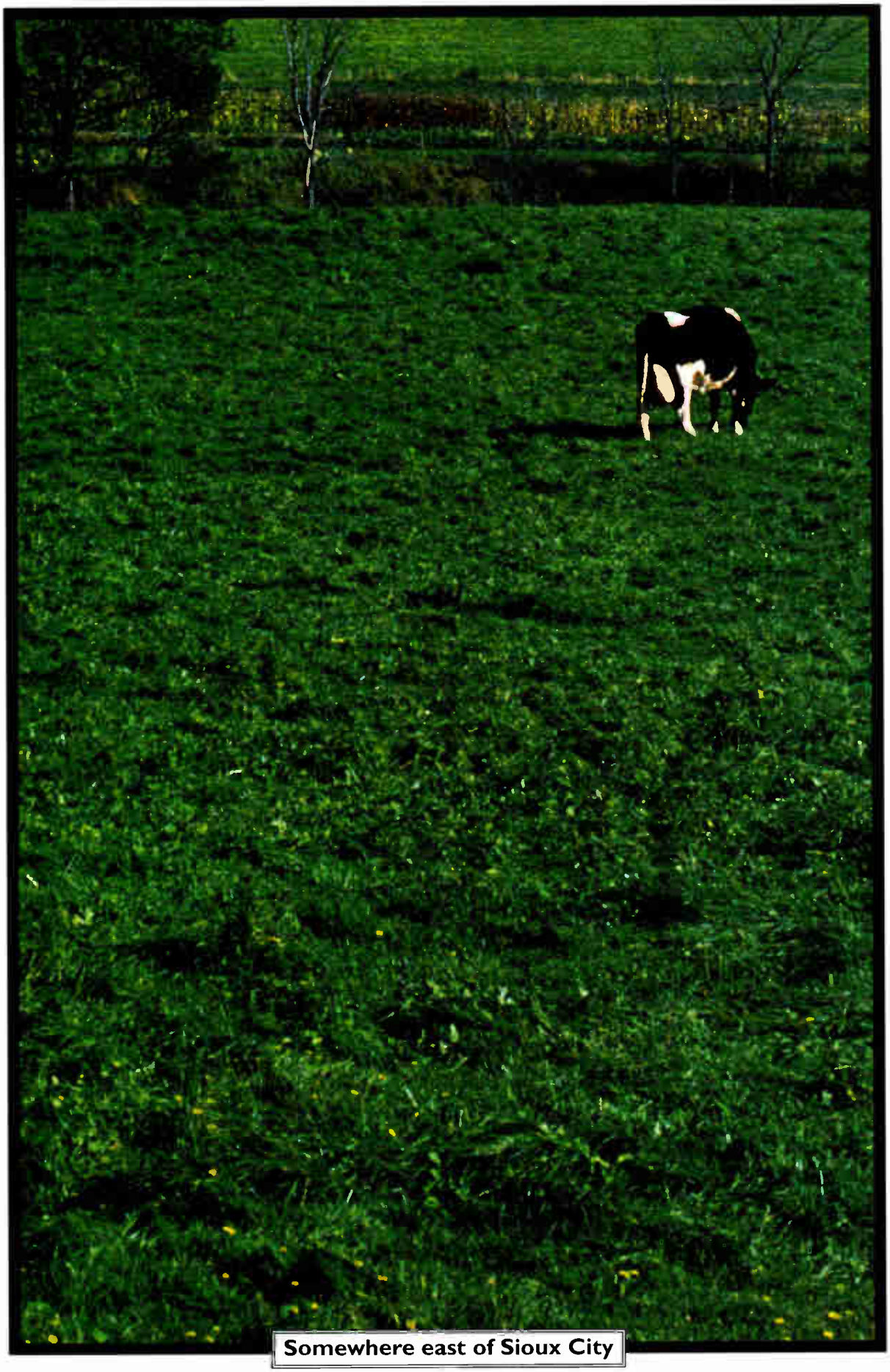

Somewhere east of Sioux City

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ANDREW REINHARDT

THE GUANGDONG GATEWAY

HONG KONG—When outsiders contemplate the Asian computer industry, they usually think first of Japan. Many also know about the huge success of Taiwan and Singapore, which have established themselves as electronics manufacturing powerhouses, and some are aware of Korea's struggle to capitalize on its success in semiconductors. But for most people, Hong Kong does not spring readily to mind.

The reason is simple: The computer industry here is relatively small and nearly invisible, especially to Americans. The bulk of the territory's computer industry consists of OEM manufacturers of motherboards, floppy drives, add-in cards, and clones. Most of the companies are small—some have 20 or fewer employees—and with the notable exception of an AST facility, there are few local manufacturing plants operated by foreign multinationals.

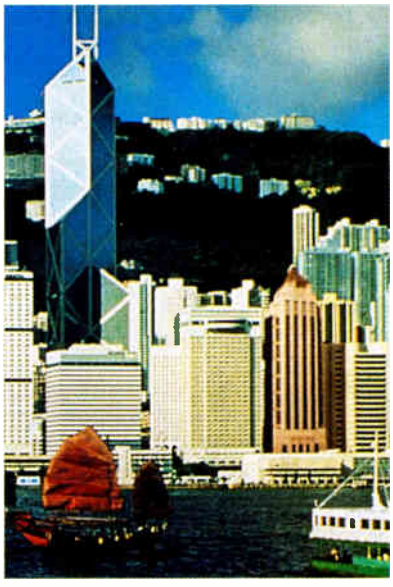
As personal computers become more commoditized and buyers more price-sensitive, however, Hong Kong's role could greatly expand. The territory's trump card is its close relationship with mainland China, which offers a nearly inexhaustible supply of inexpensive and reliable labor. (Economic prosperity has come so fast to Taiwan and Singapore that labor costs there are already too high for dime-a-dozen products like serial I/O or VGA boards.) Strong ties to China also promise another potential payoff: Hong Kong vendors look across the border and see a mouth-watering market of 1.2 billion consumers.

The Fastest Tiger

Ruled since 1898 by the British, Hong Kong has long been an international center for trade and commerce. It is one of the "Four Tigers"—four nations in east Asia (the others are Singapore, Taiwan, and South Korea) that have experienced massive economic growth in the last two decades. Hong Kong leads the pack, with a per-capita GNP of more than $10,000 and sustained annual growth rates of more than 8 percent throughout the 1980s. Boosters credit the growth in part to Hong Kong's laissez-faire economic policy, which has encouraged a business culture of entrepreneurship and opportunism.

It is hard to picture what will happen to Hong Kong when it returns to Chinese stewardship on July 1, 1997. Under an agreement signed in 1985 between the British and Chinese governments, Hong Kong will remain a "special administrative region" of China for at least 50 years, which means, in theory, that it will be allowed to maintain a capitalist economy with little Chinese intervention. Still, anxiety about 1997 led to a "brain drain" from Hong Kong in the late 1980s: An estimated 260,000 people and perhaps tens of billions of dollars fled the country to Canada, Australia, Singapore, and the U.S. The situation has stabilized since then, however, as many former residents—foreign passports safely secured—are now returning here to conduct business.

As 1997 approaches, Hong Kong hopes to profit from China's huge labor force—and its vast potential market



Aside from the worry about the long-term future of Hong Kong, the factor that has most affected the colony's role in the personal computer industry is government action, or lack thereof. With its policy of "positive nonintervention," the government eschewed the publicly sponsored industry parks and technology consortia that have propelled Taiwan and Singapore to prominence, preferring to let market forces run their course. This has meant that more start-ups were launched in Taiwan and more foreign businesses moved production to Singapore. Says one businessman, "Singapore really puts out the red carpet for people. They even have chauffeured limos pick up executives at the airport."

Hong Kong offers instead a rough-and-tumble brand of capitalism, backed by ready access to capital and excellent communications and transportation infrastructures. This recipe has attracted finance, marketing, and distribution companies, and Hong Kong houses the regional offices of many Fortune 500 companies, including DEC, Hewlett-Packard, and Microsoft. These tend to be front-office, not manufacturing, operations.

The trend now gathering steam here is to foster a front-end/back-end business model that combines Hong Kong's world-class connections, technical skills, and business savvy with low-cost Chinese labor. Businesspeople here believe this duality may someday allow Hong Kong to surpass other "tigers" in the computer business.

continued

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The Ties That Bind

The front-end/back-end model isn't unique to Hong Kong. As labor costs have risen in Singapore, for example, manufacturers there have increasingly turned to poorer countries like Thailand and Malaysia for assembly and testing. What sets Hong Kong apart is that the division between it and China is only a political boundary, just one hour by train from downtown. The people on either side of the border speak the same dialect (Cantonese) and share a common heritage, and they are quickly moving toward economic integration, as well as eventual political union.

By comparison, when Singaporans go offshore to seek less expensive labor, they must contend with air travel, different languages, and shipping logistics. For the Taiwanese, the situation is even worse: Taiwan uses the Mandarin dialect and is several hours by air from southern China, and Taiwanese law prevents businesses from owning plants in China.

Thus, people here believe that their city could become the gateway to one of the world's great electronics manufacturing centers. To back up their beliefs, they are investing millions of dollars in Chinese plants in the neighboring province of Guangdong. Most of this investment is in the Shenzhen Economic Zone, just across the border from Hong Kong. Millions of Chinese workers are employed there in plants that have sprung up over the last 10 years.

One firm typifying the dual model is CIM Systems, founded in 1984 by its president, Peter Yim. CIM Systems has facilities in Hong Kong, Shenzhen, and Fremont, California. "The Hong Kong plant offers fast turnaround and responsiveness for high-margin products, while the Chinese facility does higher-volume, lower-cost items," says Yim. Among the products manufactured in China are desktop and laptop motherboards, fax modems, power supplies, and video-game assemblies.

Yim says his goal is to "combine the best of both worlds." To an increasing degree, that includes shifting engineering tasks to China, where, he says, there are "very talented people lacking only in experience of doing the job." CIM Systems has opened a "software factory" in Shekou, China, to reduce software development costs. As with hardware projects, the work is split up: Engineers in Hong Kong design and specify projects, while programmers in Shekou write and test code. "The programming capabilities of Asia, especially China, should not be overlooked," Yim says.

Ergo System, a maker of floppy drives, motherboards, and clones, has embraced a similar strategy. The company employs 500 manufacturing workers in China and is establishing an R&D center there. According to marketing manager Connie Ang, land costs in China are 10 to 100 times lower than in Hong Kong, and labor is easier to find. "We think manufacturing in China gives us a competitive edge," she says. "There is some loss of flexibility, some occasional problems in transportation, but the cost savings outweigh this by a long shot."

Ang and other Hong Kong managers argue that the stability of the Chinese work force is a strong draw. According to Dr. James Fok, a program director at the Hong Kong Productivity Council, "We pay them higher wages than they're used to, so we can obtain the best people and keep them for a longer time." Nobody seems to dwell on the irony of laborers from a "worker's state" clambering for employment with capitalist enterprises, nor do they exhibit any concern about possibly exploiting Chinese labor. Says Wilson Chan, a marketing executive for Juko Electronics, a maker of motherboards and palmtops: "Getting a job with Juko makes them feel very lucky, and they will fight to stay."

China uses incentives to lure investment deeper into the mainland.

The Glittering Prize

Under the complex rules established by the Chinese government, foreign companies can bring parts into the Shenzhen free-trade zone and ship out finished goods with no import or export duties. Products made there, however, cannot be sold into China except with tariffs of 100 percent to 200 percent. A second region, farther north in the Guangdong province, offers different rules: Some duties must be paid, but finished goods can be sold in China with no tariffs. Juko Electronics, for example, has an 800-employee plant in the Suwa Scientific Park 2 hours north of Hong Kong, from which it is allowed to sell 30 percent of its output to Chinese customers.

China can use incentives like this to lure investment deeper into the mainland, because every Hong Kong company's ultimate dream is to get a chunk of the virtually untapped Chinese market. Although China now lacks the means to purchase much computer technology, most people expect this situation to change dramatically. Peter Yim predicts that Shenzhen's economy will catch up to Hong Kong's in 10 years. Only 10 years after the Shenzhen Economic Zone was established, its economy is already half the size of Hong Kong's, according to Yim.

The opportunity to sell products in China is especially attractive to Hong Kong companies because their late entry into the computer business cost them the chance to compete in the U.S. market. Most Hong Kong manufacturers sell largely in Europe, where smaller, more fragmented markets and generally higher prices have allowed them to get a foot in the door. "We decided to concentrate on Europe a few years ago," says Connie Ang. "It was too hard to tackle the Taiwanese makers in the U.S."

The late start has also caused many Hong Kong companies to forfeit the established desktop sector in favor of emerging product areas. Thus, interest in imaging, multimedia, and hand-held systems is high. Perhaps the best-known Hong Kong brand name is Bondwell, a maker of laptops and notebooks. Another company, Ever-Success Computer, has developed a hybrid fax machine and 386SX computer that attaches to a TV set and sells for $1150. Others are aiming to deliver 1-pound systems based on Chips & Technologies' PC/Chip, which has been well received here. The focus on hand-held systems meshes well with efforts to sell into China: Dr. Fok predicts that China may leapfrog over dated technologies such as wired telephones and desktop computers directly into cellular phones and portable systems.

The common thread in Hong Kong's computer business is relentless energy tempered with pragmatism. While some worry that China's takeover of Hong Kong will indelibly alter the territory's free-wheeling economy, almost everyone is forging ahead with ambitious expansion plans. "We don't know what will happen politically, but we're sure we'll be able to manufacture and distribute our products the same as before," says William Yuen, a sales manager at Bondwell. "We see China as a great growth opportunity." ■

Andrew Reinhardt is BYTE's West Coast bureau chief. You can reach him on BIX as "areinhardt."

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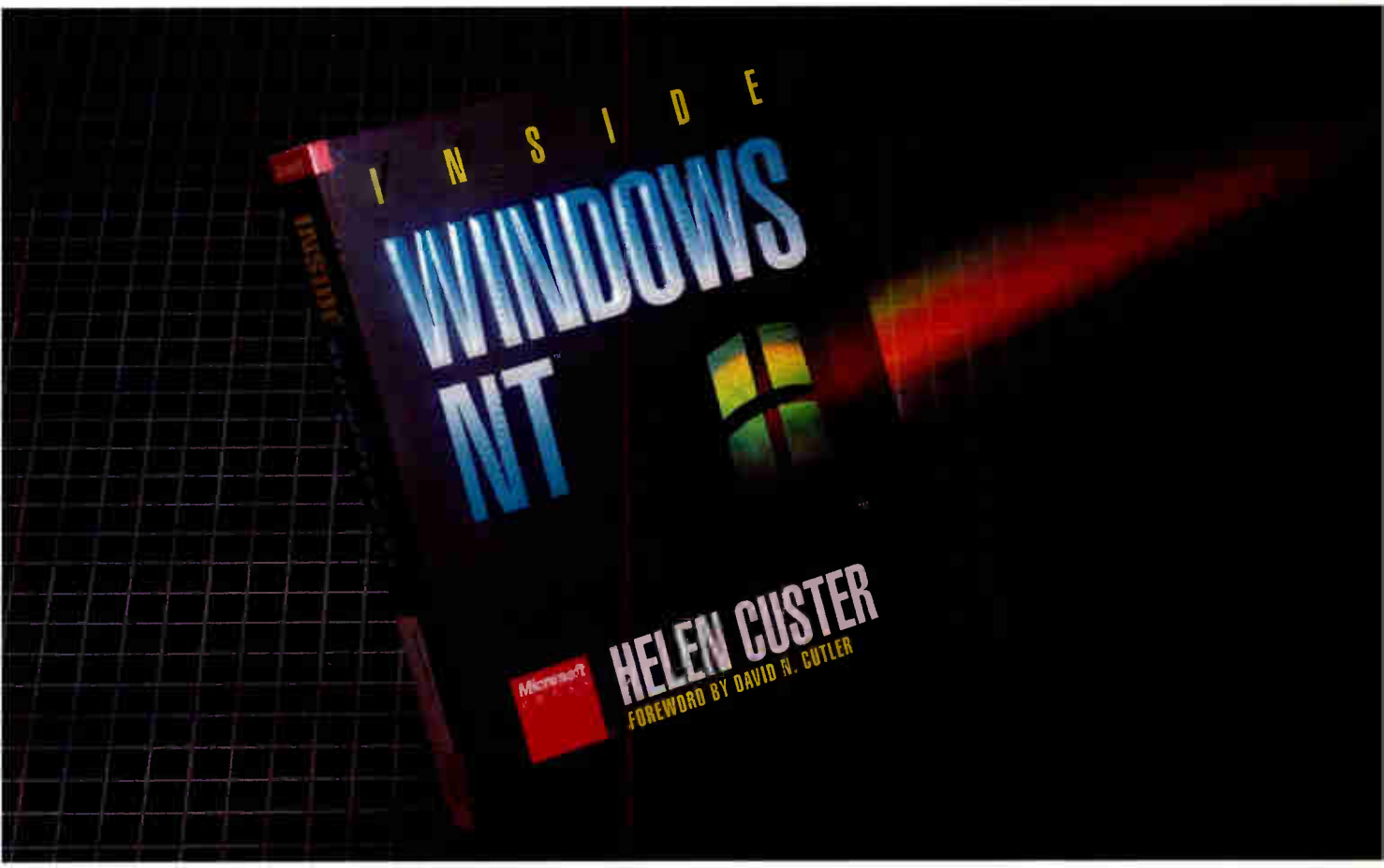
Insider Information



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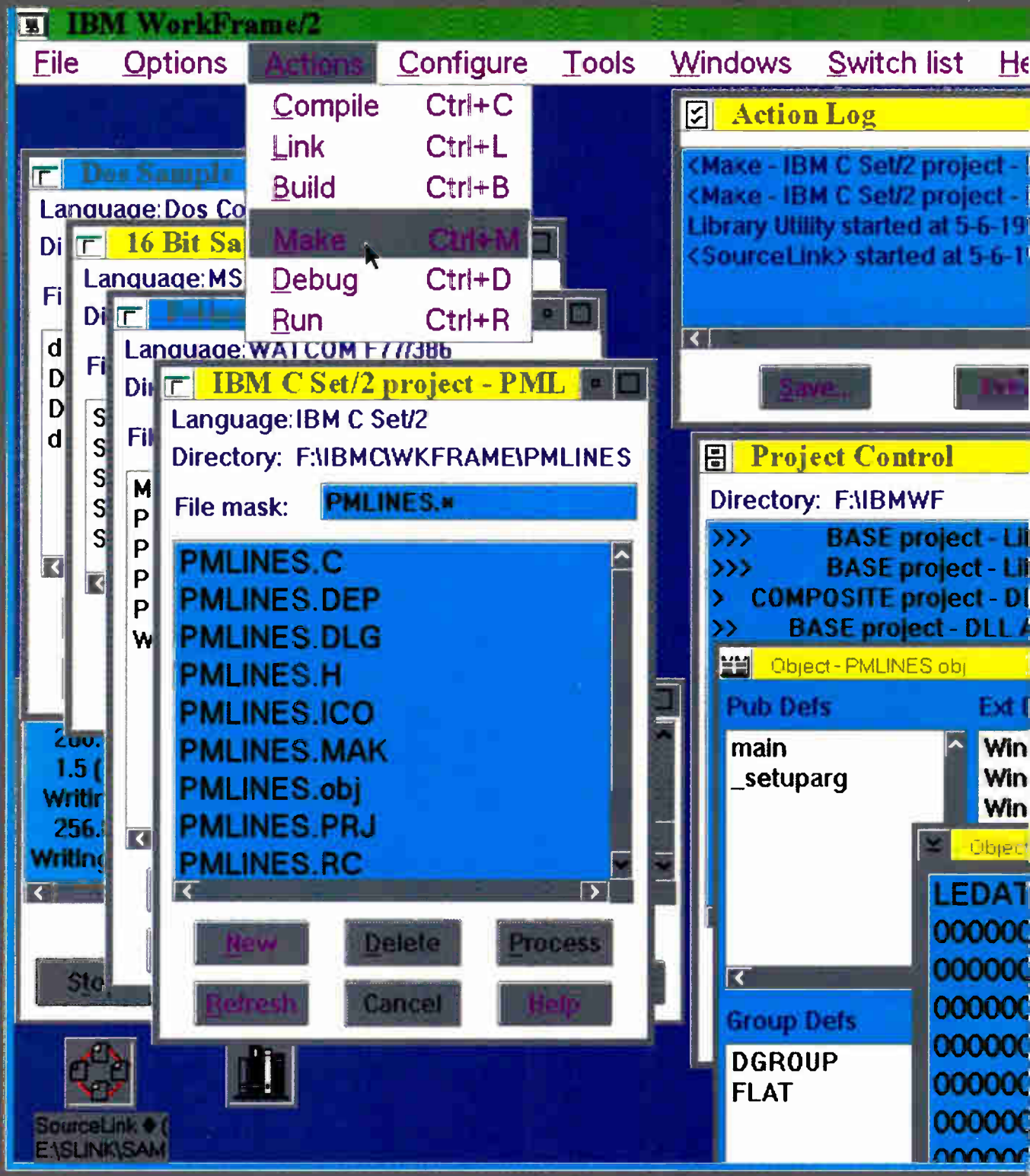

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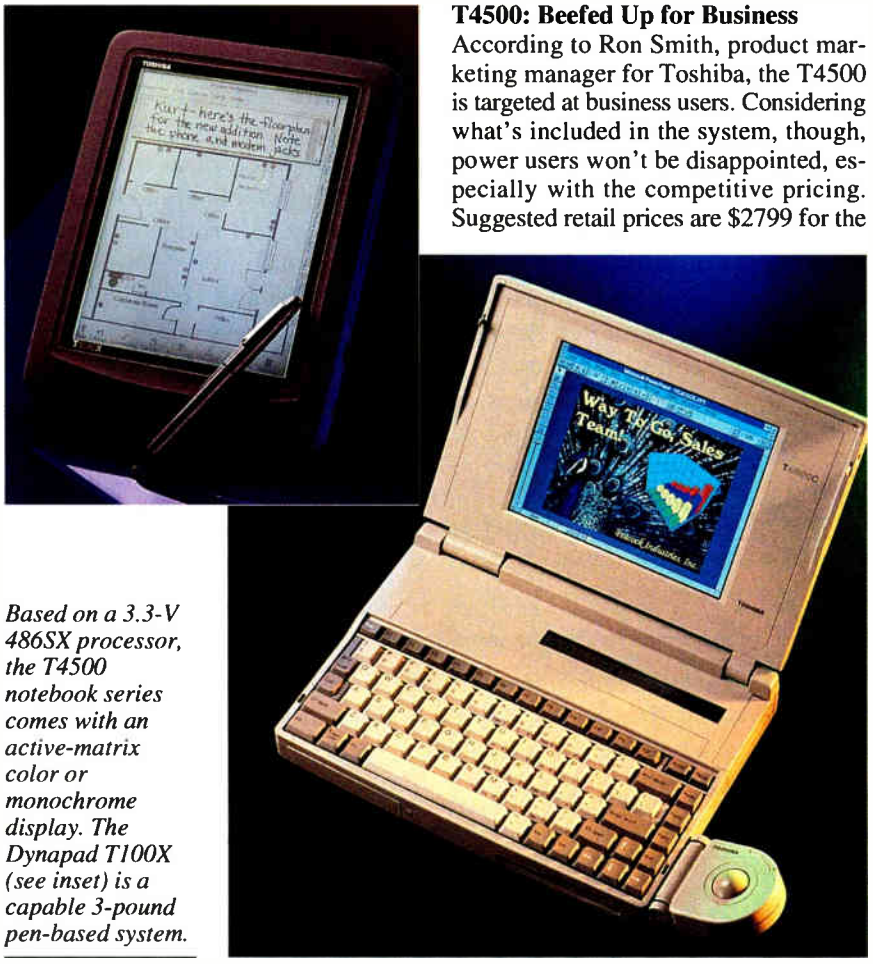
World Radio History

Two Toshiba Systems to Go

GENE SMARTE

Toshiba stays on the cutting edge with a 3.3-V 486 notebook and a promising pen-based system

Toshiba America Information Systems thinks that a lot of business users are in the market for a more powerful notebook. It also believes that a smaller group of computer users with specific applications needs a pen-based system. Based on a look at preproduction versions of the T4500 series notebooks and the Dynapad T100X, Toshiba should have hits in both categories.



Based on a 3.3-V 486SX processor, the T4500 notebook series comes with an active-matrix color or monochrome display. The Dynapad T100X (see inset) is a capable 3-pound pen-based system.

T4500: Beefed Up for Business

According to Ron Smith, product marketing manager for Toshiba, the T4500 is targeted at business users. Considering what's included in the system, though, power users won't be disappointed, especially with the competitive pricing. Suggested retail prices are $2799 for the system with a monochrome display and $4399 for the system with an active-matrix color display.

While you'll pay a hefty price for the T4500C with its color display, its 6½-pound weight compares favorably to the monochrome version's 6 pounds, and its thickness increases only slightly from the 11¼ by 8⅛ by 1⅛ inches occupied by the monochrome version. The monochrome display is 9½ inches diagonally, with 640- by 480-pixel resolution and 64 shades of gray. The color display is also 640 by 480 pixels, but it has 256 simultaneous colors. It measures 8⅝ inches diagonally.

Aside from the major display and minor weight and thickness differences, the two units are identical. Both use a new 3.3-volt 20-MHz Intel 486SX processor. Keith Comer, senior product planner, said that Intel asked Toshiba if it wanted a 3.3-V 486SX. This processor fit in with Toshiba's future plans, and the company designed the T4500 with the new processor in mind, including use of 3.3-V RAM.

Smith says that while Toshiba believes it's the only company using the processor right now, Intel may make it available to others. The 486SX includes 8 KB of internal cache memory. According to Toshiba, the T4500's battery life will equal or surpass systems based on Intel's new 3.3-V 486SL (see the text box "A Higher End for Compaq Notebooks" on page 47).

The T4500 includes a nifty LCD strip that replaces the usual set of LED status indicators. Icons show battery capacity remaining; power-saving modes; hard disk access; cursor, number, and Caps Lock modes; and other system operating conditions. This is a nice, well-executed touch.

Other standard system features are an 80- or 120-MB hard drive, 4 MB of RAM (user-expandable to 20 MB using Toshiba's memory cards), a 1.44-MB floppy drive, an 18-mm PCMCIA slot, and a snap-on (i.e., no-cord) Microsoft Ballpoint pointing device that clicks into a hot-shoe connector on the right side of the system. Smith acknowledges that this puts left-handed users at a disadvantage, but Toshiba will exchange the Ballpoint for a traditional mouse.

Around back are connectors for simultaneous external video output (up to 1024 by 768 pixels), serial and parallel expansion, Toshiba's docking station, and an external keyboard and mouse. There is no coprocessor socket. A PCMCIA modem card that fits entirely inside the machine,

World Radio History

A Higher End for Compaq Notebooks

Ed Perratore

Compaq understands that differentiation is the key to success in the burgeoning notebook market. But it's not ignoring another business axiom: Don't mess with success. Among features of its new LTE Lite 4/25C and 25E, the company managed to honor both rules while letting you choose between two options: lower power consumption and a brilliant monochrome display.

Compaq introduced the notebooks on November 9, the same day Intel announced the 3.3-volt 486SL microprocessor that runs the LTE Lite 4/25C, which ranks among the first notebooks available to use the low-power processor. The LTE Lite 4/25C, however, owes its rated 2- to 3-hour battery life more to advanced power management than to its 25-MHz 3.3-V CPU. In addition to existing LTE Lite features such as hibernation, advanced power management reduces the clock speed of the processor between keystrokes.

Other features of the LTE Lite 4/25C will be familiar: an 8½-inch, 256-color, active-matrix display (made by Sharp); 4 MB of RAM standard; and a 120-MB hard drive. Besides the processor and advanced power management, other new items are a whopping 209-MB hard drive option, 32-bit memory cards, and an LTE Lite option called QuickConnect ($79), which plugs into the unit and replicates the ports for fast hookups to your desktop peripherals.

There's one more notable option. The SpeedPaq 144 Modem, expected to sell at $649, is an internal fax modem that can interface using an optional cable to a Motorola or Nokia cellular phone for 9600-bps wireless transmission. (For some other phones, you'll need to add a cellular interface box as well.) Available for all LTE Lites using an enhanced option slot, the SpeedPaq will send data (other than faxes) at 14,400 bps.

The Compaq LTE Lite 4/25C (right) uses Intel's new low-power 486SL processor. The LTE Lite/25E features an eye-grabbing active-matrix display.

The "black-and-white" description of the LTE Lite/25E's brilliant UltraView active-matrix, TFT (thin-film transistor), 9½-inch display is a misnomer. You get a light blue on black that is about as pleasing to the eye as you're likely to see in a monochrome display. Viewed under a magnifying glass, the pixels betray no fuzziness; you'll never see a hint of ghosting.

The VGA display supports 16 levels of gray—64 if you descend to 320- by 200-pixel resolution. If you're running an external display, you can get 256 colors at VGA resolution or 16 colors at Super VGA. Extended text is also new: The screen will display slightly taller characters to fill the top and bottom of the screen.

Other notable points of the 25-MHz 386SL-based unit are the same 64-KB cache found in existing LTE Lite/25C units (see "Compaq's Newest Notebooks," October 1992 BYTE). The model numbers 84 and 120 represent hard drive capacities (DOS 5.0 and Windows 3.1 are installed on both the LTE Lite/25E and 4/25C). RAM is 4 MB standard (with a maximum of 20 MB), and the typical duration of the nickel-metal-hydride battery is 3 hours. The product weighs 6½ pounds.

In BYTE's low-level benchmark tests, the preproduction LTE Lite/25E ranked more than a third faster than the Toshiba T2200SX on CPU performance. Keep in mind, however, differing factors such as Toshiba's slower 20-MHz 386SX processor and the 386SL's internal cache. The 4/25C beta version scored only 80 percent as fast as the 486SX-based Toshiba T4400SX in CPU tests, but video and disk tests pushed the Compaq well ahead.

Compaq is doing all it can to keep its products up to date. In this flurry of new products, the next best thing after price is distinctive features. Compaq hopes to catch your eye on both counts.

Ed Perratore is a BYTE news editor based in New York. He can be reached on BIX as "eperratore."

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NEWS

FIRST IMPRESSIONS

including the jacks, is in the works.

The monochrome system comes standard with a nickel-cadmium battery pack that will give you more than 3 hours of typical use. The color system includes nickel-metal-hydride batteries that also provide at least 3 hours of life.

Smith says that you can expect about 20 percent and 38 percent speed improvements, respectively, in Excel and Word compared with a 25-MHz 386SL. Going to 3.3 V also gets you about 40 minutes more operating time per charge. While I didn't have time to fully discharge the battery pack, the BYTE benchmarks showed that the T4500's performance ranks it about where you'd expect: between a 33-MHz 386 and a 25-MHz 486 desktop system.

Dynapad T100X: Pen Progress

Toshiba admits that pen-based computing is a vertical market. The technology, particularly the handwriting-recognition capability, just isn't ready for broad-based applications. There is, however, plenty of pen appeal for niche applications.

The Dynapad is built around a 3.3-V 25-MHz 386SLV from AMD. This sleek electronic tablet measures 10⅜ by 7⅛ by 1⅜ inches and weighs just over 3 pounds. Kyp Walls, the senior brand manager for Toshiba, says research suggests that 3 pounds is the most a user wants to lug around all day.

The Dynapad has a 40-MB hard drive (with 18-millisecond access), 4 MB of RAM (user-expandable to 20 MB), a 9½-inch VGA (i.e., 16 gray scales) transreflective display, two PCMCIA slots, and serial, parallel, PS/2 keyboard, and floppy drive connectors. Power comes via nickel-metal-hydride batteries, with a nominal operating time of 2½ hours. Walls said that the batteries may last up to 7 hours if the system remains in the lowest power-consumption mode. Recharge time is 1½ hours.

You can order the Dynapad configured with either Windows for Pen Computing or PenPoint. The pen fits into a slot on one end of the enclosure and remains visible. Toshiba reports that while some pen-based systems store their pens out of view, this can lead to trouble if you don't notice that the pen isn't in its storage compartment.

Walls says that many projected Dynapad owners will use the system outdoors. The backlit transreflective screen lets you turn on backlighting when needed. In sunlight, however, you can switch off the backlighting and still have a readable display. At night, you can use the backlight; during the day, save the batteries and let the sun do some of the work.

While handling the Dynapad, I had some reservations about being able to hang on to the smooth, rounded-corner design. The rubberized-paint finish does provide a finish that can be gripped, though, and different cases (some water-resistant) should be available soon.

It's difficult to get too excited about pen-based systems unless you have a specific use in mind. Toshiba believes that medical personnel, salespeople, fleet workers, and nonoffice workers everywhere are eager to move from paper to pen. Meanwhile, the promise of pen-based computing continues to intrigue us all, and the Dynapad is a great example of technology in progress. ■

Gene Smarte is a BYTE senior news editor based in Los Angeles. He can be reached on BIX as "gsmarte."

THE FACTS

T4500
with 80-MB hard drive, $2799
with 120-MB hard drive, $2999

T4500C
with 120-MB hard drive, $4399

Dynapad T100X
$3499

Toshiba America Information Systems, Inc.
Computer Systems Division
9740 Irvine Blvd.
Irvine, CA 92718
(800) 334-3445
(714) 583-3000
fax: (714) 587-6034
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Compaq LTE Lite 4/25C
Model 120, $4099
Model 209, $4399

Compaq LTE Lite/25E
Model 84, $2999
Model 120, $3199

Compaq Computer Corp.
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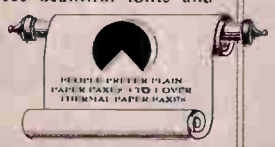

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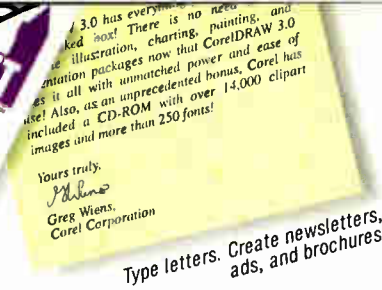

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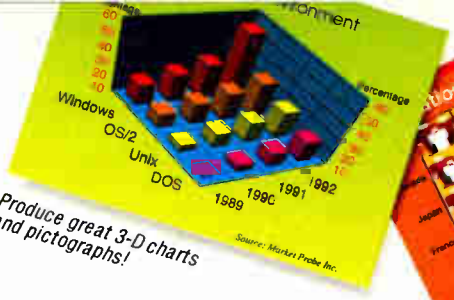

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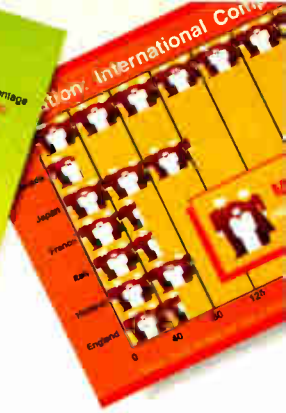

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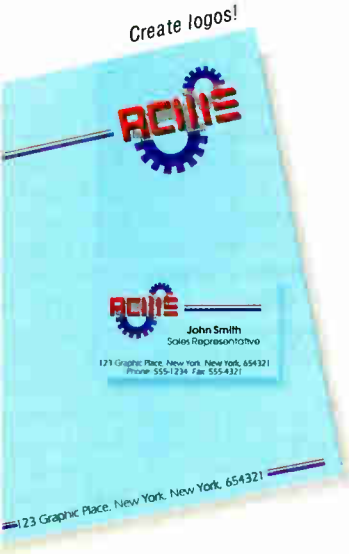

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UnixWare: New Hope for Unix?

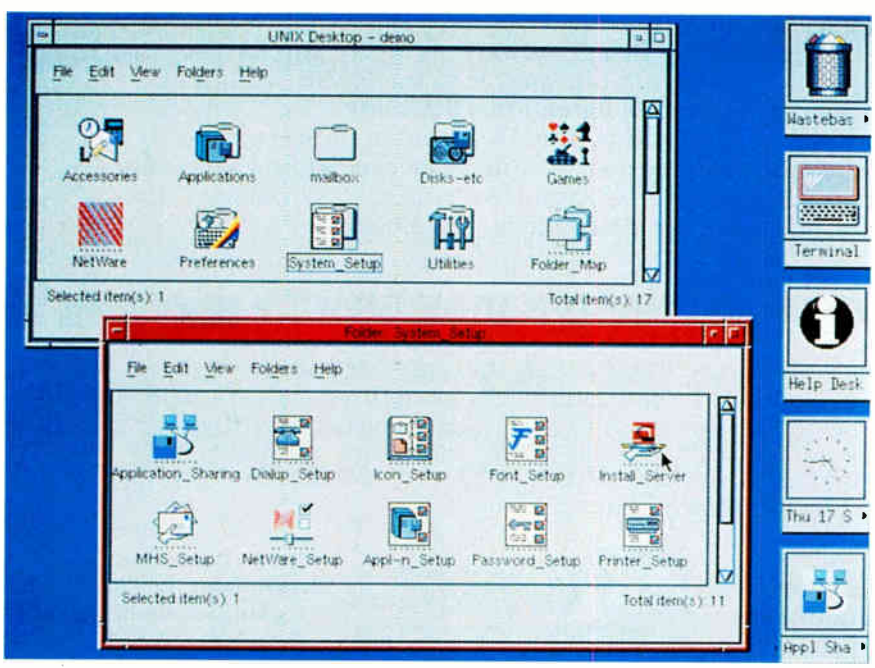
TOM YAGER

Is Univel's UnixWare enough to finally bring Unix to the PC user's desktop?

The coming together of Unix System Labs and Novell to form Univel resulted in what may be the PC Unix that can do real battle with the likes of Windows NT—UnixWare. Probably the biggest bombshell to hit the Unix market in years, UnixWare is Univel's hope for networked applications.

I evaluated the beta release of the UnixWare Application Server Edition on a Uniq 486/50 with 8 MB of memory and an AMI EISA SCSI caching hard drive controller. The entire software set is contained on a single CD-ROM, easing installation considerably. It required an overnight installation, however, to bring in all the modules.

At least two potential audiences might be served by UnixWare: traditional Unix users who are looking for better application compatibility and support, and those with demanding applications who seek a standards-based way to distribute the applications through a network. For the first group, UnixWare will feel familiar. System V release 4.2 inherits many of its traits from previous System V releases. Of course, the unique benefits of release 4.2 distance this release from its predecessors. Some of these benefits are real-time processes, dynamically loadable kernel modules, nearly universal source code compatibility with other popular Unixes, and standardization of components.



UnixWare's modular architecture provides growth for networked applications.

The second audience—those who aren't "traditional" Unix users—is the one Univel seems most interested in reaching. In an effort to dispel the fears of those who view Unix as a user-hostile system, the installation of UnixWare results in a system that boots to a graphical log-in dialog box. Old-fashioned Unix types can make the graphics go away with a hot-key sequence, but that graphical touch symbolizes what Univel is pinning its hopes on.

The installation and the graphical interface make this the easiest PC Unix to get running. The installation is vastly improved by a collection of little things, such as the DOS FDISK-look-alike partition setup interface, the routine that reaches out and verifies the settings of your network card, and the mouse installation that indicates whether you've set it up right.

The default interface for UnixWare is the X Window System, running under a desktop manager that provides a Mac-like metaphor of folders and icons. You can choose whether you prefer your desktop to look like Open Look or Motif, thanks to an X toolkit (i.e., programming interface) called MOOLIT. Other applications built using the MOOLIT tools can also take on either interface's appearance and behavior. MOOLIT is not a Motif-compatible programming interface, so you must translate or rebuild existing Motif applications using third-party Motif libraries.

It's Your Serve

UnixWare's Application Server Edition includes the facilities required to set up a PC as an engine that shares files and runs programs remotely. DOS users running a NetWare shell can run nongraphical Unix applications across the network through a Novell Virtual Terminal session. Other UnixWare users, particularly Personal Edition users running the optional TCP/IP and NFS (Network File System) upgrade, will get the most benefit from UnixWare's distributed computing support. Through X, you can launch applications that run on the application server but present their interfaces on your own desk. Under the covers, client/server applications can converse via a variety of protocols.

continued

World Radio History

Perhaps the most notable triumph over Unix's fabled unpleasantness is the wrapping of NFS in an application that allows UnixWare users running NFS to set up a controlled peer-to-peer LAN. The style of presentation is similar to that of the file-sharing interface under the Macintosh's System 7.0. Even if you do not understand a thing about Unix or networking, you can attach to any NFS server and have the network link appear as a folder on your desktop.

One thing that made me a little nervous was the struggle I had with the drivers for the graphics system. UnixWare's implementation of X uses dynamically loadable libraries, so configurations can be changed on the fly. The beta release defaults to the only "safe" VGA setting: 640 by 480 pixels and 16 colors. I tried to get a more ambitious display mode going, but, despite going through a pile of cards that seemed compatible with UnixWare, only an old Orchid ProDesigner card let me fire up a 640- by 480-pixel, 256-color mode. This is a beta release, though, so driver problems are to be expected.

Yes, But Is It Unix?

Univel apparently chose to keep much of Unix's old feel. "Just users" can forget there's Unix under there, though. And on features alone, UnixWare is one hot number: networked file, mail, printer, and application sharing; NetWare client connectivity; DOS compatibility; high-performance multitasking and virtual memory; a network-capable windowing system with scalable Adobe Type Manager fonts; two levels of hypertext help—and these are just the highest of the high points.

As with most operating systems, the chance that UnixWare will succeed is governed less by its capabilities than by how effectively Univel can coax developers onto the UnixWare bandwagon. Unix System Labs was wise to bring Novell in. As a Unix fan and a user who expects *everything* from his network, I think UnixWare looks like just the ticket. ■

Tom Yager is director of BYTE's Multimedia Lab and author of Unix Program Development for the IBM PC *(Addison-Wesley, 1991). He can be reached on the Internet at tyager@bytepb.byte.com.*

THE FACTS

UnixWare
Personal Edition, $495
Application Server Edition, $2495
Software Development Kit, $995

Univel
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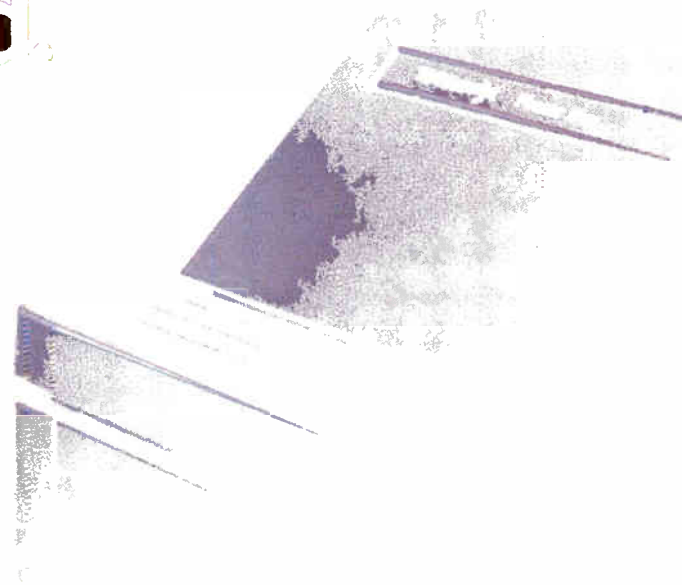

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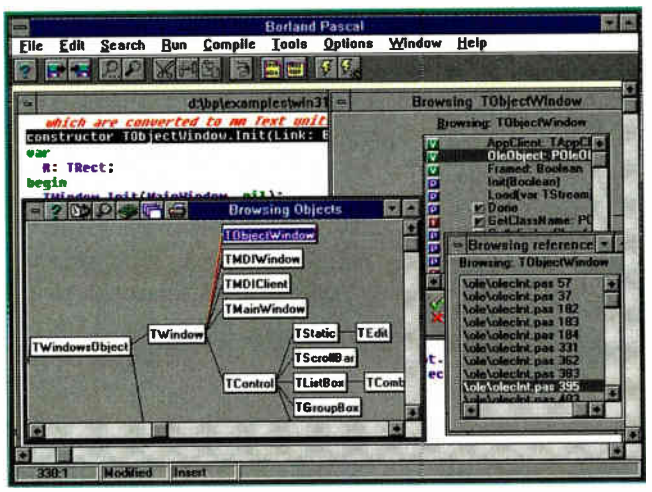
Borland Revamps Its Pascal Lineup



Turbo Pascal was the breakthrough product that established Borland International in 1983. Ever since, it has remained entrenched as the most popular midrange programming language on PCs—more powerful than BASIC, and surpassed only by C and C++ for professional development. With the recent release of **Turbo Pascal 7.0** and **Borland Pascal with Objects 7.0**, Borland hopes to retain its position as programmers migrate from DOS to Windows.

These new releases add numerous enhancements and also update Borland's entire Pascal line. TP 7.0 is positioned as an entry-level language. It's for programmers who want to write DOS applications in real mode (i.e., 8086/8088 compatible) and learn object-oriented programming. Next up the ladder is Turbo Pascal for Windows 1.5, a Windows-only package that remains unchanged.

BPO 7.0 is the high-end package for professionals who want to write object-oriented code for either DOS or Windows. It was created by combining all that comes with TP 7.0 and TPW 1.5 and adding some additional goodies as well. For example, BPO has a new DOS development environment for writing large 80x86 protected-mode applications using extended memory beyond 640 KB. Although TP has a command-line compiler that runs in protected mode, it targets real mode only.

Another major new feature is that BPO lets you write DOS programs that can call routines in Windows DLLs—something not found in any other programming language. On top of that, BPO makes it a snap to write your own DLLs. It takes only three more lines of code than declaring an internal function or procedure, and two of those lines are `Begin` and `End`.

Windows programmers will appreciate BPO's new printer objects, which reduce the amount of code you must write to print documents. The object browser is improved and can be accessed outside the debugger. A new utility, Turbo Profiler, helps you analyze and optimize your code. Another utility, WinSight, is an improved version of the Windows message viewer in TPW. And if your program crashes on a fatal error, a new postmortem debugging tool called WinSpector will find out why.

Other new features that are common to both TP and BPO will please DOS and Windows programmers. For example, the compiler's capacity has been quadrupled to more than 4 million lines of code in files as large as 25 MB. New optimizations produce faster-running code, especially on 386 machines, because the run-time library automatically uses the 386's 32-bit instructions for long-integer math.

According to Borland, all text-file I/O routines—including `Read`, `Write`, `ReadLn`, and `WriteLn` operations with all data types—are 30 percent to 100 percent faster. To informally test this, I used a beta version of BPO to recompile some programs written with the previous version of TP and noticed an improvement in speed.

New reserved words include `Break` and `Continue`, for ending or resuming execution in the middle of a loop; `PChar`, for declaring null-terminated strings; `Inherited`, for calling the method of an ancestor object without specifying the ancestor's type; and `Public`, for separating methods and fields that are public or private.

When calling functions and procedures, you can now pass constants as well as variables and values. You can also pass arrays or strings whose sizes aren't specified in the subprogram's declaration.

Almost the only thing missing in Borland's Pascal lineup is a visual programming interface, such as the one in Microsoft's Visual Basic. There's no doubt that Borland has greatly reduced the amount of code you must write to construct a Windows user interface, thus turning what could be days of tedious work in C into a few hours' of work in Pascal. But with Visual Basic, even a nonprogrammer can build a user interface and event framework in minutes without any code at all.

Although BPO and TPW include Resource Workshop, a Macintosh-style resource editor, it's poorly integrated, and you still have to wire the resources into your code and manage your own event loop. To address this issue, Borland is offering a $49.95 add-on called ProtoGen, which lets you visually create a user interface and automatically generate Windows-ready Pascal source code. Also, I've heard hints of a better solution still to come. Until then, Borland's Pascal may not be the easiest route to Windows programming, but it's the easiest way to write high-performance Windows programs.

—Tom R. Halfhill

continued

THE FACTS

Turbo Pascal 7.0
$149

System requirements:
DOS 3.3 or higher, 512 KB of RAM, and a hard drive or two floppy drives. Protected-mode compiler requires a 286 or higher, 2 MB of RAM, and a hard drive.

Borland Pascal with Objects 7.0
$495; $149 upgrade from any previous version of Turbo Pascal.

System requirements:
A 286 or higher with 2 MB of RAM, a hard drive with 27 MB of free space, DOS 3.3 or higher, Windows 3.x, EGA or better graphics, and a mouse.

Borland International, Inc.
1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95067
(800) 331-0877
(408) 438-8400
fax: (408) 439-9273
Circle 1175 on Inquiry Card.

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To anyone who has ever dreamed that personal computing could be even easier than it is today.

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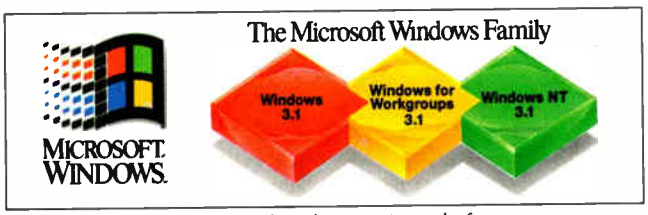

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After all, people need their computers to do more these days than increase their level of personal productivity.

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So we've added two new operating systems to the Windows family.

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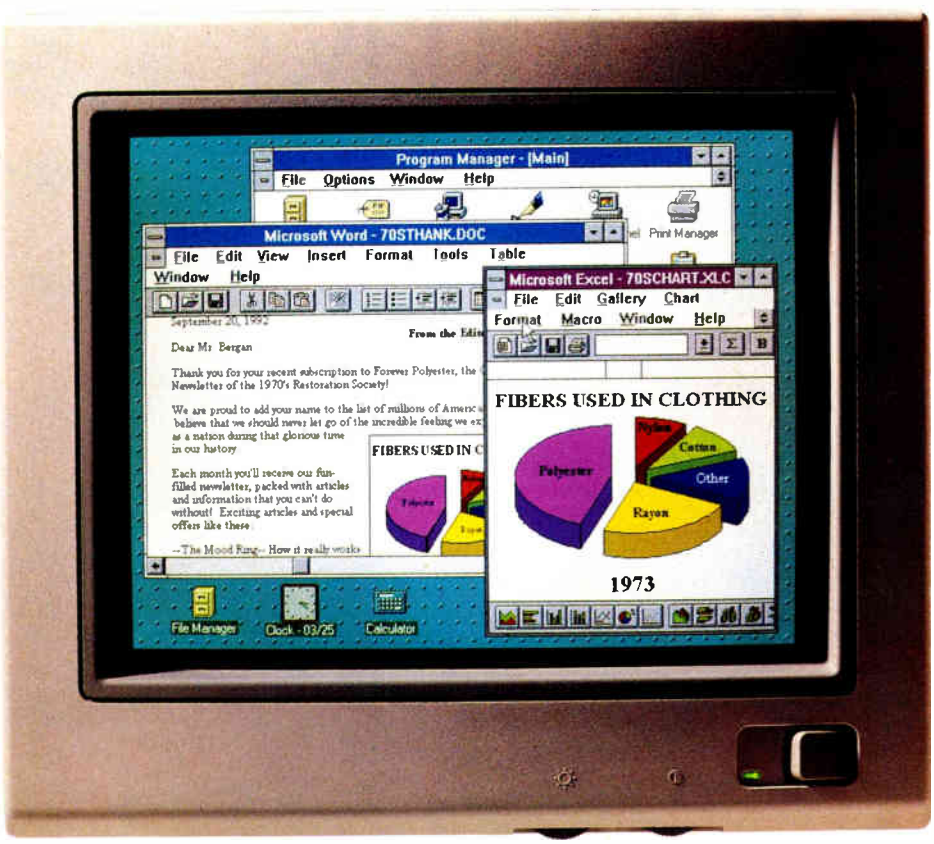
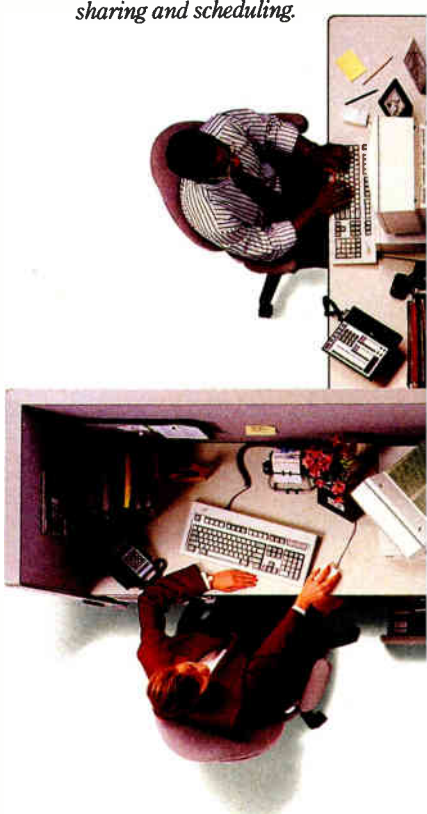
Windows for Workgroups lets people work together through built-in electronic mail, file sharing, printer sharing and scheduling.





"If you're a developer, you can get a copy of the Win32 Preliminary SDK for Windows NT by calling Microsoft Developer Services at (800) 227-4679. © 1992 Microsoft Corporation. All rights reserved. Printed in the USA. Inside the 50 United States, call

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wake-up call.

Workgroups 3.1. It has built-in networking that gives you a whole new level of productivity.

And we'll soon be releasing the Microsoft Windows NT™ 3.1 operating system.

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There's one way to make sure a new PC is going to be easier to use. Just look for this logo.

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If you'd like more information, call us at (800) 426-9400, Department HM4, for your free 8-page color brochure. It's time for you to get started on a new day.

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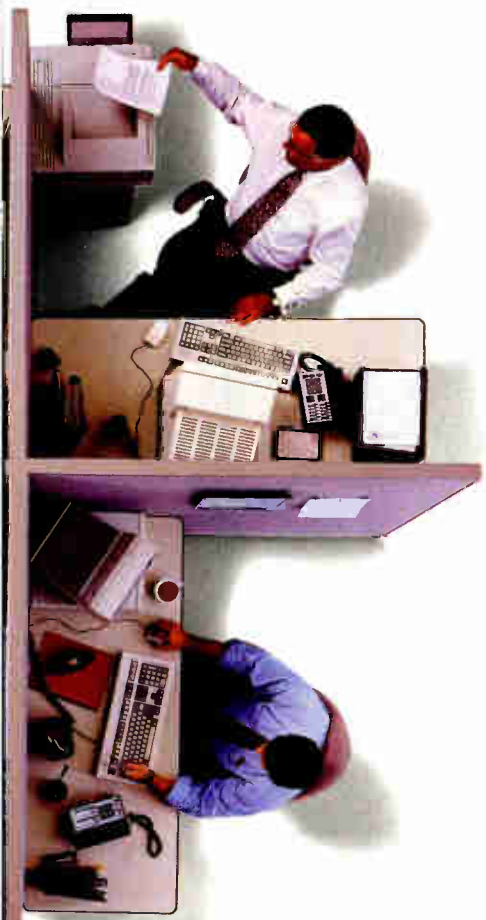

MICROSOFT WINDOWS NT 3.1

It's a fully 32-bit, scalable, multitasking Windows operating system with built-in networking capabilities and advanced security. It will be available to end users in early 1993.

0) 426-9400, Dept. HM4. Outside the U.S. and Canada, call (206) 936-8661. Customers in Canada, call (800) 563-9048. Microsoft is a registered trademark and Windows, Windows NT and the Windows logo are trademarks of Microsoft Corporation.

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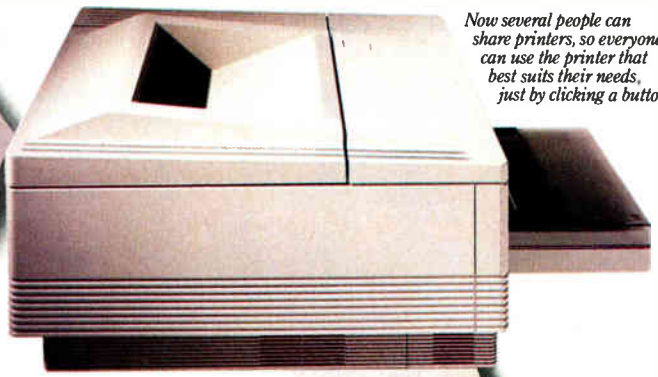
Introducing Wind
It's based on the idea th
require a generous a

All it takes is a few clicks of the mouse to share files and share information. No more long walks down the hall.

Now several people can share printers, so everyone can use the printer that best suits their needs, just by clicking a button.



MICROSOFT WINDOWS FOR WORKGROUPS

We've also included Microsoft Schedule+, so you can manage calendars and schedule meetings with others. And you can spend more of your workday actually working.

Since we've included Microsoft Mail, you can instantly send electronic mail to individuals or everyone in your workgroup. You can even add sounds and pictures.

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ows for Workgroups. at business relationships mount of give and take.

As anyone in business would tell you, success often depends on how well you can work with others.

Not coincidentally, this is the strength of the Microsoft® Windows™ for Workgroups 3.1 operating system.

In fact, with its built-in networking, one could describe Windows for Workgroups as downright gregarious.

The file manager toolbar lets you use your network as fast as you can point and click. It gives you access to commonly used functions, such as sharing files and sending documents, at the touch of a button. How could sharing information be any easier?

For starters, you can say goodbye to the old "mind if I borrow your disk" routine. With Windows for Workgroups, you'll be able to share files and applications, even printers, faster than you can say "eject."

And then there's this handy little feature called Schedule+.

Say you want a meeting on Tuesday with Matt, who has a meeting with Duncan and Karen, who, wouldn't you know it, are meeting with Jim that same day.

No problem.

Just a couple of clicks and, zip, everyone's schedules are laid out right in front of you. So you can book a meeting without making a jillion phone calls.

Even things as basic as sending memos are simplified with Microsoft Windows for Workgroups. Now you can send electronic mail, including voice and graphics, to anyone in your workgroup.

In other words, Windows for Workgroups lets you share something with your coworkers other than frustration.

But just because it has these advanced capabilities doesn't mean that you'll need an advanced degree to understand it.

Quite the contrary.

Microsoft Windows for Workgroups is based on the familiar interface that millions of people have come to love. Even if you've never used Windows, it's the ideal starter network.

And since it works with Windows-based and MS-DOS® applications just like Windows 3.1, you can preserve and build on any investment you make in Windows.

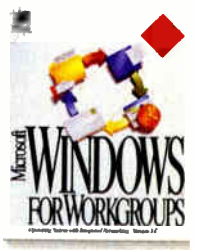
Which brings up our final point.

Windows for Workgroups is great for creating workgroups on existing networks, like LAN Manager and NetWare®, as well.

All in all, Microsoft Windows for Workgroups will give you an entirely new level of productivity.

To find out more, go to your local computer retailer. Or call us at (800) 426-9400, Dept. HM4, for the store nearest you.

Once you find out everything it can do, you'll want to share it with everyone.



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Epson Progression: Born to Run Windows

The **Epson Progression** is the first system to incorporate the Wingine 64200 graphics chip from Chips & Technologies, a hot new graphics engine with a unique memory architecture that promises snappy Windows performance—and a good price. C&T's Wingine is such an integral part of Epson's system design, in fact, that the company initially introduced the machine as the Epson 486/Wingine PC.

C&T's Wingine 64200 graphics chip is not an accelerator, such as those from S3 and ATI Technologies; that is, it does not provide BitBlt or line-drawing capabilities in hardware. Instead, the Wingine is a superfast frame-buffer controller. In a Wingine design, the CPU accesses video memory directly through the system-memory controller. The connection between the system-memory controller and VRAM (video RAM) is direct and thus does not run through the Wingine chip. To the processor, VRAM "looks" exactly like any other memory on the CPU's memory bus.

This architecture shines when moving big blocks of memory from system RAM to VRAM. C&T claims that its new chip achieves data transfer rates of up to 60 MBps when used with very fast CPUs. It's not as good for applications in which you need to make modifications to data that is already on-screen, however. Thus, you'll see the most benefit from the chip (versus accelerators) when you're working in bandwidth-hungry applications such as Microsoft Video for Windows and the least benefit in operations like scrolling or writing text.

The Wingine's other major selling point is its low cost. At the chip's introduction, C&T sold it for just $18 in OEM quantities. This pricing, along with an uncached memory design, helps Epson deliver the Progression at a very reasonable $2799 in a 486/33 configuration with a 240-MB hard drive.

Besides its graphics capabilities, the Progression offers a fast uncached memory architecture Epson calls VirtualCache. VirtualCache refers to a collection of memory-optimization strategies, including familiar optimizations such as page-mode interleave and innovations such as page-prediction hardware and other patented techniques. Both reads and writes are buffered on a 64-bit path through the memory controller. Epson contends that this design, plus the 486's internal 8-KB cache, delivers high system performance without the considerable expense of a second-level cache.

The Progression's benchmark scores were a mixed bag of good and not-so-good results. I tested a Progression with a 486/33 processor module, running BYTE's Windows graphics tests and standard system benchmarks.

On BYTE's Windows benchmarks, the Wingine-based Progression places somewhat below such accelerators as Orchid Technology's Fahrenheit VA and ATI's Ultra Pro running in similarly configured machines. On basic graphics tests (e.g., drawing rectangles and polygons) the Progression excels. However, it was slower on text and line-drawing operations. What you'll notice in using the Progression is that the operations that normally "feel" slowest in Windows are those that are the most enhanced.

Outside Windows and running as a plain Super VGA engine, the Wingine still ran quite well. BYTE's System Video index puts the Progression just ahead of Hewlett-Packard's local-bus-based 486/33u and a little behind Compaq's 433i. However, the Progression's uncached memory system is clearly somewhat slower than the cached designs of the other two systems; BYTE's CPU benchmark measured a gap of about 13 percent between the Progression and HP's and Compaq's cached 486/33 systems. The difference in the benchmark is primarily due to the better performance of the cached systems on 8-bit memory accesses. Epson maintains that 16- and 32-bit memory reads and writes, on which the Progression performed well, are much more commonly executed operations.

In addition to benchmarking, I used the Progression while working in Windows, which let me try out Epson's gorgeous 17-inch monitor. The monitor was somewhat hard to tweak for each frequency, but once I got that going, it looked great. The Wingine-based graphics system runs at resolutions of up to 1024 by 768 pixels and in 256 colors at high refresh rates. Together, the Wingine/monitor pair created a nice Windows environment.

The Progression also delivers all the features we've come to expect from brand-name, midrange desktops: an expandable CPU module, IDE and peripheral support on the system board, easy access to drives and other components, and plenty of room (six slots) for expansion. It's a solidly built machine.

The Progression presents an unusual mix of high performance and low cost. Its Wingine accelerator is fast—and although it's not fastest at all applications, it provides a system that's considerably less expensive than a clone with an off-the-shelf ATI Ultra Pro. The system's VirtualCache doesn't quite deliver cached performance, but it saves the expense of SRAM (static RAM) and a more crowded and complex system board.

—Steve Apiki

THE FACTS

Epson Progression
with a 486DX/33 processor, 4 MB of RAM, and a 240-MB hard drive, $2799
17-inch Professional Series monitor, $1099

Epson America, Inc.
20770 Madrona Ave.
P.O. Box 2842
Torrance, CA 90509
(310) 782-0770
fax: (310) 782-5220
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BOB'S Tropical Fish GRUBS

2nd Notice

Your account is now 60 days **PAST DUE.** We hope you are paying more attention to your guppies than you are to us. Remit your payment to avoid further action.

Please pay your bill so we can pay our bills.

BOB'S Tropical Fish GRUBS

3rd and FINAL NOTICE

Your account is now ***Seriously Delinquent.*** If you do not pay the total amount due by Friday midnight, your guppies will be repossessed, your credit damaged and your fishing license revoked.

Remember, we know where your guppies live.

BOB'S Tropical Fish GRUBS

Thank You

We appreciate your prompt payment. As always, we value your patronage and we look forward to seeing you soon.

P.S. By now, you've discovered the phenomenal rate at which a Tahitian Swayback Guppy grows. Coincidentally, for a limited time, our 100-gallon aquariums are now on sale.

Have a nice day!

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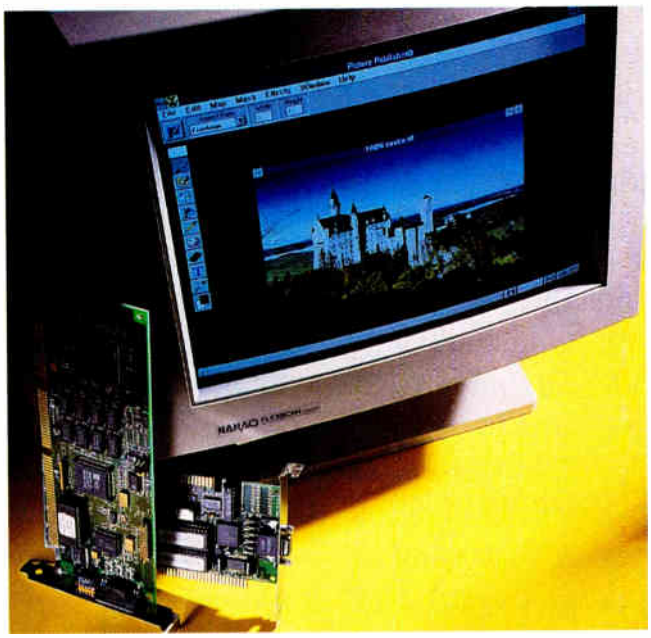
A Window to Windows

To do the things that make Windows powerful (e.g., running multiple applications, passing data between programs, and working with two or three open windows on the desktop), you need real estate. Standard VGA resolution just won't cut it anymore. The 15-inch Nanao **Flexscan F340iW** strikes a nice compromise, being within the price range of a quality 13- or 14-inch monitor and much more usable at resolutions beyond standard VGA.



The Flexscan F340iW displays bright colors and crisp images, and the design addresses ergonomic and ecological concerns. Some impressive features at this price include a flat-screen CRT, fast refresh rates, support for multiple scanning frequencies, and VLF and ELF emissions.

Clearly, a lot of thought went into the design of this monitor. A row of push-button controls and a single analog knob are conveniently placed below the screen. You press a push button to activate an adjustment and use the knob for positioning. Once you've made all the adjustments, you can store up to three setting configurations. On different computers or in various display modes, the monitor automatically restores the optimal configuration to match your hardware. The unit powers down if no video source is sensed. The Flexscan F340iW won't take the place of a larger screen if your applications include such things as desktop publishing or CAD, but I recommend it highly for mainstream Windows use.

The other side of the display equation, the graphics adapter, also deserves special consideration on a Windows platform. Hercules has introduced an accelerator, the **Graphite Card**, with a new 32-bit GUI accelerator chip from IIT. The IIT chip is the crest of a new wave of 32-bit accelerator chips from major players such as S3 and ATI Technologies. Although I had a preproduction ISA-bus board with beta drivers, preliminary benchmarks indicate that this new chip is a screamer. At 1024- by 768-pixel resolution with 256 colors, the Graphite Card's Wintach scores were significantly higher than those posted by boards based on currently available graphics chips. The 1 MB of VRAM (video RAM) enables 24-bit color and resolutions of up to 1280 by 1024 pixels (interlaced). Hercules plans to offer a VL-bus version of its card. Given the performance of the ISA-based Graphite Card, the VL-bus version should be a real speed demon.

Western Digital is also going the VL-bus route with the new version of its **Paradise Accelerator**, which will be available soon. I ran the card in a preproduction VL-bus system using beta software drivers, so it was hard to make solid recommendations, but graphics speed on the VL bus itself is indisputable. From everything I've seen so far, the VL bus is the way to go.

—Stanford Diehl

THE FACTS

Flexscan F340iW
$899

Nanao Corp.
23535 Telo Ave.
Torrance, CA 90505
(310) 325-5202
Circle 1177 on Inquiry Card.

Graphite Card
$399

Hercules Computer Technology, Inc.
3839 Spinnaker Court
Fremont, CA 94538
(510) 623-6030
Circle 1178 on Inquiry Card.

Paradise Accelerator
$300

Western Digital Corp.
8105 Irvine Center Dr.
Irvine, CA 92718
(714) 932-5000
Circle 1179 on Inquiry Card.

Delrina's New Fax Software Adds OCR

Fax boards and modems improved on the traditional fax machine by giving you a way to send faxes from within a word processing or spreadsheet application. But without OCR (optical character recognition), once you get the fax image in your PC, you still have to rekey the faxed document so you can open the file in a word processor.

Delrina Technology's **WinFax Pro 3.0** solves that problem through an OCR component with a spelling checker that can automatically convert faxes into an editable format such as ASCII or RTF (Rich Text Format). The OCR component is potentially a big time-saver, as is the program's advanced phone book. With the phone book, you can sort fax recipients

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Sorry, you're going to have to plug it in yourself.

By now, you really should know that the Microsoft® Windows™ operating system makes computing easier.

Now Microsoft is working with personal computer manufacturers to make it even easier for you to get up and running.

We call it Microsoft Windows Ready-to-Run. Quite simply, when you see the Ready-to-Run logo, it means that a PC already has Microsoft Windows installed.

There is no need for installation disks. No set-up procedures. No additional steps.

What's more, it means the personal computer has already been optimized to run Windows-based applications.

Just flip a switch and you're ready to start working with Microsoft Windows.

Oh, there is one little technical matter concerning an electrical plug and a wall outlet. We apologize for any inconvenience this may cause.

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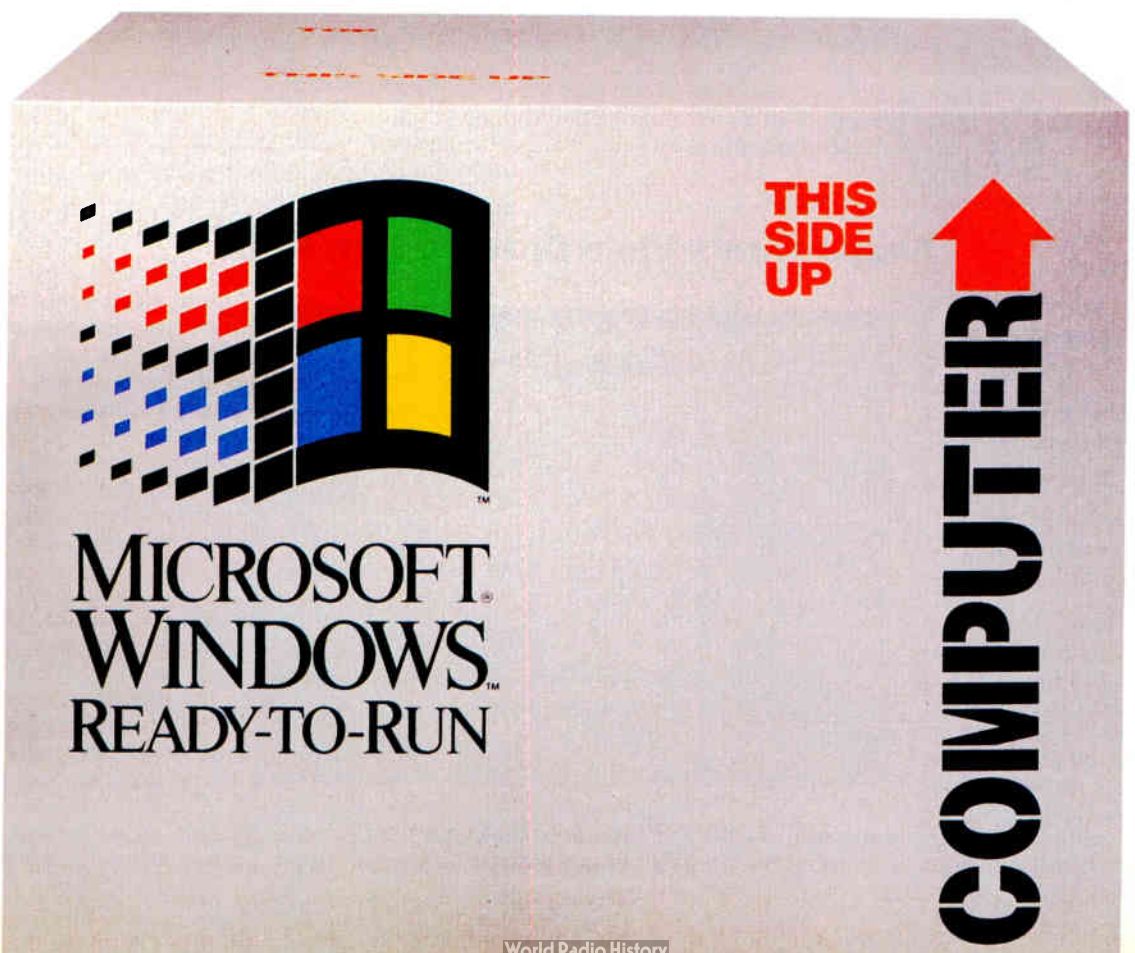

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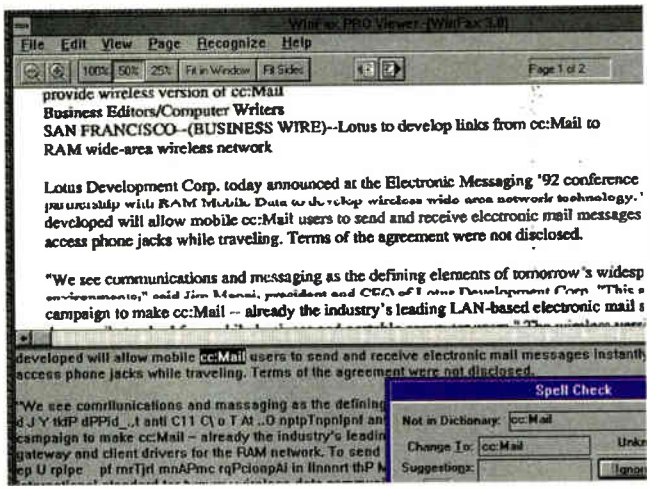
by name or company, organize them into groups, and within seconds send a fax with a customized cover page to multiple recipients.

While testing a beta version of WinFax Pro 3.0, I found that the degree of recognition accuracy varies from fax to fax and even from sentence to sentence within the same fax. Character recognition of a fax document is no picnic. Not only does the program have to deal with the usual riddles of OCR (e.g., determining if a character is a *1* or an *l*), it also has to deal with compressed characters and sentences, streak marks, and other extraneous doodles.



WinFax Pro 3.0 incorporates Caere's AnyFax OCR engine, which is optimized to handle the anomalies of fax-to-text conversion. Delrina provides several options to maximize recognition accuracy. You can block out graphics portions of a fax so the program will not attempt to "OCR" it and tell WinFax to automatically recognize multiple-column articles. A Vacuum tool helps clean up faxes.

Even with all those tools, you can still get a few words or partial sentences of gibberish when recognizing poor-resolution faxes. For example, in one fax press release that I received, the words *We see communications and messaging as the defining elements* were recognized as *We see comrllunications and massaging as the defining elements*. However, other sentences in the same press release were recognized perfectly. A split-screen Interactive Text Edit option lets you view the original fax as you fix the text version (see the screen).

With so many faxes floating around these days, you want to get your fax noticed. This is where WinFax's cover-page designer comes in. Using the designer, you can create a cover page with bit-map logos or an attention-getting cartoon to make your fax stand out. In about 10 minutes, I was able to design a fax cover page with variable text fields. With variable text fields, WinFax can automatically insert a recipient's name, company, subject, or other variable into a cover page. If you're not feeling artistic, WinFax Pro comes with a selection of predrawn cover pages.

Features such as compression of fax send-and-receive logs, archived faxes, support for TWAIN-compliant scanners, and fax annotation make this a well-rounded program. If you're standing in line at the fax machine or retyping fax documents, you're wasting time. What are you waiting for?

—David Andrews

THE FACTS

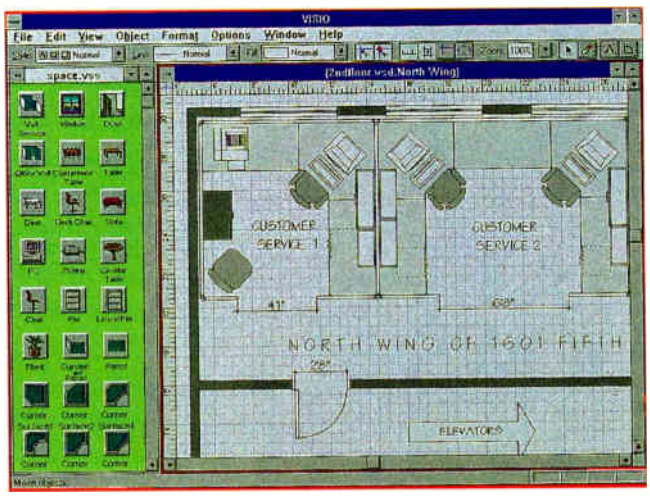
WinFax Pro 3.0
$129

Delrina Technology, Inc.
6830 Via Del Oro, Suite 240
San Jose, CA 95119
(800) 268-6082
(408) 363-2345
Circle 1180 on Inquiry Card.

Shapeware's Visio Draws a New Path

If you cringe at the mere thought of drawing, Shapeware has the software you've been waiting for. A Seattle-based software firm started in 1990 by two founders of Aldus, Shapeware has introduced **Visio**, a Windows drawing tool that's meant for the rank-and-file business user rather than the sophisticated graphic arts community.

Visio is designed to create business forms in dozens of varieties. The $299 program lets graphics novices build business or technical drawings easily by using drag-and-drop drawing techniques with hundreds of objects included with the more than two dozen stencils (or templates) that are included with the package.



Although it is possible for you to draw fairly complex images with Visio, the program isn't designed to compete with two-dimensional drafting and CAD packages. Likewise, Visio isn't targeted at graphics stalwarts such as Aldus FreeHand or Adobe Illustrator; neither does it compete with presentation packages such as Harvard Graphics, Lotus Freelance, or Microsoft's PowerPoint.

Instead, Shapeware's founders are hoping to usher in a new drawing metaphor, one using precut shapes that can be dragged into an image and shaped, massaged, or manipulated into the exact form you need to convey your message. With Visio's 15 stencils, you have 300 objects, or master shapes, at your disposal. These master shapes allow you to

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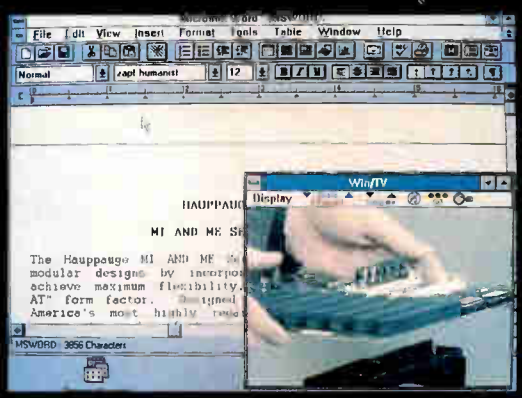

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create flowcharts, organization charts, network and logic diagrams, block diagrams, Gantt charts, office space plans, and even basic maps.

After a brief introduction, I found it easy to become acclimated to the Visio drawing metaphor, and I readily admit to being someone without innate drawing skills. With my beta copy of Visio, however, the ability to drag and drop shapes into a drawing quickly made building documents a breeze.

Visio's stencils appear on the left side of the screen after you select the type of drawing you wish to create. After pulling in several features of a flowchart, for example, you can size shapes, rotate or flip shapes horizontally or vertically, zoom in and out, and draw connecting shapes or lines. The Visio drawing engine, which supports OLE, will let users or third parties build libraries of shapes, stencils, templates, and macros that they can add to the system.

In the short time I used Visio, I became comfortable with its basic drag-and-drop approach to building a drawing. For all its apparent simplicity, Visio offers several sophisticated features, including the ability to use ShapeSheets—a spreadsheet-like interface that defines the underlying geometry of each SmartShape—to fine-tune every aspect of a drawing's shapes. With that capability and its many other drawing features, Visio has a good chance to leave its mark on the business graphics market.

—Patrick Waurzyniak

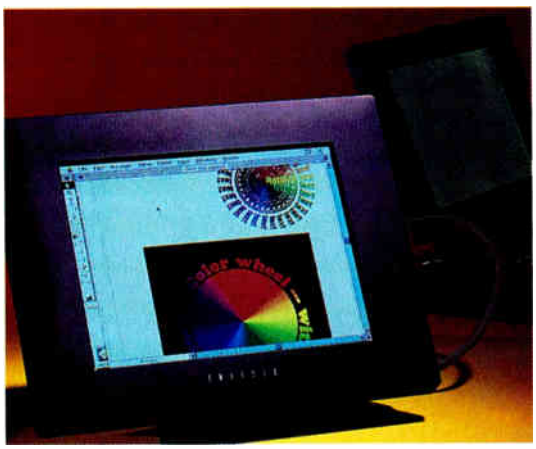
THE FACTS

Visio
$299

System requirements:
A 20-MHz 386SX or higher with 4 MB of RAM, VGA or higher graphics, Windows 3.1, and a Windows-compatible pointing device.

Shapeware Corp.
1601 Fifth Ave., Suite 800
Seattle, WA 98101
(206) 467-6723
fax: (206) 467-7227
Circle 1181 on Inquiry Card.

Bright Colors, Flat Panel



Suppose you have a color business presentation loaded and ready to go in a Mac PowerBook 180, but the client doesn't have a color monitor; or suppose the space on your desktop is at such a premium that even a small color monitor won't fit. Envisio's **ColorFrame**, a compact flat-panel color display, provides a solution for both problems.

The ColorFrame weighs only 4 pounds (the external power supply adds an extra 2 pounds), which makes it easily transportable. Its svelte 9- by 12- by 2½-inch dimensions let you pack it into a briefcase or onto a cramped desktop. The tiltable 10½-inch-diagonal active-matrix color LCD screen, made by Sharp, has a resolution of 640 by 480 pixels. Although the screen can support 4096 colors, the Envisio driver limits the display to only 256 colors. This lets the ColorFrame function with Envisio's NoteBook Display Adapter 030 for 68030-based Mac notebooks or with the built-in video of the Mac IIci, IIsi, LC, PowerBook 160, PowerBook 180, and Quadras in the 8-bit display mode.

I tried a prototype ColorFrame on a PowerBook 170 equipped with an NDA030. When I left this arrangement outside my office, practically everyone who went by stopped to comment on the ColorFrame's rich colors. The unit's backlit screen was bright, sharp, and responsive. Screen updates were snappy, and the pointer didn't ghost while mousing among application menus or on the Desktop.

When the PowerBook went to sleep, the only effect on the ColorFrame was to turn the pointer into a stopwatch icon. That's because the ColorFrame has a built-in 300-KB frame buffer that preserves the display's contents in this type of situation. I pressed a key on the PowerBook and the computer woke up, the stopwatch became a pointer, and I was back in business where I left off.

The ColorFrame's light weight let me easily tote it home, and the easy-to-tilt screen let me compensate for my desk's height and the room's lighting. I didn't have a chance to try the ColorFrame with a Mac Quadra 950 because the panel was not yet calibrated for its video, nor was an adapter cable available designed to tell the Quadra what the ColorFrame's resolution was.

The only flaw I can find with the ColorFrame is its price: $5495. This is several hundred dollars more than the list price of a fully loaded PowerBook 180 (with 8 MB of RAM, a 120-MB hard drive, and the Express Modem Kit). If you spend your life on the road lugging a PowerBook and a bulky color monitor around to give presentations, however, you might want to seriously consider the ColorFrame on the merits of its transportable weight and size, as well as its sharp screen—and hang the price.

—Tom Thompson

THE FACTS

ColorFrame
$5495

System requirements:
A color Mac or PowerBook with built-in video, or a PowerBook equipped with Envisio's NDA030.

Envisio, Inc.
510 First Ave. N, Suite 303
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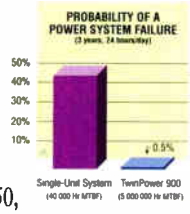

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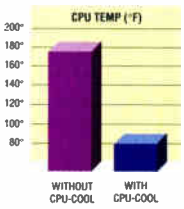
486 CPU COOLER



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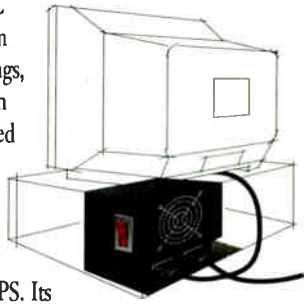

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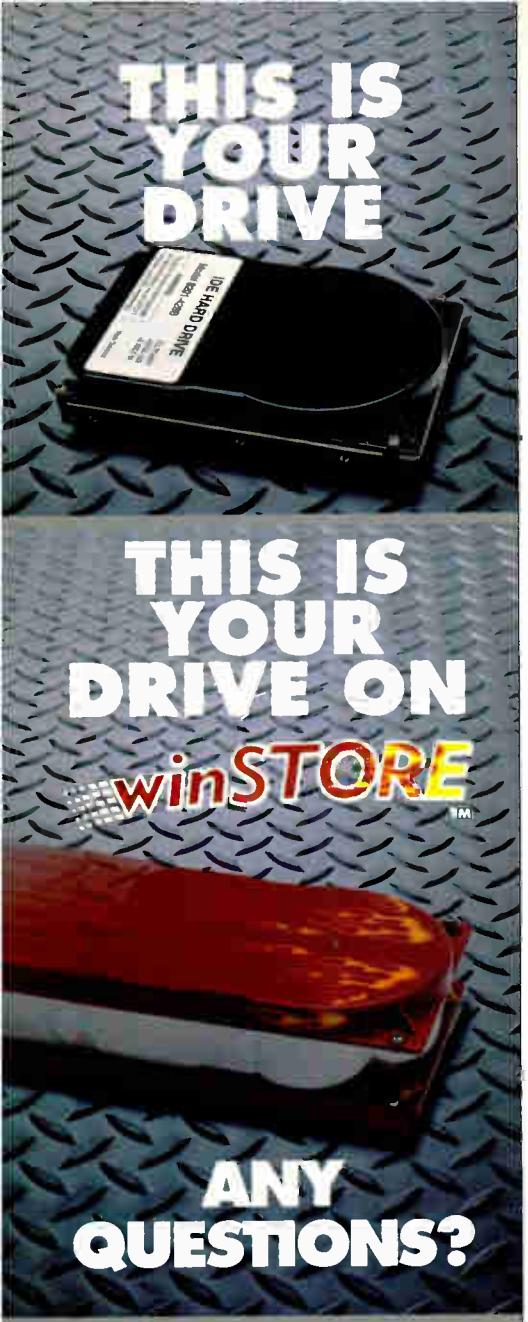

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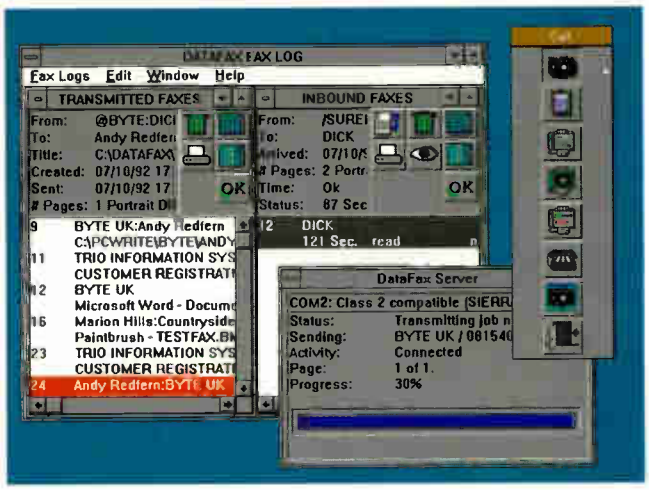
NEWS

FIRST IMPRESSIONS

Flexible Windows-Based Fax Facilities



LONDON—Fax machines became popular because they're so simple to use, and it's reasonable to expect PC fax software to be just as easy. **Datafax** from the Swedish firm Trio Information Systems comes as close to this ideal as any other product I've encountered.

Datafax is a suite of five Windows programs, two of which you leave running as background tasks to receive and send faxes. Datafax works by installing its own printer driver and capturing printer output from any Windows application to send as a fax. When you print from inside an application such as Microsoft Word, the Datafax phone-book window pops up and you click on the recipient's name to put the output into the fax queue.

The main module of Datafax is Winserve, a fax-server program that controls your fax modem and monitors incoming and outgoing traffic. When Winserve is running, faxes are automatically sent in the background (either immediately or according to a schedule). When Winserve is not running, the faxes accumulate in the outbound queue, ready to be sent in chronological order the next time you run the program.

Running the Faxq program lets you inspect the four fax logs—outbound, inbound, successfully sent, and erroneous—at any time, and you can view any pending fax simply by clicking on its name. To receive incoming faxes, you run the Infax program. The Infax icon is designed to stay on top and to blink whenever a new fax arrives.

The other two modules are Faxoffice and Captive. Faxoffice is your general command post, where you set up your fax modem parameters, design cover sheets with a built-in drawing program, view the fax logs, and maintain your phone book. Datafax supports Class 1, Class 2, and SendFax-compatible modems, among others. An ingenious import dialog box in Datafax's phone book lets you convert data from most other database formats without any preprocessing. International support is excellent. You can specify a national character set for each phone-book entry.

Faxoffice really comes into its own in a networked Datafax installation, where it allows you to relay faxes to other network users, reject junk faxes, and produce comprehensive statistics with bar charts of fax usage that are broken down by hour/day/week/month and country. You can use a nondedicated 386 workstation as the fax server.

The Captive program enables you to clip material directly from the screen and send it as a fax. Even more convenient is the ability to dash off a cover-sheet-only fax note at any time simply by clicking on the Captive icon.

Datafax is generally good-looking and slick to use. It was completely robust during my test. I recommend Datafax without hesitation. ■

—Dick Pountain

THE FACTS

Datafax
single-user, $99 (about 600 krona); five-user network license, from $595 (from about 3570 krona)

Trio Information Systems
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Sweden
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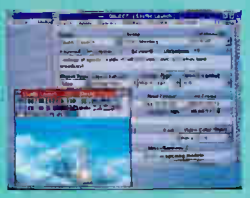
by Lenel Systems



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List: $595 Ours: $499
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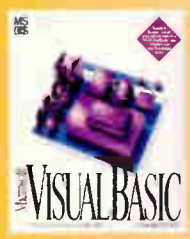
Microsoft Visual Basic for DOS
by Microsoft Corporation



Award-Winning productivity–now available for DOS! Draw forms and controls,write event-procedures, use and create custom controls–in DOS! Create all-new apps or combine with existing C/C++ or Pascal code. Highly compatible with VB/Win for multi-platform development. Even run existing MS Quick Basic/Basic PDS code! Includes a native 80 x 86 compiler that creates 100% standalone .EXE files, 386 code generation, MOVE overlays, an integrated ISAM and much more!

Standard Edition List: $199 Ours: $139
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Lahey F77L-EM/32
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Industry leading 32-bit FORTRAN Language System includes Phar Lap's 386/DOS Extender. VCPI, XMS, and DPMI compliant extender enables users to access up to 4GB and operate in the OS/2 and MS Windows DOS box. The extender is royalty-free and includes virtual memory support. 5.1 includes Editor, profiler, make utility, library manager, video graphics and 486 optimizations. Support for popular VAX, IBM VS and 90 features.

List: $1390 Ours: $1015
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World Radio History

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Multimedia Toolbook
by Asymetrix

Complete Multimedia Authoring.
Create your own multimedia applications for MS Windows. Simple interface and set of ready-to-use multimedia objects make it the fastest and easiest way to develop multimedia apps. This award-winning tool provides a complete package versatile enough to develop new applications or put a new face on existing ones, with no runtime fee.

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FAX*cetera* # 2776-0005

Bsupport for Novell's Btrieve
by Information Architects

A set of utilities to create, edit, and manipulate Btrieve data files. Other functions include data recovery, application debugging, exporting, and BUTIL replacement. Some products include Royalty-Free Distribution and C source. Versions for DOS text, Windows, and OS/2. An absolute MUST for any Btrieve developer.

List: $309 Ours: $259
FAX*cetera* # 2390-0007

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by Task Software

Create complete User Manuals four to five times faster! Manuals include Contents, Tutorials, Figures, Reference, Index, Appendices, and more! Flexible "Intelligent Text" writes up to 90% of the manual. Features 28 soft fonts, automated page layout, and global format control! Easy to use DOS system with pulldown menus, mouse support, and on-line help!

List: $199 Ours: $179
FAX*cetera* # 1004-9001

C-Heap
by Library Technologies

Best-fit malloc( ) cuts fragmentation. Dole facility reduces per-block overhead and fragmentation. Three ways to use virtual memory -autoswap or blocks copy; optional disk I/O cache. Allocate heap and vmem blocks >64K. Access UMBs, page frame via malloc ( ), DOS=UMB not req'd. Two near, two far heaps. All memory models supported. Hundreds of functions, thorough documentation, no royalty. Specify compiler.

List: $229 Ours: $209
FAX*cetera* # 1003-1701

RoboHELP™
by Blue Sky Software

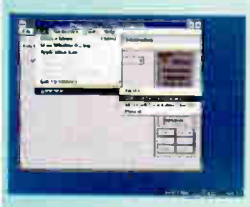
Cut your Development time by 95%. RoboHelp enables you to design, test and create a comprehensive on-line, context sensitive Help System for Windows applications using graphical objects, a tool palette, a mouse, and Word for Windows. Just fill in the actual text when prompted and RoboHELP generates all the source code for the On-Line Help System.

List: $495 Ours: ~~$449~~ NOW! $399
FAX*cetera* # 2602-0005

C/apprentice
by SymbTech

New technology for maintaining and constructing C source programs. C Functions can be mechanically evaluated, analyzed and changed based on your maintenance objectives. Every part of a C source file can be analyzed/changed, including comments, whitespace, preprocessor commands, as well as C code itself. Convert C source to equivalent C++ code, migrate C code to parallel vector machine architecture, or locate and change windowing function calls.

DOS 386 List: $895 Ours: $759
FAX*cetera* # 2553-0002



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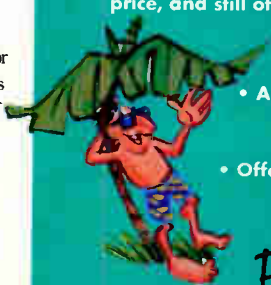

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- Offer does not apply towards obvious errors in competitor's ads
- Subject to same terms and conditions.

Programmer's Paradise®

- All prices are subject to change without notice.

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World Radio History

An Open Platform for Your Pocket

The 4.6-ounce Digital Book System-1 hand-held personal computer uses Western Digital's 16-bit CPU. An open-platform machine, the DBS-1 is designed as a mobile information tool that fits in a shirt pocket.

Capable of storing up to 90 MB of information in two removable interactive "digital books," the index-card-size unit has a QWERTY keyboard and eight function keys. The independent built-in notepad holds up to 60 lines of text, and the unit's search and spelling-checking capabilities are based on fuzzy logic. Four lithium button cells provide up to 60 hours of battery life. Digital books currently available include The Medical Letter Handbook of Adverse Drug Interactions and the Merriam-Webster dictionary.

Price: $199.

Contact: Franklin Electronic Publishers, Inc., Mt. Holly, NJ, (609) 261-4800; fax (609) 261-1631.

Circle 1272 on Inquiry Card.

Digital books snap in and out at the base of the Digital Book System-1. You can cross-reference, highlight, and transfer text from one book to the other.

Large-Screen Portable 486

BitWise Designs' ScreenStar Model 450S, built around a 50-MHz 486 CPU, has 16 MB of 60-ns RAM (expandable to 32 MB), 256 KB of cache RAM, and 500 MB of magnetic disk storage (expandable to 1 GB). The portable workstation is in a rugged suitcase shell.

The ScreenStar's 21-inch gas-plasma screen, which folds flat within the suitcase, displays at full size two 8½- by 11-inch documents at a resolution of 1280 by 1024 pixels. Two full-size ISA slots are available for application-specific adapter boards; a 5¼-inch bay can handle a second hard drive, a CD-ROM drive, or a read/write optical drive. The unit ships with Windows 3.1.

Price: $13,995.

Contact: BitWise Designs, Inc., Schenectady, NY, (800) 367-5906 or (518) 356-9741; fax (518) 356-9749.

Circle 1271 on Inquiry Card.

ScreenStar Model 450S.

Variable-Voltage Notebook

A 5-pound notebook that uses the Am386SXLV microprocessor, the CF-1000 from Panasonic has 4 MB of RAM (expandable to 12 MB). With Addstor's SuperStor disk compression utility installed, the 60-MB hard drive has a capacity of 110 MB.

VLSI Technology's VL82C315A Scamp II single-chip low-power system controller supports 3.3-V, 5-V, and mixed-mode operation without external level shifters. The CF-1000's 9½-inch VGA LCD screen has 640- by 480-pixel resolution. A detachable floppy drive lets you insert an optional second nickel-metal-hydride battery for 3 to 5½ more hours of use. The unit has serial, parallel, VGA, mouse, and dedicated AT bus ports, as well as two internal slots for RAM expansion and a modem.

Price: With 60-MB drive, $2299; with 120-MB drive, $2699.

Contact: Panasonic Communications & Systems Co., Secaucus, NJ, (800) 742-8086 or (817) 685-1213.

Circle 1274 on Inquiry Card.

Modular Choices

The modular Maxum 4150DE2 offers configurations with up to 16 GB of memory on the hard drive. Memory on the motherboard is expandable to 64 MB. Based on the 486DX2 chip, the 50-MHz system is available as a desktop, tower, and minitower.

A typical desktop model comes complete with 4 MB of RAM; 64 KB of memory cache; a 330-MB IDE hard drive; dual floppy drives; a three-button mouse; and a 14-inch, noninterlaced VGA color monitor with 1024- by 768-pixel resolution. DOS 5.0 and Windows 3.1 are preinstalled.

Price: $4759.

Contact: Maxum Systems, Inc., Brooklyn, NY, (718) 643-3385.

Circle 1273 on Inquiry Card.

Unstoppable PCs

The Unstoppable series of fault-tolerant 486-based PCs and servers uses RAID-5 disk arrays, ejectable hard drives, and a UPS (uninterruptible power supply) to allow the Astrix ArrayServer and ArrayPC to automatically recover data in the event of power or drive failures. Equipped with EISA or ISA buses, the ArrayServers have 1.1 GB of storage using four hot-swappable SCSI drives (380 MB or larger), a 500-W UPS, and a 486DX/50 with a 256-KB cache and 16 MB of RAM.

Price: Starts at $7991.

Contact: Astrix Computer Corp., Milpitas, CA, (408) 946-2883; fax (408) 946-1610.

Circle 1275 on Inquiry Card.

World Radio History

Smart Input

Not a robot but a 3-D laser digitizer, the Digibot II measures 44 by 28 by 30 inches. It "reads" multidimensional objects up to 18 inches in diameter and 18 inches tall and then produces a list of *x*, *y*, and *z* coordinates accepted by any CAD/CAM/CAE software that reads 3-D points.

Designed to be fast and precise, the Digibot II scans at 1200 points per minute at an accuracy within 0.002 inch. Digibotics includes systematic and adaptive scanning software for even or uneven surfaces.

Price: $49,000.

Contact: Digibotics, Inc., Austin, TX, (512) 832-6544; fax (512) 832-1163.

Circle 1276 on Inquiry Card.

Portable Printing

The 4.4-pound Hewlett-Packard DeskJet Portable printer can be easily toted on trips, offering HP's laser-quality ink-jet printing to travelers. Using the same thermal ink-jet print technology as HP's DeskJet desktop printer line, the DeskJet Portable offers 300-dpi resolution and prints up to 3 ppm. You can manually feed in letter-, legal-, and A4-size paper as well as transparency film and labels. An optional sheet feeder that holds 50 sheets of paper or transparencies is available.

The printer offers several built-in fonts and can use TrueType fonts. The unit has an internal recharger as well as an optional rapid recharger; battery life averages 100 pages per charge.

Price: HP DeskJet Portable, $599; cut-sheet feeder, $99; rapid recharger, $99.

Contact: Hewlett-Packard Co., Palo Alto, CA, (800) 752-0900; in Canada, (800) 387-3867.

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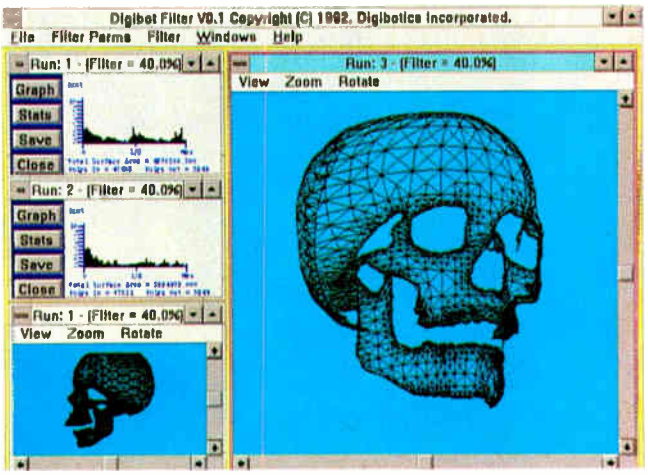


Adaptive screening software in the Digibot II automatically produces a greater number of points in an object that contains a sharp curve than in one that contains a gradual curve.

The WriteMove II, a portable printer for Mac PowerBooks, weighs 2½ pounds (including a rechargeable battery) and tucks into your PowerBook carrying case. Supported fonts include 21 from Linotype, Adobe Type Manager, and TrueType. The WriteMove's print features include 360-dpi resolution, preview, print later, and print in the background. You can choose to use the multistroke or the single-stroke ribbon. The WriteMove II also prints on envelopes and transparencies.

Price: $599.

Contact: GCC Technologies, Bedford, MA, (800) 422-7777 or (617) 890-0880; fax (617) 890-0822.

Circle 1278 on Inquiry Card.

Power Backup

The PowerTape QIC (quarter-inch cartridge) backup system, available as internal SCSI 5¼-inch drives or external devices, runs on AT, ISA, and EISA PCs. The PowerTape is also compatible with a variety of major network operating systems.

A new technology in the system achieves data transfer rates of 300 KBps (18 MB per minute) and compressed data capacity of 4 GB per cartridge. The PowerTape complies with the QIC-2GB industry standard but costs only about half as much as previous QIC systems that use 4-mm helical scanning technology.

Price: $1995.

Contact: Colorado Memory Systems, Inc., Loveland, CO, (800) 451-0897 or (303) 669-8000; fax (303) 667-0921.

Circle 1279 on Inquiry Card.

Grabbing Eyes

Grab that image with the ComputerEyes/RT frame grabber. But why isn't this software? Because this SCSI device for Macs can capture 24-bit color images from any standard video source.

The ComputerEyes/RT connects easily to a wide range of Macs and can capture color or black-and-white images at 1/30 second. Video inputs include NTSC composite video and S-video. You may predefine capture size and number of frames while choosing among TIFF-, PICT-, PICT2-, MacPaint-, or Quicktime-compatible formats. You need a Mac with at least 2 MB of RAM running System 6.07 or higher.

Price: $599.95.

Contact: Digital Vision, Inc., Dedham, MA, (617) 329-5400; fax (617) 329-6286.

Circle 1280 on Inquiry Card.

CD Fever

With either a Mac or a PC, you can watch movies on CD with Chinon's line of multimedia CD-ROM drives. Using nonproprietary SCSI drives, these models call on a 64-KB data buffer to average a 350-ms access time and a data transfer rate of 150 KBps. They support the full MPC and Quicktime specifications.

The top-of-the-line Model CDC-435 works with both the Mac and PC and includes a 12-function remote control; a headphone jack with volume control; and random-play, intro-only, repeat-single-track, and repeat-all buttons. The other models, internal and external, represent a variety of features with a range of audio and multimedia capabilities.

Price: $695 to $895.

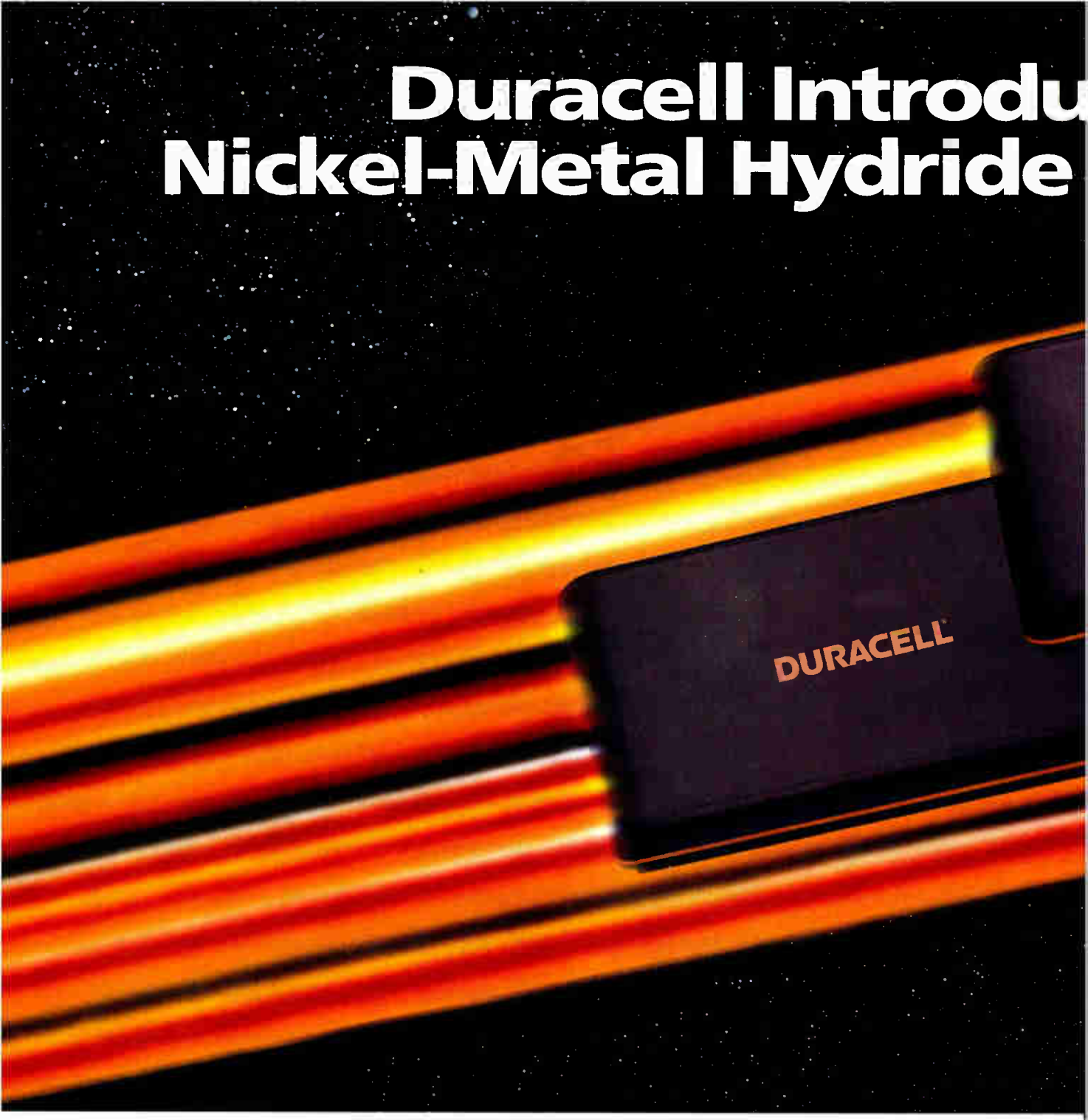
Contact: Chinon America, Inc., Torrance, CA, (310) 533-0274; fax (310) 533-1727.

Circle 1281 on Inquiry Card.

The PowerTape QIC comes with Colorado Backup for DOS software and a DT-4000 data cartridge.

World Radio History

Duracell Introdu
Nickel-Metal Hydride



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Introducing DURACELL® Nickel-Metal Hydride Rechargeable Batteries, a limited number of standard sized packs that will soon be conveniently available in millions of retail outlets worldwide. Exactly where your portable products must be found if you hope to gain a larger share of the growing consumer market.

World Radio History

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DURACELL®
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World Radio History

Four-Channel Converter

Built to the Inmos TRAM (transputer module) format, the adt164 high-speed A/D converter provides four channels of simultaneously sampled data at 1 MHz per channel with a resolution of 12 bits. Sophisticated triggering lets you set the conversion rate via a software-programmable trigger level on an analog input signal, an external TTL-compatible signal, or a software command. The maximum conversion rate is 1 megasample per second.

The 4⅛- by 3⅛-inch module can store up to 4 MB of data in on-board memory and has an on-board 32-bit transputer. The adt164 is built around a CMOS converter from Burr-Brown and uses a T400 or T805 processor.

Price: About $3050 to $4240 (£1795 to £2495).

Contact: Sunnyside Systems, Ltd., West Lothian, U.K., +44 506 460345; fax +44 506 460314.

Circle 1282 on Inquiry Card.

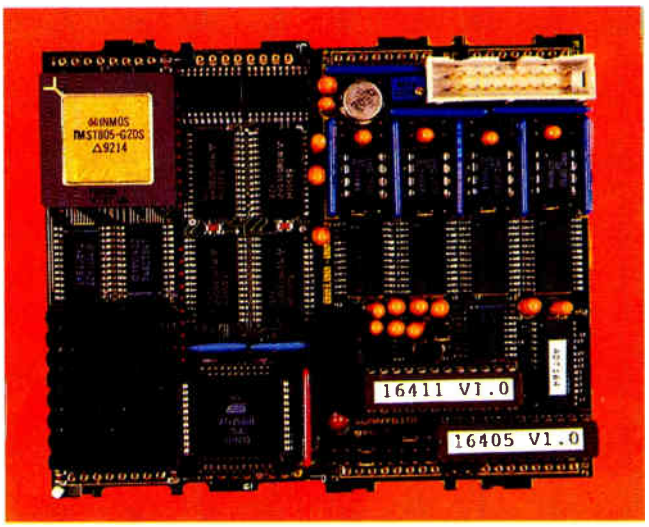
Sentry in a Slot

The System Sentry PC monitoring system tracks DC voltages from the power supply and the battery and monitors the PC's internal temperature. The half-card signals readings that exceed whatever high and low limits you define, notifying the host PC via an interrupt or reporting to another PC over a direct connection via its serial port. The card fits in an 8-bit slot and has an LED built into its bracket.

Price: $379.95.

Contact: Berkshire Products, Inc., Duluth, GA, (404) 418-1286; fax (404) 418-1289.

Circle 1283 on Inquiry Card.



The adt164 is built around Burr-Brown's new CMOS converter, which allows the module to reach high speed with low power consumption.

Control Your Cache

A caching controller that's compatible with the ISA bus, the MC-2068 connects two IDE hard drives as large as 2 GB each, two floppy drives, and a Colorado Memory Systems tape backup subsystem. The controller has a cache access time of less than 0.5 ms and a disk transfer rate of 24 Mbps. The 512-KB cache is expandable to 8 MB through the use of 256-KB or 1-MB SIMMs.

Price: Without DRAM, $249.

Contact: Maple Systems, Inc., San Jose, CA, (408) 456-0355; fax (408) 456-0356.

Circle 1284 on Inquiry Card.

TV on Your Mac

Lapis Technologies' L-TV NTSC interface card lets you connect your Mac LC, LCII, or Performa 400 to your TV and use the TV as a display device. The L-TV provides up to 16-bit-mode displays on your TV at a maximum resolution of 640 by 480 pixels.

TV-Show software turns your TV into a presentation device while letting you watch and control the action on an Apple 12-inch monitor. The software also includes keyboard-selectable flicker filters to adjust the picture quality on the TV.

Price: $349.

Contact: Lapis Technologies, Inc., Alameda, CA, (510) 748-1600; fax (510) 748-1645.

Circle 1285 on Inquiry Card.

Double the Resolution

An add-in card that fits in the optional I/O slot of the Hewlett-Packard LaserJet Series II and III printers, the doubleRES IV raises the resolution from 300 dpi to 600 dpi. With its own Windows driver, the card can use all the features of Windows printing, such as embedded and downloaded TrueType fonts.

Other characteristics include proprietary data compression, which enhances printing speed, and enough self-contained memory that no additional memory is needed on the LaserJet for the increased resolution. Network and shared connections are supported.

Price: $595.

Contact: Laser Printer Accessories Corp., San Diego, CA, (619) 485-8411; fax (619) 487-5809.

Circle 1286 on Inquiry Card.

Two for Sound

The MPC-compatible BSR MediaMaster sound board has a built-in microprocessor, 384 KB of RAM, and 16-bit A/D and D/A converters. The result is the ability to record and play back sound at 44.1 kHz, the sampling rate used to record audio CDs. The board includes vector-based processing with 128 built-in digitized instruments and sound effects and ships with MPC Windows applications and audio recording, mixer, jukebox, and CD music launcher programs.

Price: $199.90.

Contact: DAK Industries, Inc., Canoga Park, CA, (800) 325-0800 or (818) 888-8220.

Circle 1287 on Inquiry Card.

Advanced Gravis's UltraSound, a 16-bit playback, 32-voice sound card is equipped with wave-table synthesis and 256 KB of memory (expandable to 1 MB). The card is AdLib and SoundBlaster compatible and has a Windows 3.1 multimedia driver and a set of general MIDI patches. The UltraSound Studio 8 program lets you record and play back sampled music.

Price: $199.

Contact: Advanced Gravis Computer Technology, Ltd., Burnaby, BC, Canada, (800) 663-8558 or (604) 431-5020; fax (604) 431-5155.

Circle 1288 on Inquiry Card.

World Radio History

Why do they call it a dongle?

He wasn't famous. He didn't drive a fancy car, but dressed in his favorite Comdex T-shirt and faded blue jeans, he set out to change the course of the computer software industry. Quite a task for a lonely software developer.

Sitting in front of his computer, drinking pots of coffee and smoking cartons of cigarettes, he'd write pages of code.

It took time. Years in fact. But he did it. He wrote the most powerful computer program in the world. Now came the hard part. Selling it.

The Most Powerful Program in the World

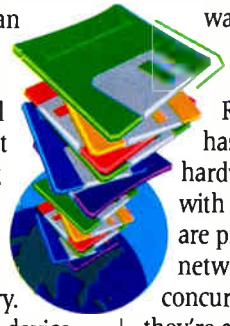
Determined to make those long years pay off, he called on every distributor, VAR and dealer in the world. He drove from Beantown to San Diego. Flew from Dublin to Borneo. Everyone loved the program.

So he sold a few. Only a few.

Back in Boston he waited. After a long year with only 13 orders he set out to see what happened. As he drove across the country and flew around the world he discovered everyone knew about his program. Everyone had it too.

The Global Marketplace

From Paris to Prague, his program was everywhere in Europe. When he got off the plane in Hong Kong he found his program stacked to the ceiling in every computer store. Amazed in disbelief, he bought a hundred cartons of cigarettes and a hundred pounds of Indonesian coffee and flew back to Boston.



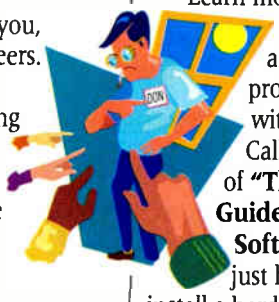
Beaten, battered and bruised he went back to the drawing board. This time he would really change the face of the software industry. He would develop a device that would prevent unauthorized distribution of software programs.

Call It What You Like

He developed a hardware key. His peers applauded his efforts. Finally, a solid solution for revenue protection.

But he didn't know what to call it. He thought of naming it after an exotic place he visited in his travels. Madagascar was a bit too long, though.

"Name it after you, Don!", urged his peers. So he did. Soon everyone was calling the key a dongle, after Don Gall — the lonely software developer who did what he had to do.



You've Come A Long Way, Baby

Today, dongles are different. Fact is, they've come a long way. Leading the industry with security solutions, Rainbow Technologies has changed the face of hardware keys. They work with multiple applications, are programmable and network versions control concurrent usage. And they're always transparent to the end-user.

Sentinel Family from Rainbow

Truth is, more and more developers are using keys. And the Sentinel Family is the most widely used in the world. In fact, over 6,000 developers use Sentinel from Rainbow. Why? They are simply the most effective, reliable and easy to implement keys on the market.

Learn more about securing your software and how keys provide developers with extra value. Call for a free copy of **"The Sentinel Guide to Securing Software."** And see just how easy it is to install a hardware key into your application in just minutes. Try it with our low cost Sentinel Evaluation Kit. Order one for your DOS, OS/2, Windows, Macintosh or UNIX based application.

And remember, when you need a dongle, you need Sentinel — the only dongle Don Gall would use.

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Some call it a dongle. Those who know, call it Sentinel.

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International offices are located in the United Kingdom, Germany and France.

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world radio history

Compudyne™. Latest Technology. Highest

Compudyne is the PC manufacturing and direct marketing arm of CompUSA™, the Computer SuperStore (NASDAQ symbol; CUSA)—inventors of big volume, deep discounting PC retailing, and the largest chain of computer super stores in the country. Compudyne manufactures top quality, fully-supported computers as available from only the largest PC manufacturers at prices typically found only at garage shop clone houses.

Result? We're already one of the largest direct PC companies in the country and guarantee that our prices are the lowest of any currently advertised.

CBG &H BEST BUY

486DX/33 Laptop Issue, September 1992

We are to notebooks what Griselda of Skyland was to Pomeranians; the lightest.

PC MAGAZINE

486DX/33 "Honorable mention" August 1992

Notebooks

Feast your eyes on "one of the best notebook values around" (Mobile Office 7/92), snugly packed into a slim, trim, 5.5 lb package (including battery). All include these nifty features:

- 11"x 8.5"x 1.6" (yes, only 1.6" thick!)
- Full 10", 64 grayscale brilliant VGA screen
- Internal 3 1/2" 1.44 MB floppy drive
- Built-in trackball saves carrying a mouse
- MS/DOS 5.0 and Microsoft® Windows 3.1 installed ready to run
- Polaris PackRat 4.1™ Personal Information Manager™
- External SVGA monitor and keyboard support
- Expansion Station
- User-installable FAX modem and other options
- Full keyboard—dedicated 'page up/down', 'home' and 'end' keys
- Built-in serial (2) and parallel (1) ports
- FCC Class B certification

Notebook	CPU	RAM (MBs)	HD (MBs)	Battery Life (Hrs)	Price
386SX/20	Intel 80386SX-20 MHz Optional 80387SX Last years' model, 6.5 lbs. *while supplies last*	2 standard, 16 max	60	1.5+	$999† $37/mo*
386SXL/25	386 SXL- 25 MHz Optional 80387SX This years' model, 5.5 lbs. *while supplies last*	2 standard, 4 & 6 options	60	3.5+	$1,399 $52/mo*
386SXL/25	386SXL–25 MHz, Optional 80387SX	2 standard, 4 & 6 options	80 *More MBs!*	3.5+	$1,599 $59/mo*
386SL/25	Intel 80386SL–25 MHz, 64 K CPU cache Advanced SL power mgm't. Optional 80387SX co-processor	as above	80	3.5+	$1,799 $67/mo*
486SX/25	Intel 80486SX–25 MHz, Built-in 8K CPU cache	4 standard, 8 & 20 options	80	2.5+	$1,999 $74/mo*
486DX/33	Intel 80486DX–33 MHz, Built-in 8K CPU cache	as above	130	2.5+	$2,899 $107/mo*

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SERVICE & SUPPORT

- Toll-free technical support
- On-site service for desktops†† and overnight replacement for portables.
- Next-day shipping for most systems.

1-800-932-COMP (2667)

††Within 100 miles of any Dow Jones Service Center. **Does not include Windows 3.1 or mouse. √ Must be returned "as new" in original package. †Last years' model. Actual photo not shown. Actual weight 6.5 lbs. Trackball not included. Most specs different from current model.

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Quality. Lowest Prices. Guaranteed.

Desktops

Order one of our pre-configured systems or custom-configure your own, choosing from a myriad of options. All systems include...

- Microsoft® Windows 3.1 and MS/DOS 5.0
- Microsoft compatible serial mouse
- 200 watt power supply
- 101 AT-style keyboards
- FCC Class B certification

MICROSOFT® WINDOWS™ READY-TO-RUN

- Built in serial (2), parallel (1) and game (1) ports
- Artisoft's LANtastic® LAN
- 8 i/o board slots
- U/L listing

Get Horizontal...

Our standard desktop systems feature aesthetic yet rugged plastic-over-steel construction with "one screw" assembly for quick easy upgrades. They support 3 externally accessible 5.25" drive bays and 2 internal 3.5" units.

Get Vertical...

For those who prefer the aesthetics and footprint of a desktop tower or need the added drive capacity for file server applications, our mini tower offers an astonishing 6 drive capacity; 4 external plus 1 internal 5.25" and 1 internal 3.5" unit in a mere 8"x 16" desktop footprint for only $100 more.

Options, Options, Options...

- Displays: Mono or color VGA; 1024 and 1280 interlaced or non-interlaced; 14" to 20"
- Hard Drives: 40; 80; 105; 120; 211; 483; 680 MBs or 1.2 GBs
- Internal CD-ROM (Inc. Groliers Encyclopedia, Toolworks, Reference Library and PC-SIG)
- Internal FAX/Modem: 9600 bps send/receive fax; 2400 bps modem; inc. WinFax and Quicklink Software.
- And many more!

Desktop	CPU	RAM (MBs)	HD (MBs)	Floppy	Display	Price
386DX/33	Intel 80386DX–33 MHz	1 standard 32 max	40	1.2 or 1.44	16 bit SVGA card, 14" 640x480 VGA Color Monitor	$849 ** $32/mo*
386DX/33 or 486SX/25	Intel 80386DX–33 MHz or Intel 80486SX–25 MHz, w/built-in 8K CPU cache	2 standard 32 max	80	as above	as above	$999 $37/mo*
486SX/25	Intel 80486SX–25 MHz Built-in 8K CPU cache	as above	80	1.2 & 1.44	16 bit SVGA card, 14" 1024 x 768 SVGA Color Monitor	$1,199 $44/mo*
386DX/33 CACHE	Intel 80386DX–33 MHz 64K CPU cache	4 standard 32 max	120	as above	16 bit SVGA card & Hi-Color Support 14" 1024 x 768 SVGA, .28 Interlaced Color Monitor	$1,399 $52/mo*
486SX/33	Intel 80486SX–33 MHz 8K CPU cache	as above	120	as above	as above	$1,499 $56/mo*
486DX/33 CACHE	Intel 80486DX–33 MHz 128K CPU cache	as above	120	as above	16 bit SVGA card, 1MB Video RAM & Hi-Color Support, 14" 1024 x 768 SVGA Non-Interlaced Multisync Color Monitor	$1,799 $67/mo*
486DX/50 CACHE	Intel 80486DX–50 MHz 128K CPU cache, True 50 MHz CPU	as above	120	as above	as above	$1,999 $74/mo*
486DX2/66 CACHE	Intel 80486DX2–66 MHz, 128K CPU cache New Double Clock CPU	8 standard 32 max	200	as above	16 bit SVGA, Superfast Windows, Accelerator card, 1MB RAM, 14" 1024 x 768 SVGA Non-Interlaced Multisync Color Monitor	$2,499 $93/mo*

If you can find a PC that meets or exceeds our equivalent specification, but is shipping at a lower advertised price, we'll match the price.

intel inside

PC WORLD BEST BUY

486SX/25
Best Buy,
December 1992

all NEW!

PC MAGAZINE

486SX/25
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October 13, 1992

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Circle 207 on Inquiry Card.

Intranetworking Hub

Integrating routing/switching, wiring-concentrator, and communications-server technologies, the Network 9000 intranetworking hub lets you hot-swap processor modules, I/O modules, power supplies, and even the cooling fans without powering down the chassis or disturbing users. In addition, when you swap any processor module, the hub automatically reloads the new module with software and reconfigures it.

The Network 9000 is available in five- or 14-slot chassis. Both chassis contain three Ethernet segments, four Token Ring segments, two FDDI (Fiber Distributed Data Interface) segments, and a dedicated management bus. Modules available for the Network 9000 include high-density Ethernet concentrators, local and remote bridges/routers, high-density terminal servers, and integrated routers/concentrators.
Price: Five-slot version, $2495 and up; 14-slot version, $4495.
Contact: Xyplex, Inc., Boxborough, MA, (508) 264-9900; fax (508) 264-9930.
Circle 1289 on Inquiry Card.

Xyplex's Network 9000 improves network reliability and manageability.

600-MB Tape Backup

Designed for networks with storage capacities of up to 600 MB, the Master/DC 5¼-inch half-height internal or external tape drive has a data transfer rate of 243 KBps uncompressed and comes with two levels of error correction: Read-After-Write and ECC (Error Correction Coding). With the drive, you get either GigaTrend's MasterSafe Lite, a workstation-based backup-and-restore solution that backs up from and restores to any file server on the network (as well as the host workstation), or its MasterSafe NLM (NetWare loadable module) advanced network backup software (for networks that have from one to four file servers).
Price: $2250 and up.
Contact: GigaTrend, Inc., Carlsbad, CA, (619) 931-9122; fax (619) 931-9959.
Circle 1293 on Inquiry Card.

cc:Mail for Unix

An Open Look GUI implementation of cc:Mail, cc:Mail for Unix lets you create multimedia messages and file attachments in the Unix environment and share them with other cc:Mail users regardless of their computing platform. In addition, you can store cc:Mail message files on any file server that is accessible from your Sun Sparcstation through NFS (Network File System).

The package provides graphical icons, pull-down menus, pop-up dialog boxes, pinnable windows, and built-in support for SMTP-based E-mail systems. You can drag and drop files, including sound and graphics files, from the File Manager into any cc:Mail message; send and receive faxes within cc:Mail; ask for return receipts; and access the bulletin boards shared by all cc:Mail users. You can also communicate with users of most major mainframe and public E-mail systems, such as PROFS, X.400, and MCI Mail.
Price: Unix Platform Pack, $895.
Contact: Lotus Development Corp., Cambridge, MA, (617) 577-8500; fax (617) 253-9150.
Circle 1294 on Inquiry Card.

Token-Ring Adapter Cards

All three of Madge Networks' new token-ring products—the Straight Blue 16/4 MC Adapter Card, the Straight Blue 16/4 ISA Plus Adapter Card, and the Straight Blue 16/4 ISA Adapter Card—can operate at 16 or 4 Mbps. Both the Straight Blue 16/4 MC (a 16-bit Micro Channel architecture bus card) and the Straight Blue 16/4 ISA Plus (a 16-bit ISA card) support shielded twisted-pair cabling, unshielded twisted-pair cabling, and remote booting via built-in support for remote program load. An 8-bit ISA card, the Straight Blue 16/4 ISA supports remote booting but only STP cabling.
Price: Straight Blue 16/4 MC and Straight Blue ISA Plus, $545; Straight Blue 16/4 ISA, $445.
Contact: Madge Networks, Inc., San Jose, CA, (800) 876-2343 or (408) 441-1300; fax (408) 441-1335.
Circle 1290 on Inquiry Card.

Receive and Answer E-Mail

A rewritten-from-scratch version of the original shareware program, Qmodem-Pro communications software for the PC lets you receive E-mail messages and, regardless of the source, send replies to BBSes, E-mail services, and fax machines.

New features include an enhanced off-line mail reader; mouse support; pull-down menus and resizable windows; a spelling checker; up to 4095 entries per telephone book, with an unlimited number of books; Class 1 and 2 send-only fax capability; group dialing; and MCI Mail and CompuServe E-mail gateway support. Qmodem-Pro also supports 125 preconfigured modems; ZMODEM, Kermit, CompuServe B+, YMODEM, XMODEM, and ASCII internal protocols; up to 10 external protocols; and Wyse 50, VT220, VT320, and TVI 925 terminal emulations.
Price: $99.
Contact: Mustang Software, Inc., Bakersfield, CA, (805) 395-0223; fax (805) 395-0713.
Circle 1291 on Inquiry Card.

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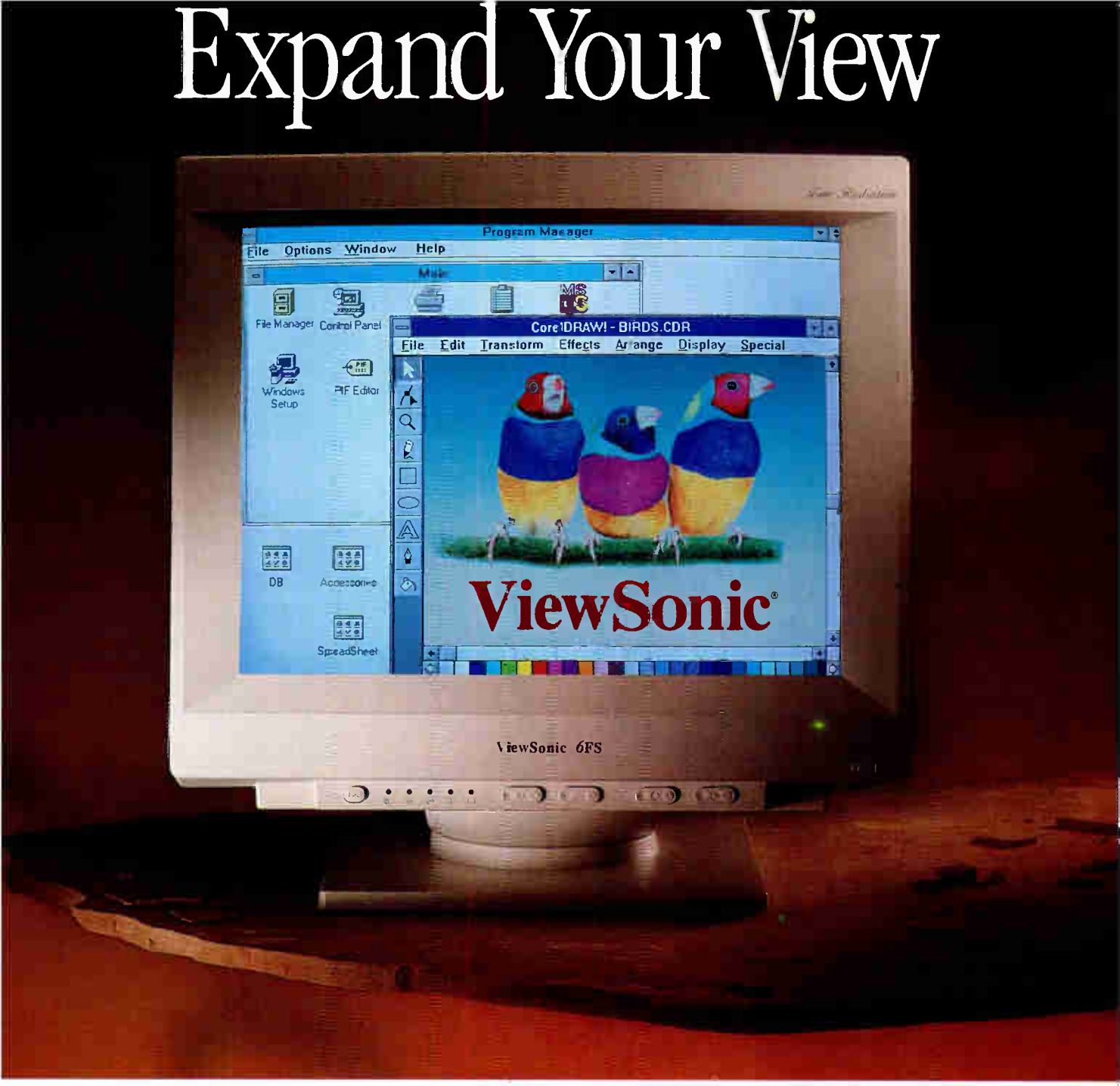
Expand Your View



Yes, it's definitely time you expanded your view to the non-interlaced 15" ViewSonic 6FS monitor.

For one thing, you get 36-percent more viewing space than with a standard 14" monitor. And, since you can display more information on the screen with the larger 15" flat square screen, this is an ideal monitor for Windows, Graphical User Interface (GUI) and desktop publishing environments.

Thanks to the ultra high 72Hz refresh rate with resolution up to 1,024 x 768, the ViewSonic 6FS produces the most vivid and precise **flicker-free** image anywhere. In addition, the non-glare screen reduces irritating reflections.

The monitor, compatible with all standard resolutions, features 32 programmable modes with digital controls to store and customize the display to fit your specific needs. It also is certified to meet strict MPR-II Swedish certifications for low emissions, which makes it environmentally safe. It's a fact– the ViewSonic 6FS offers special features normally available only on larger, more expensive monitors.

Expand your view, not your budget, with the affordable 15" ViewSonic 6FS monitor.

ViewSonic®
20480 E. Business Parkway
Walnut, CA 91789
(714) 869-7976 (800) 888-8583 Fax: (714) 869-7958

For immediate faxed information, call the FaxSonic "hot line" at (714) 869-7318–it's available 24 hours a day.

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Circle 185 on Inquiry Card (RESELLERS: 186).

As they say, it's all in the genes. Introducing the ThinkPad™ from IBM. The slickest, sleekest little number that ever crunched one. A mere seven-and-a-half pounds of brains and beauty that begs you to take it anywhere. And once you own one, that's exactly what you'll do.

All this in only 11.7"

Introducing

ThinkPad

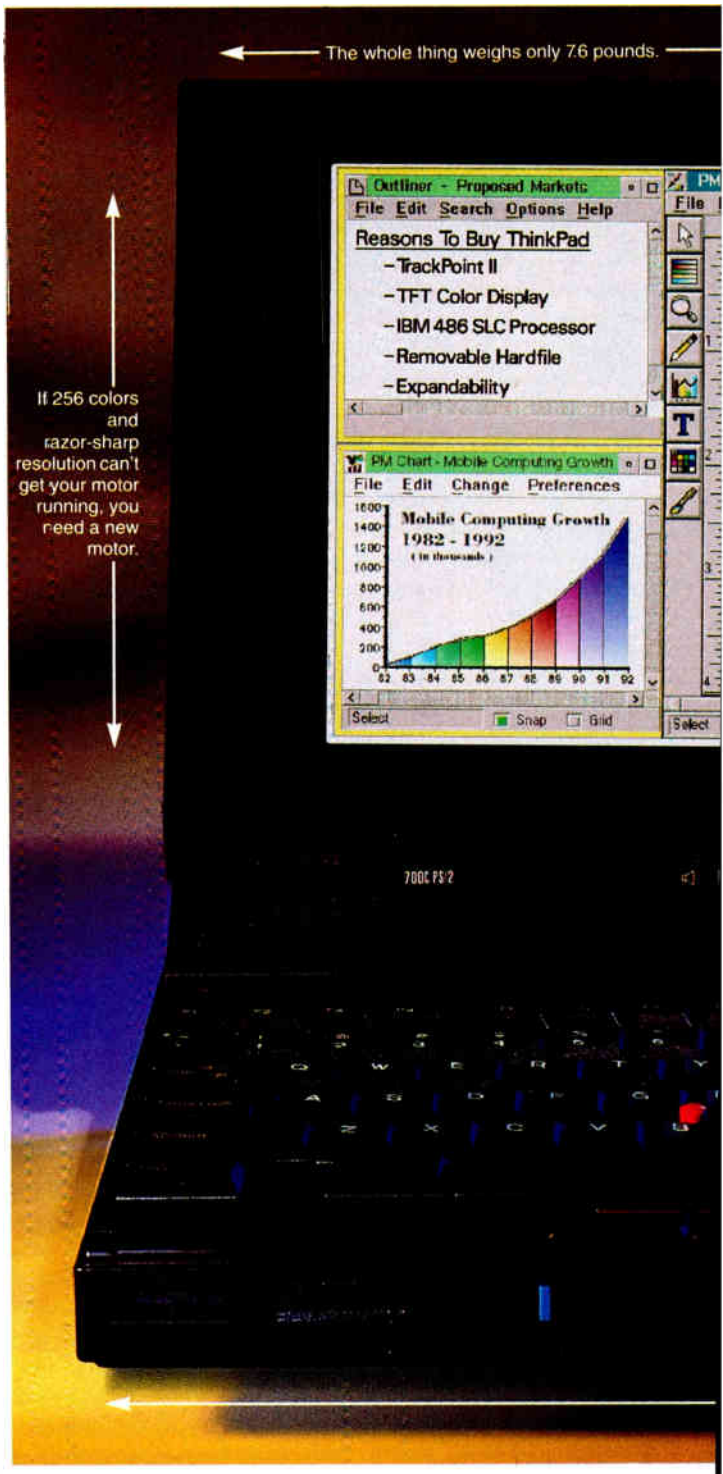
The top-of-the-line ThinkPad 700C sports a screaming 486 SLC™ 25 MHz processor. But it's built for comfort too. There's a surprisingly roomy interior, with a full-size, ergonomically designed keyboard. And a screen that literally bends over backwards.

Strategically placed on the keyboard is a little red spot called the TrackPoint II.™ It does what a mouse would do with a few million more years of evolution. Nothing dangles; it's part of the soul of the machine. You can operate it with one fingertip. And it lets you think on any terrain, even one without any flat surfaces.

The ThinkPad's screen is a thing of almost aching beauty. Its 640 × 480 VGA resolution is sharper than that of many desktop computers. It displays 256 colors. And it's the biggest screen on any notebook. So it's very easy on the eyes.

The ThinkPad comes standard with things some other notebooks don't even offer as options. Like 4MB

*Depending on usage and configuration. **MSRP. Dealer prices may vary. †Warranty information available from the Personal Systems HelpCenter or an IBM authorized dealer. 700T warranty is available in USA and Canada only. ††In Canada, call 1 800 465-7999. IBM is a registered trademark and ThinkPad, HelpWare, HelpCenter, SLC and TrackPoint II are trademarks of International Business Machines Corporation. PRODIGY is a registered trademark of Prodigy Services Company. © 1992 IBM Corp.



Its mother was
Its father wa

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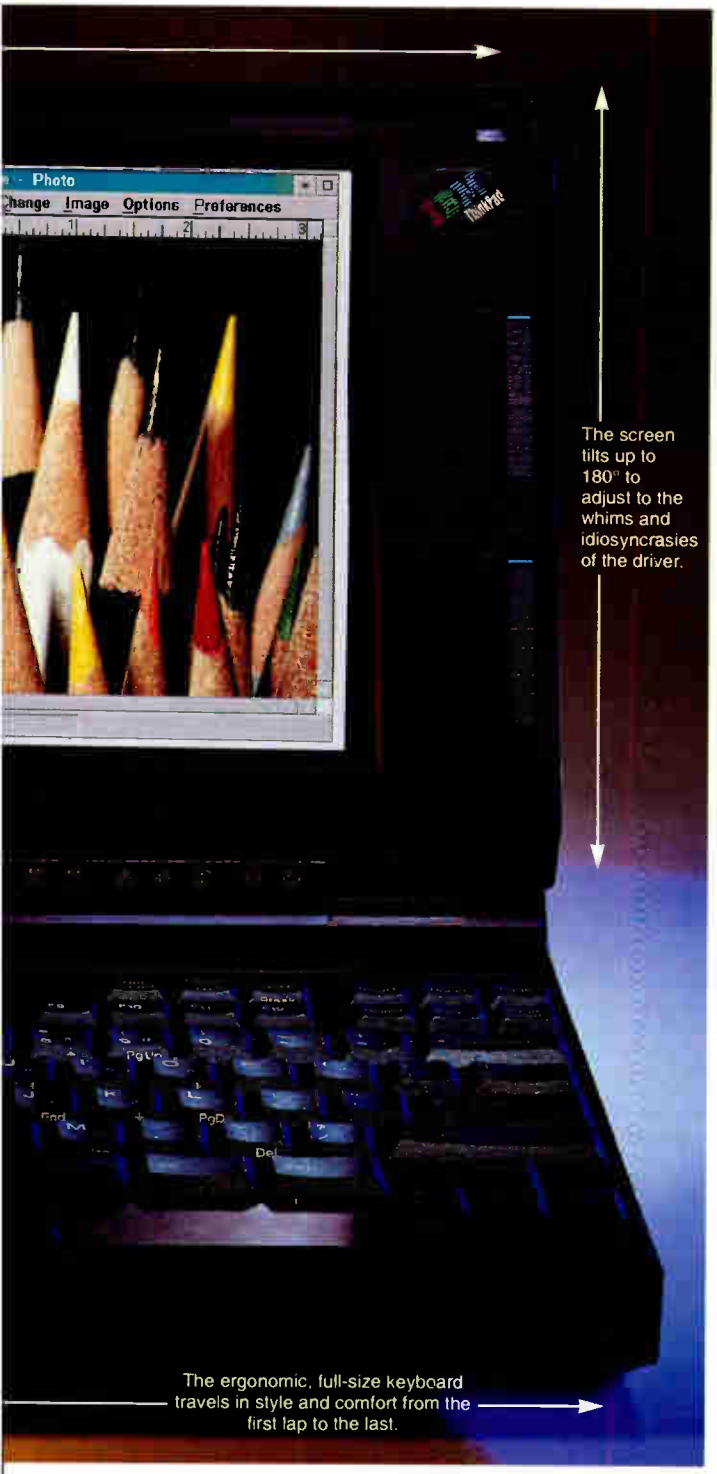

of memory upgradable to 16MB. 120MB of hard disk space. Pre-installed DOS 5.0 and PRODIGY.* You can soup it up with a turbo-charged 486SLC2 50/25 MHz processor—just one of the upgrade products IBM offers. And the hard disk is removable, so it's easy to upgrade and share your ThinkPad, not to mention the great security and virtually unlimited storage.

The world's smallest stick shift.

ThinkPad blows the doors off its competition in an even more surprising arena. Price. Any ThinkPad in the line will give you more for your money—and for your psyche—than any other notebook.

If you have questions along the way, ThinkPad Models 700C and 700 are supported by HelpWare,™ an invaluable service package that includes a three-year international warranty.†

ThinkPad	Model 700C	Model 700
Processor	486 SLC/25 MHz	486 SLC/25 MHz
Display	10.4" Active Matrix 256-Color Screen	9.5" Monochrome Display 64 Grayscale Screen
Battery Life*	2–4 Hours	3.8–7.5 Hours
Weight	7.6 Lbs. with Battery	6.5 Lbs. with Battery
Warranty	3 Years (International)	3 Years (International)
Price**	$4,350	$2,750

For more information or an IBM authorized dealer near you, call our Personal Systems HelpCenter™ 24 hours a day, 7 days a week at 1 800 772-2227.††

Then just park one in your lap and see what happens.

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a mainframe.
s a Maserati.

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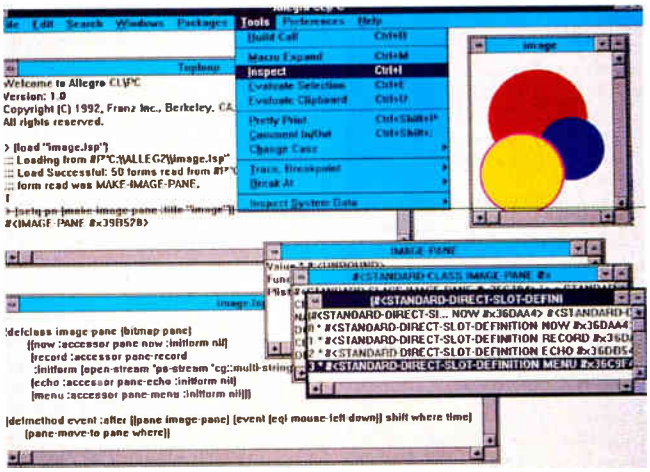
NEWS

WHAT'S NEW • PROGRAMMING SOFTWARE

CLOS-Based Development

Based on CLOS (the Common Lisp Object System), Allegro CL\PC 1.0 is a full-featured OOP (object-oriented programming) solution for Windows that lets developers design, build, and maintain complex applications. The software's programmable and extensible development tools include an editor, a structure editor, an inspector, a debugger, a tracer, and a stepper and time profiler. Allegro CL\PC 1.0 also features Common Graphics, an object-oriented layer on top of the Windows API, and a DLL interface to code written in languages such as C and FORTRAN.
Price: $595.
Contact: Franz, Inc., Berkeley, CA, (510) 548-3600; fax (510) 548-8253.
Circle 1296 on Inquiry Card.



Allegro CL\PC's Garbage Collector automatically manages memory allocation, reducing the number of design errors, and the Runtime Generator creates compact, faster applications for royalty-free delivery.

UUCP for MKS Toolkit

New features of MKS Toolkit 4.1 include MKS UUCP, an `awk` compiler, MKS Make, and Windows icons that put frequently used utilities, such as `sh`, `find`, `vi`, `grep`, and `awk`, just a click away. The MKS UUCP facilities provide interactive mail composition and mail reading, a `uucp` command that prioritizes requests to transfer or receive files, a `uux` command that allows command execution from a remote machine running MKS UUCP, and the ability to create custom applications.

The new `awk` compiler creates freestanding DOS programs from a working MKS AWK program, so you can create and distribute applications without royalties. In addition, you can use these applications independently of MKS Toolkit and MKS AWK. The MKS Make feature minimizes file maintenance by letting you create a recipe for large or small software projects.
Price: $299.
Contact: Mortice Kern Systems, Inc., Waterloo, Ontario, Canada, (519) 884-2251; fax (519) 884-8861.
Circle 1297 on Inquiry Card.

CASE Tools for Autocoding

SAGA, a CASE tool for acquiring and processing data in a real-time environment, provides synchronous data streams for safe and efficient application coding and presents graphics and text through block, gate, and logic diagrams. SAGA lets you capture, check, and implement your software designs.

You edit and display information at three levels: Hierarchy, which displays an overall view of the software architecture; Network, which displays data hierarchy and data communication between components; and Data-View, which displays data types and definitions. SAGA coordinates information at each level so that changes are immediately propagated during the development process.

SAGA also provides 70 ready-to-use components and the facility to add further components with C code or SAGA's own formal language. In addition, SAGA lets you verify completed system, subsystem, or component designs at any stage prior to final code generation.
Price: About $188,080 (100,000 French francs).
Contact: Verilog, Toulouse Cédex, France, +33 61 19 29 39; fax +33 61 40 84 52.
Circle 1298 on Inquiry Card.

Prefabricated Software Tools

Now you can quickly create applications from prefabricated software components using Digitalk's open language-neutral technology called PARTS (Parts Assembly and Reuse Tool Set). The first product using this technology, PARTS Workbench for OS/2 2.0, consists of a catalog of prebuilt components, both visual and nonvisual, and a workbench window. You create applications by dragging parts from the catalog into the workbench and then "wiring" parts together by drawing lines between them. The PARTS technology lets you assemble and reuse software components written in languages such as Smalltalk/V or C.
Price: $1995.
Contact: Digitalk, Inc., Los Angeles, CA, (310) 645-1082; fax (310) 645-1306.
Circle 1299 on Inquiry Card.

Port Windows Applications

WNDX Portable Development Tools 2.0 combines WNDX run-time libraries and resource creation tools that let you create GUIs that transport in as little time as it takes to recompile and relink to other popular platforms. The company says the tools let you build Windows applications that are portable to popular graphical operating systems (i.e., Mac, OSF/Motif, Open Look, OS/2, and DOS) with no loss of performance.

The WNDX portable GUI run-time libraries provide a single consistent API of more than 1000 functions and attributes for any language with a C-style interface. The package's WNDX Opus, an objected-oriented GUI design tool, makes developing GUI resources (i.e., dialog boxes, menus, icons, cursors, patterns, color palettes, and strings) as easy as "pick and drop."
Price: $695.
Contact: The WNDX Corp., Calgary, Alberta, Canada, (403) 244-0995; fax (403) 244-1039.
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Since when is Raima first in Corporate Database Development?

Since April 7, 1992

Raima Database Manager was the database of choice in the [illegible] Open. The competition featured [illegible] built with Windows development [illegible] and two of the finalists [illegible]

800 DB RAIMA Also available for DOS, OS/2, and UNIX

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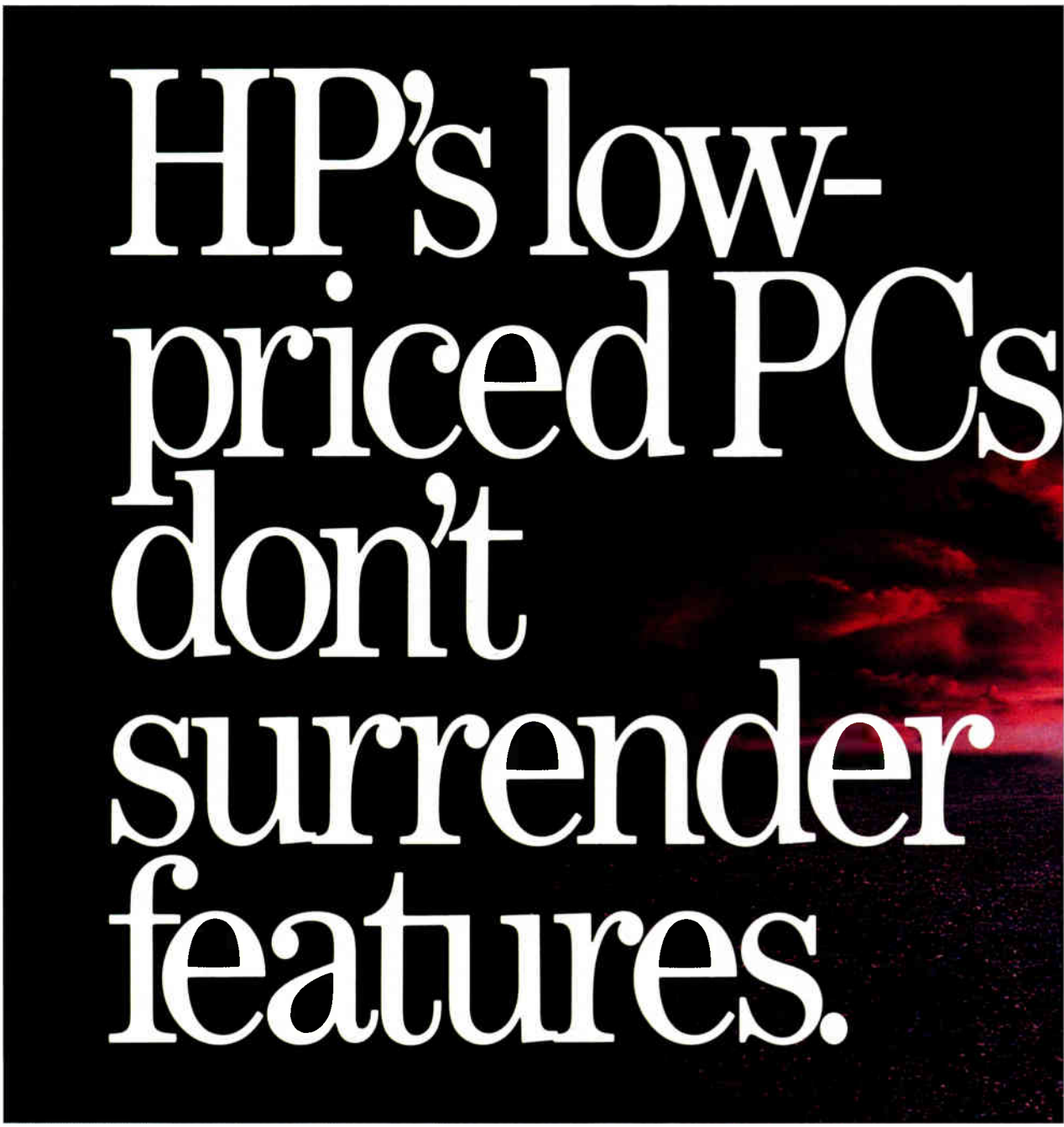
HP's low-priced PCs don't surrender features.



Novell Labs Tested & Approved

intel inside

HP Vectra 486N Specifications

- 32-bit Intel SX, DX and DX2 processors at 25, 33, 50 and 66 MHz
- 4 MB RAM, expandable to 48 MB
- Local bus integrated Ultra VGA+ Video with graphics accelerators
- 85-430 MB hard drive
- 3.5" floppy drive
- Three 16-bit expansion slots
- ROM-based internal diagnostic and system guide
- Integrated Flash BIOS and boot-ROM
- Multilevel hardware security
- Chip-upgradable

*Suggested U.S. list prices for HP 486/25N and HP 486/33N Model 1 PCs. Monitor not included. Microsoft is a U.S. registered trademark of Microsoft Corporation. Windows 3.1 is a product of Microsoft Corporation. The Intel Inside logo is a U.S. trademark of Intel Corporation. © 1992 Hewlett-Packard Company PPG-656

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Now we're calling the shots.

Those cheap PCs don't stand a chance. Hewlett-Packard has introduced 486 models starting at under $1,200.* With prices of our entire line of HP 486 and 386 PCs down as much as 42% in the last 9 months.

But our low prices have not come at the expense of quality, performance or the features you want.

To scream through those high-powered Microsoft® Windows and CAD projects, our revolutionary local-bus technology and fast graphics accelerators really fly. And, with true multivendor compatibility, HP PCs fit easily into your computer environment.

We've also made big advances on the networking front. Many models come with preinstalled network interface cards and boot-ROMs. And, of course, HP PCs are fully tested and certified with all the major NOSes.

Our security features are so convenient your people will actually use them. And our 486 desktop PCs are chip-upgradable. So you can count on always having the latest and greatest.

All this for as little as $1,200! And for a few hundred dollars more, we'll throw in a hard drive with preinstalled DOS 5.0, Windows 3.1 and a mouse.

To be a winner in the price wars, call **1-800-752-0900, Ext. 7094** for your nearest HP PC dealer. Or call **1-800-964-1602** for immediate details. Then start calling the shots.

HEWLETT PACKARD

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PowerPoint 3.0 for the Mac

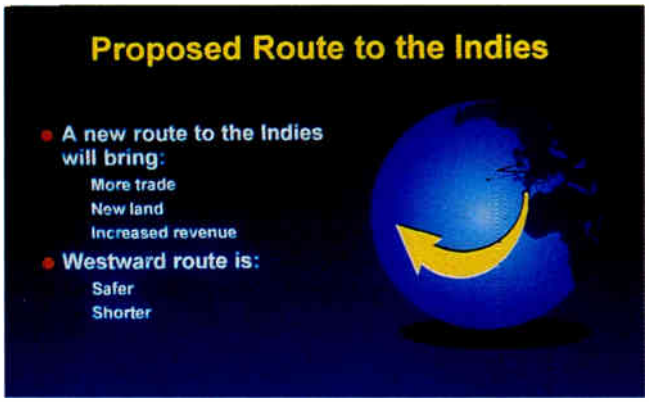
Microsoft PowerPoint 3.0 for the Mac integrates word processing, outlining, graphing, drawing, and presentation management tools. You can produce presentations that include 35mm slides, overhead transparencies, speaker's notes, audience handouts, and electronic slide shows. Version 3.0 for the Mac also has menus, commands, and keyboard equivalents consistent with PowerPoint 3.0 for Windows, so you can share files between them and run cross-platform presentations.

Features include 160 templates; the Slide Master, which provides visual consistency and format control; 84 graphing styles; automatic build slides with flying bullets, transition effects, on-screen notation, sound, and video; 35 PostScript fonts; over 500 pieces of full-color clip art; graphics importing; and 5000 professionally designed color schemes. The Slide Sorter lets you view miniatures of all your slides, copy and paste between presentations, and rearrange your slides.

Price: $495.

Contact: Microsoft Corp., Redmond, WA, (206) 882-8080; fax (206) 936-7329.

Circle 1302 on Inquiry Card.



Microsoft PowerPoint 3.0 for the Mac comes with a Freeform tool for combining polygons and freehand drawing in one object; drawing manipulation tools; a toolbar; and 24 adjustable shapes for creating diagrams.

Productivity for X Window System

GlobalView for X gives Unix workstation users in the X Window System environment the ability to create, manage, retrieve, share, and distribute documents. You can also share GlobalView documents via Sun's NFS (Network File System) or distribute them via standard Unix mail.

You can create and integrate text, graphics, and tables into a single document using creation tools such as color, style sheets, redlining, a thesaurus, a spelling checker, equations, footnotes, and long-document options. GlobalView for X also includes file filters for importing and exporting 20 popular PC, Mac, and Unix workstation file formats. To extend the functions of GlobalView for X, XSoft offers six additional software modules.

Price: Floating license with all file filters and one optional software module, $1495; additional software modules, $495 each.

Contact: XSoft, Palo Alto, CA, (415) 424-0111; fax (415) 813-7162.

Circle 1303 on Inquiry Card.

Manufacturing Control Software

Team One provides full control over manufacturing operations, customer orders, scheduling, inventory, vendors, and warehousing. It lets you control 100 million individual product structures, 2 billion customer records, 2 billion processes per product, and 100 million product levels, all on a DOS PC.

Eclipse Software also offers Team One Lite, a single-user version that limits the maximum number of inventory items to 10,000 and the number of products and subassemblies to 250 items.

Price: Team One, about $3000; Team One Lite, about $1200.

Contact: Eclipse Software, Lakewood, CO, (303) 238-9431; fax (303) 238-9720.

Circle 1304 on Inquiry Card.

A Pinboard on Your PC

A business planning tool for the PC, MapBase combines a simulated pinboard with databases, spreadsheets, and detailed maps. The software also includes tools for defining and managing territories, calculating drive-time zones and catchment areas, analyzing data, adding pictures and graphics, and producing graphs, charts, and maps for presentations, reports, and slide shows. A built-in dBase-compatible database lets you edit, browse, calculate, replace, sort, and search.

MapBase uses a digital map of Great Britain that includes more than 67,000 road miles; 33,000 places; post-code sectors; telephone codes; national, county, and district administration boundaries; and population data. It is also available with maps of Germany, Benelux, France, Europe, and the U.S.

Price: About $758 (£495).

Contact: NextBase, Ltd., Farnham, Surrey, U.K., +44 784 421422; fax +44 784 420072.

Circle 1305 on Inquiry Card.

Windows Contact Management

The Windows version of the Maximizer contact management package provides priority tasking; four-view schedulable calendars with conflict notification and alarms; data-entry tables; templates for creating letters, fax forms, invoices, and reports; fax transmission to one person or the entire database; database search and list-manipulation capabilities; and a separate editor for multitasking editing and printing. The software's to-do Hotlist lets you prioritize tasks and mark them as completed. You can sort the Hotlist by date, time, priority, client, task, or completion status.

Maximizer for Windows automatically logs call results in the client's notes as a file containing the name and phone number of the person called, the date/time, the subject, personal notes, appointments, and any changes in database categories.

Price: $249.

Contact: Richmond Technologies & Software, Inc., Burnaby, BC, Canada, (604) 299-2121; fax (604) 299-6743.

Circle 1306 on Inquiry Card.

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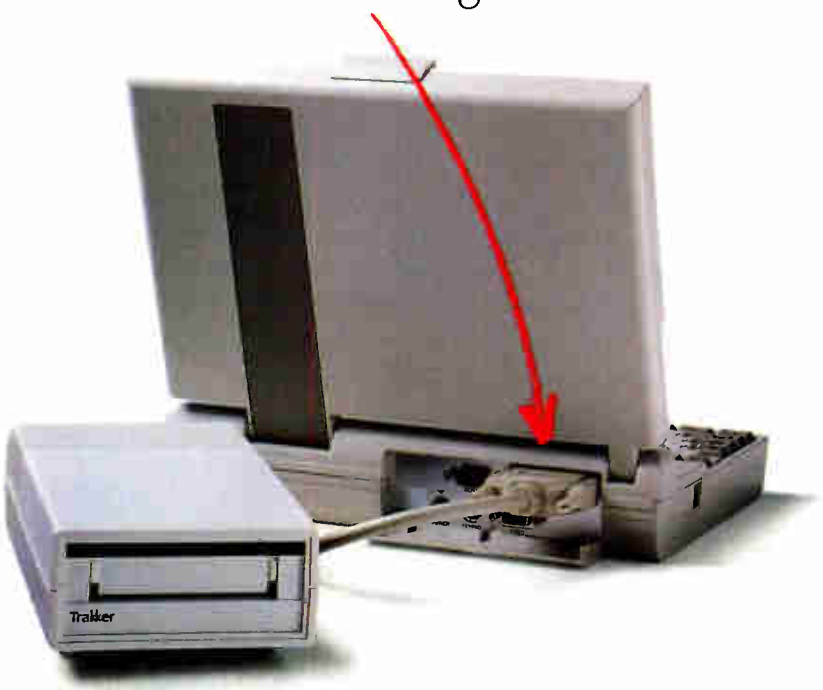
Plug and Play Tape Backup.

The Plug.



That's it. Go Play.

Now, tape backup is easier than ever. Unpack Trakker and plug it into your computer's parallel printer port. That's it. No assembly, no installation, no problem. Trakker goes anywhere. It's light and compact, the ideal solution for backing up notebooks and laptops. And Trakker can back up unattended, so you can go anywhere, too.

Trakker is available in two models. At $448, Trakker 120 (120 MB capacity, using data compression) is the price leader. And Trakker 250 (250 MB capacity using data compression) is the fastest in its class at up to 8 MB/minute. Both give you QIC Industry Standard Recording Format, as well as Novell® and LANtastic® certification.

For more information, please call **1-800-451-0897** ext. 1667 today.

Trakker™

Backup so simple it's advanced.℠

COLORADO™ MEMORY SYSTEMS INC.

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Circle 84 on Inquiry Card (RESELLERS: 85).

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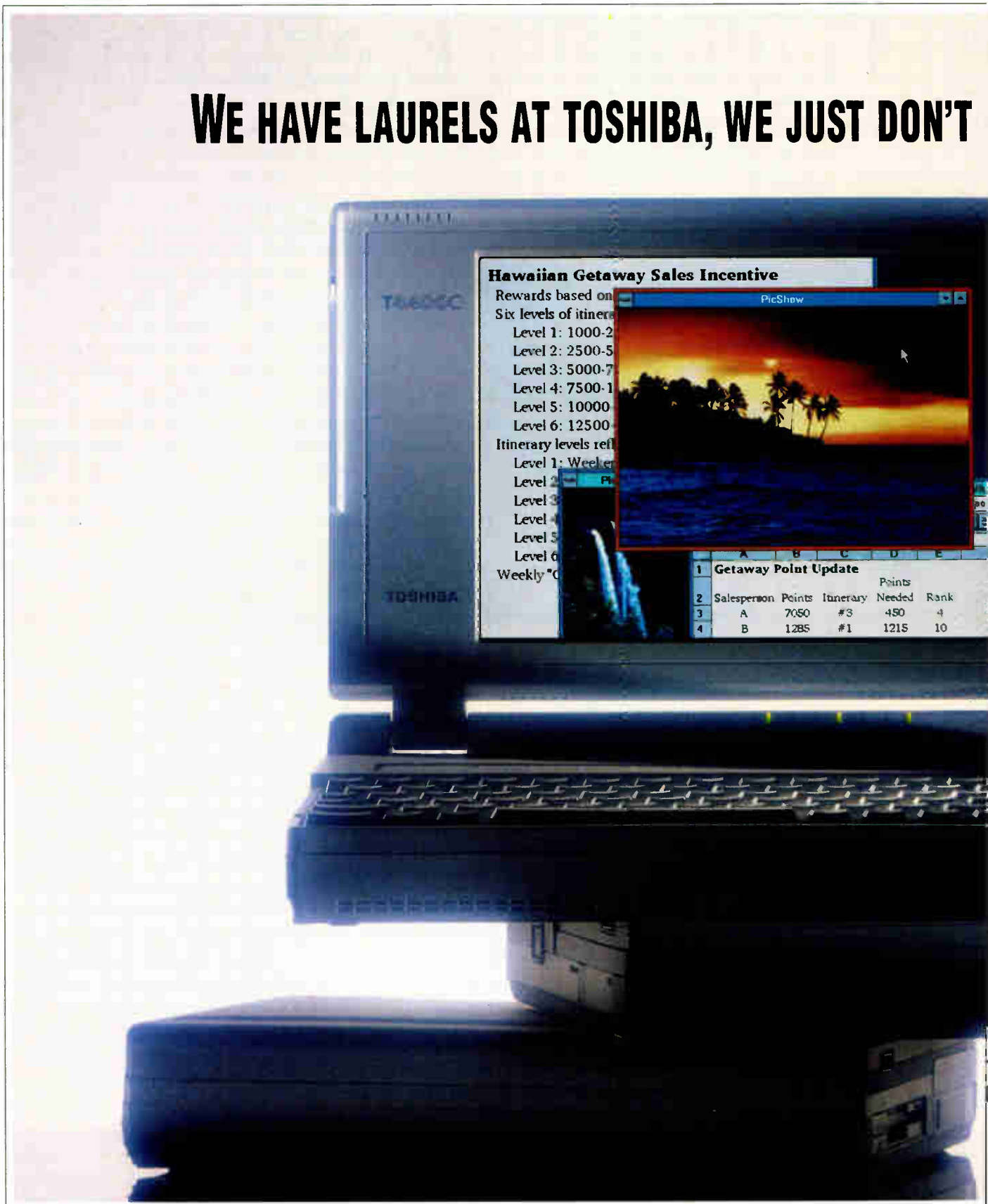
WE HAVE LAURELS AT TOSHIBA, WE JUST DON'T



PRESENTING THE T44

World Radio History

REST ON THEM.

PC MAGAZINE EDITORS' CHOICE

August 1992
Toshiba T4400SXC

The PC Magazine's Editors' Choice Award is just one of the many awards our highly acclaimed T4400SXC has captured.

The new T4400C is available with a blazing 25 MHz 486DX processor.

With our T4400C, you have a choice of either a 200MB or 120MB hard drive.

Our T4400 series features our MaxTime power management system that gets the maximum out of every battery charge.

Immediately after capturing the "Editors' Choice" award from *PC Magazine* for our T4400SXC, we asked our engineers to better it.

They responded with the T4400C. A notebook that redefines what is possible in 486 color technology.

Take for example its TFT-LCD active matrix color screen. We pioneered this technology and now we've advanced it even further by enlarging the screen to a full 9.5 inches. Amazingly, it provides an eyeball-popping 256 simultaneous colors at 640 x 480 resolution from a palette of 185,193 colors, making it the best TFT color display on the market.

If you think that's impressive, check what's under the hood. You'll find a choice of either a blistering new 25 MHz 486DX processor with a massive 200MB hard drive or the renowned 25 MHz 486SX with a 120MB hard drive. And both offer 4MB RAM expandable to 20MB.

Of course, if your needs are more modest, we offer a T4400SX with a large 9.5" monochrome LCD screen, a not-so-modest 25 MHz 486SX microprocessor and 120MB hard drive.

Our engineers even extended battery life. By offering such MaxTime™ power management features as automatic display and hard drive shut down, AutoResume and AutoSave.

To test-drive the T4400C yourself, feel free to call the number below for the location of your nearest Toshiba dealer.

Our operators don't like resting either.

In Touch With Tomorrow.

TOSHIBA

1-800-457-7777

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BBN/Probe for Unix

The Unix version of BBN/Probe provides interactive data reduction and analysis capabilities on Sun Microsystems and DEC workstations. BBN/Probe 3.0 gives you direct access to complicated and nonstandard data sources without reformatting and provides an interactive environment that lets you perform sophisticated analysis and graphing. The interface also provides a means to create real-time displays of data streams for monitoring critical parameters of a test.

The software's high-level structured programming language lets you create procedures to perform repetitive analyses, produce quick-look reports, and automate entire applications. With BBN/Probe's Flexible File Server, you can directly access the data in its original pulse-code modulation frame format without having to reformat data into standardized files. In addition, the Data Dictionary helps you unpack various standard and nonstandard data formats.

Price: $13,000 and up.
Contact: BBN Systems & Technologies, Cambridge, MA, (617) 873-2559; fax (617) 873-3776.
Circle 1307 on Inquiry Card.

CAD Software for Surveyors

Available for Windows and the Mac, Pythagoras 2.0 is a CAD program for professionals involved in road engineering and land measurement and management. The software integrates specialized calculating and drawing functions with the ability to read field memory data, generate nearly finalized drawings, and import and export various file formats.

The package includes selectable, multiuser, and fixed-page coordinates; dynamic calculation of intersections and elevations; parallel and perpendicular lines; arcs and circles; and snapping to tangential points of arcs and lines. Calculation functions include intersection, three-point resection, traverse, and transformation.

A control panel shows you the current layer, coordinates, and coordinate system. Other features include a toolbox; undo and redo; and zoom in multiple levels, zoom out, actual size, and fit in window.

Price: Mac version, about $30,350 (98,000 Belgian francs); Windows version, about $36,544 (118,000 BF); optional modules for reading field memory data, about $34,067 (110,000 BF).
Contact: ADW Software B.V.B.A., Vosselaar, Belgium, +32 14 61 32 70; fax +32 14 61 82 15.
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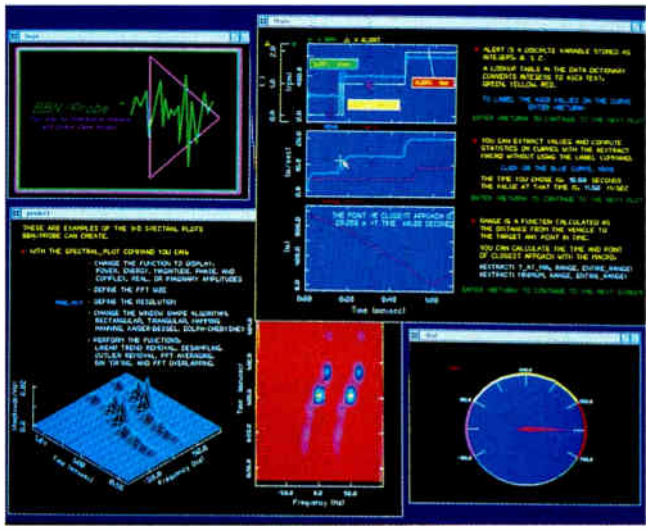

In a typical time-series analysis session, a BBN/Probe graphics window can show spectral plots, real-time displays, color thresholding, and interactively labeled time plots.

Visual Data Analysis on a PC

DADisp/Pro-32 is a 32-bit version of DSP Development's general-purpose productivity software for scientists and engineers. The package, for 386 and 486 PCs running under Windows 3.x, uses native 32-bit instructions to address up to 64 MB of onboard memory for processing large datasets.

This data analysis and display package also includes hundreds of data reduction, mathematical, statistical, Fourier transform, peak analysis, and graphical tools; mouse-controlled 3-D plot rotation; user-specified rotation angles; commands for adding, removing, and arranging windows; and new functions for saving and loading worksheets.

Price: $1895 and up.
Contact: DSP Development Corp., Cambridge, MA, (617) 577-1133; fax (617) 577-8211.
Circle 1308 on Inquiry Card.

Predictive Modeling

ModelWare Professional is the professional version of TeraNet's predictive modeling software package for DOS. It features a new Drivers tool, which automatically selects the best group of predictor variables for a user-specified dependent variable, and a new Patch tool, which fills in missing values for a given data set.

The package also includes tools that normalize data, smooth data, randomly partition data files, and provide descriptive statistics for a data file. In addition, the core modeling algorithm has been enhanced to handle extremely large training files.

Price: $1495.
Contact: TeraNet IA, Inc., Nanaimo, BC, Canada, (800) 663-8611 or (604) 754-4223; fax (604) 754-2388.
Circle 1310 on Inquiry Card.

32-bit Schematic Design Tools

Schematic Design Tools 386+ is a set of tools for designing schematics for printed circuit boards, field-programmable gate arrays, and programmable logic devices. It provides virtually unlimited design capacity, increased netlisting performance, and larger graphics part size on 386- and 486-based platforms.

OrCAD has removed the 640-KB DOS memory barrier by using extended rather than expanded memory. Using extended memory also results in smooth memory management and lets you load more libraries in RAM without compromising design capacity.

Price: $895.
Contact: OrCAD, Hillsboro, OR, (503) 690-9881; fax (503) 690-9891.
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Microsoft BallPoint is the only laptop mouse that you can adjust to four different angles.

BallPoint® mouse raises your comfort level several degrees. And its easy-to-see cursor lowers your frustration level just as much. The point being, if you use the Windows™ operating system on a laptop, BallPoint makes your work even easier. So call us at (800) 426-9400 to find out how to get one. Because next to this mouse, others are hard to handle.

Microsoft
Making it easier

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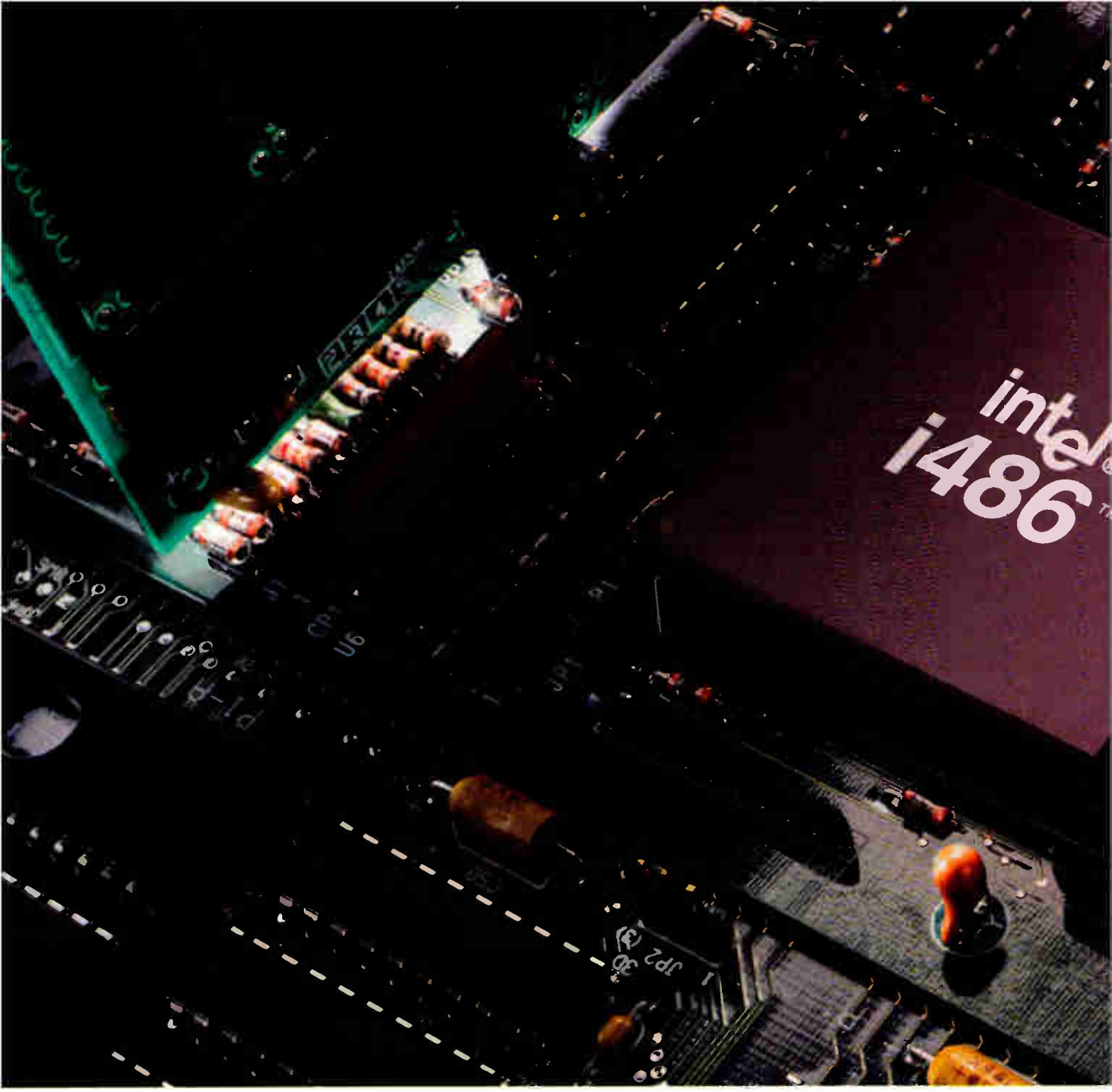


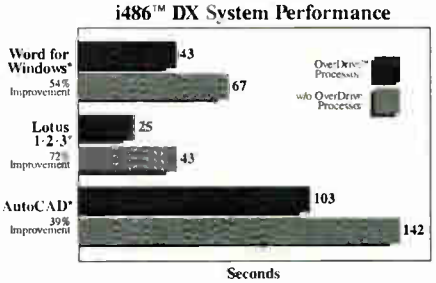
Shift all of your soft

Introducing Intel OverDrive™ Processors for your i486™ DX PC.

Would you like to visibly increase the speed of all your applications? Then it's time you shift your i486 DX or SX system into high gear.

Using Intel's ingenious "speed doubling" technology, an OverDrive Processor gives you plenty of added power—up to a 70% performance boost systemwide.

And that power will benefit every application you run on DOS, OS/2*, Windows*, or UNIX*—from AutoCAD* to WordPerfect* and



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†In cases where there is no OverDrive Processor socket, Intel recommends installation by a qualified technician.

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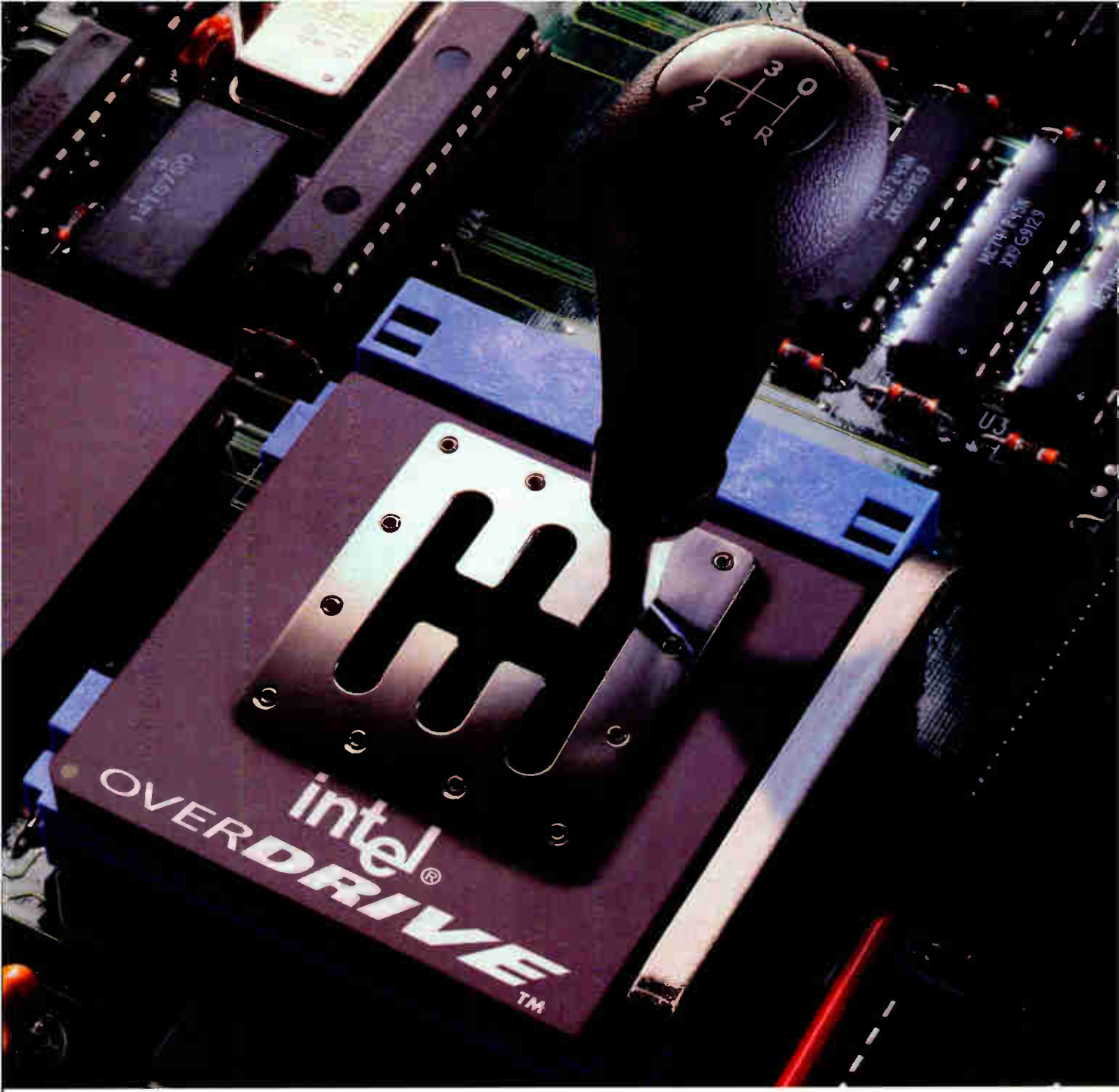

ware into high gear.

over 50,000 applications in between.

It's easy to install an OverDrive Processor. Just plug the single-chip upgrade into the vacant OverDrive Processor socket and you're ready to go. Faster.

WE MAKE COMPUTERS WORK HARDER.

Find out more. Ask for ext. 228
1-800-538-3373

So to rev up your i486 system and keep up to speed on all the latest software developments, you need the future of PC upgradability: Intel OverDrive Processors.

To find out which OverDrive Processor is right for your system or to locate your nearest dealer, call 1-800-538-3373, ext. 228. Because when it comes to running software, there's only one gear. High.

intel

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NEWS

Unix-Based Image Management

The PixelFX 2.0 family of image management software products for Unix systems includes five packages: PixelScan, PixelView, PixelEdit, PixelOCR, and PixelPrint. Each features a common Motif-based user interface, which allows multiple windows to use different toolkits interactively and simultaneously; photo retouching and image manipulation; and support for major import and export file formats.

PixelScan interfaces to popular scanners and lets you capture line art, gray-scale, and true-color images. With PixelView, you can format and display image data and convert images from one format to another. PixelEdit includes PixelBrush for image editing and photo retouching and PixelImage for manipulating images in multiple windows. With PixelPrint's Visual Printing interface, you get page preview and support for RGB to CYMK conversions. PixelOCR is an optional module that lets you convert scanned copy to text.
Price: $1595.
Contact: Mentalix, Inc., Plano, TX, (214) 423-9377; fax (214) 423-1145.
Circle 1312 on Inquiry Card.

Antivirus Toolkits

S&S International offers Windows and OS/2 versions of Dr. Solomon's Anti-Virus Toolkit that feature a faster engine, more efficient memory usage, and a new user interface. The packages can detect, identify, and deal with 2200 viruses.

The user interface lets you select the right operational level for your requirements: The checksum facility provides four levels of security and a new memory-resident checksummer, Certify, that allows program checking on the fly. The memory-resident scanner, VirusGuard, now includes support for the Extended Memory Specification to improve operational speed on systems with more than 1 MB of RAM.
Price: Windows version with quarterly upgrade, about $192 (£125); with monthly upgrade, about $330 (£215); OS/2 version with quarterly upgrade, about $229 (£149); with monthly upgrade, about $406 (£265).
Contact: S&S International, Ltd., Hertfordshire, U.K., +44 442 877877; fax +44 442 877882.
Circle 1313 on Inquiry Card.

PixelFX 2.0 Unix products let you scan, convert, manipulate, and print line art, gray-scale, and true-color images.

New Version of SuperPrint

Zenographics offers two new versions of its SuperPrint software utility that speeds and enhances Windows printing. SuperPrint 3.0 features Zenographics' new SuperRIP 32-bit Windows driver, and SuperPrint 3.0 with ZScript features the SuperRIP drivers and a 32-bit PostScript interpreter.

SuperPrint 3.0 offers SuperText, SuperPrint's type manager that scales typeface outlines from major type foundries to screen or printer, and SuperQueue, SuperPrint's fast replacement for the Windows Print Manager. ZScript translates PostScript into the GDI (Graphical Device Interface) environment and turns any SuperPrint-supported printer into an ultra-fast PostScript printer. You can view your PostScript output in a window, copy it to the Clipboard via a scalable GDI Metafile, or print it via the 32-bit SuperRIP drivers.
Price: $149; with ZScript, $295.
Contact: Zenographics, Irvine, CA, (908) 577-8303; fax (908) 303-9594.
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Double Your Disk Capacity

SuperStor Pro 2 increases your PC's disk capacity and adds Windows-based utilities that improve usability. Version 2 includes JPEG image compression and also features password protection, an integral disk cache, extended memory support, and enhancements to Addstor's proprietary Universal Data Exchange technology.

SuperStor Pro 2 compresses data automatically as it is stored and decompresses it when you retrieve it. Compression and decompression occur in real time at the record level, eliminating the need to compress or decompress an entire file before you can retrieve or write data.
Price: $99.95.
Contact: Addstor, Inc., Menlo Park, CA, (800) 732-3133 or (415) 688-0470; fax (415) 688-0466.
Circle 1315 on Inquiry Card.

Information Management

Recollect is a Windows desktop information management tool that gives you quick access to color and black-and-white photos. Its software-only image-compression features let you easily store and retrieve images.

You store information in Recollect by scanning pages or by importing files. Recollect converts scanned pages that contain text sections into ASCII format and then automatically processes the text with its built-in autoindexing. Once the information is stored, you can search through documents using free-form search capability.
Price: $795.
Contact: Rebus Technology, Inc., Auburn, CA, (916) 888-6452; fax (916) 885-0388.
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First SL notebook.

First Microsoft peer-to-peer notebook.

First upgradable-to-color notebook.

First notebook pre-loaded with network client shells.

We'd also be the first to compare ourselves to our peers. If we had any.

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You may be surprised to learn Zenith Data Systems is one of the world's biggest names in SL notebooks. Equally surprising is that we're #1 in the U.S. in SL based portables.††

For the only notebooks with built-in networking right out of the box, call Z-DIRECT.

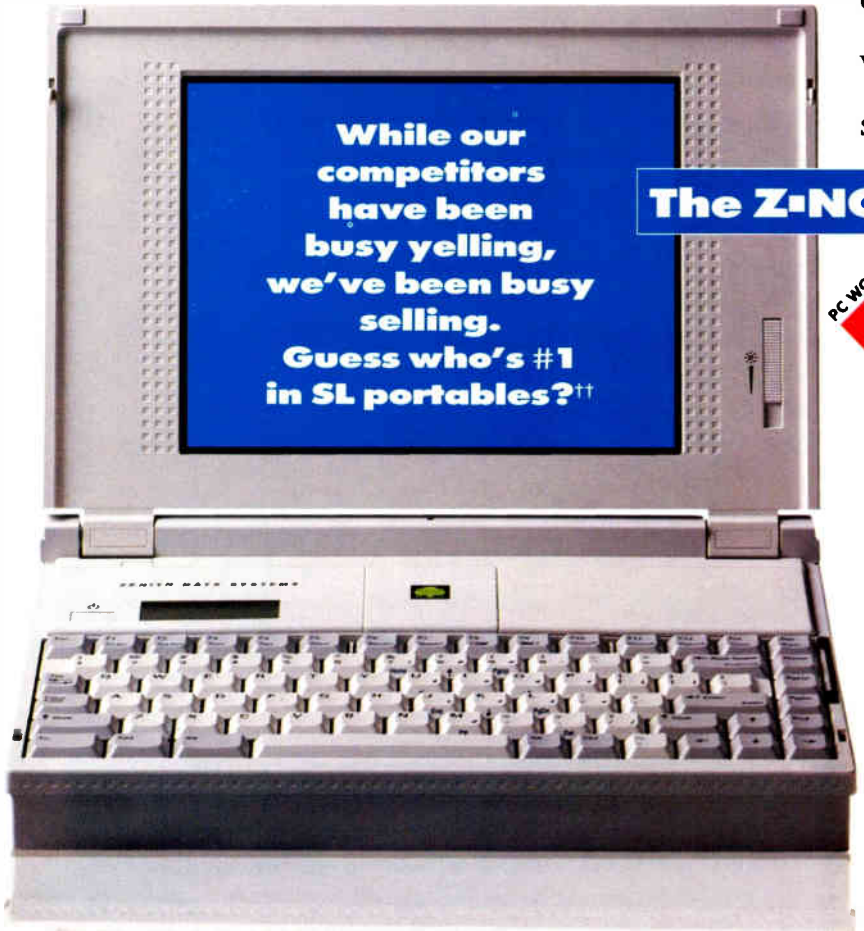
Maybe we're first in sales because we're first in technology. Zenith Data Systems created the first SL notebook. We're the first peer to peer notebook, first upgradable to color notebook and first with pre-loaded network client shells.

Now being #1 doesn't mean diddily if we don't deliver. But we're satisfying thousands by offering Z-NOTEs of uncompromising quality, with ultra-low Z-DIRECT prices, with unstinting customer assistance and unrivaled Z-CARE service.

BANYAN® VINES

So since you're shopping, we invite comparisons. Only Z-NOTE comes with built-in networking with Ethernet-compatible, high-speed communication pipes for LAN connectivity. Only

Microsoft LAN MANAGER



The Z-NOTE

PC WORLD BEST BUY

BEST OF BYTE COMDEX/Spring '92

$2399 Z-DIRECT. No ups, no add-ons no extras.

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Z▪NOTE is pre-installed with client software for all three leading network systems—Novell, Microsoft and Banyan. Only Z▪NOTE could be the first to pre-install Microsoft Windows for Workgroups. Only Z▪NOTE exclusively uses Intel 386SL microprocessors. The Z▪NOTE has an active matrix color display. The Z▪NOTE comes with MS-DOS and Microsoft Windows fully loaded and ready to run, right out of the box.

JANUARY 1993

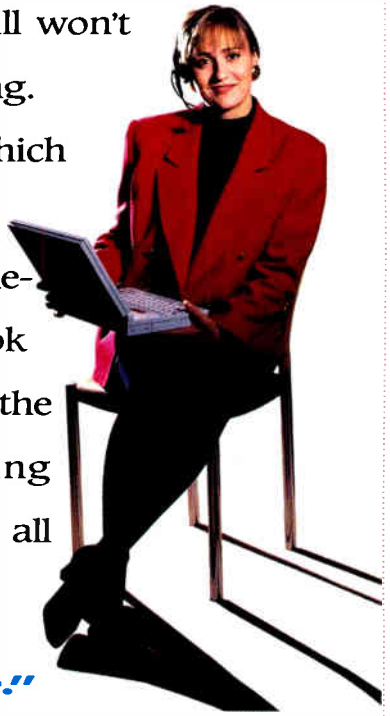
MICROSOFT® WINDOWS™ READY-TO-RUN

And only Z▪NOTE has the low Z▪DIRECT price without additional or hidden charges. Those other guys will charge up to $500 on extras to match Z▪NOTE features, and you still won't get networking.

Sandy Blagojev, Z▪DIRECT Account Executive.

"You can spend up to $500 over quote and still not get networking from those other guys."

So, which will you buy? A johnny-come-lately notebook from one of them. With none of the above. Or an award-winning Z▪NOTE from Z▪DIRECT. With all of the above.



"Prices change rapidly. Call for our latest and lowest."

48 hour delivery on all featured products. For product specifications via FAX, please call 1-800-582-8194.

Z▪NOTE™ 325L

"Built-in networking"

- Intel® 25 MHz i386™SL **upgradable to i486™**
- 85MB hard disk drive with MS-DOS® 5.0, Microsoft® Windows™ 3.1 and **Microsoft Windows for Workgroups™** pre-installed
- Logitech® TrackMan® Portable mouse
- 9.5" black-on-white LCD, upgradable to active matrix color, 640 x 480 VGA with support for 64 grey shades; and simultaneous video support
- 3.5" 1.44MB floppy disk drive
- 8.5" x 11.9" x 1.9," only 5.9 pounds
- Rapid-charge nickel metal-hydride battery for up to 4 hours* continuous use or up to 10 hours* under Rest/Resume condition
- **Pre-installed network client software for Novell® NetWare, Microsoft LAN Manager,™ Banyan® VINES®**
- **Ethernet-compatible high-speed communication port for LAN connectivity**
- 82-key keyboard with 12 full-size function keys

$2399

Z▪NOTE 325Lc

"Incredible color and price"

- Intel 25 MHz i386SL **upgradable to i486**
- 4MB RAM, user expandable to 12MB
- 120MB hard disk drive
- MS-DOS 5.0, Microsoft Windows 3.1 and **Microsoft Windows for Workgroups** pre-installed
- Logitech TrackMan portable mouse
- 8.4" active matrix color VGA LCD, simultaneous video support
- 3.5" 1.44MB floppy disk drive
- 8.5" x 11.9" x 2.1," only 6.5 pounds
- Rapid-charge nickel metal-hydride battery for up to 2.5 hours* continuous use or up to 6.5 hours* under Rest/Resume condition
- **Pre-installed network client software for Novell NetWare, Microsoft LAN Manager, Banyan VINES**
- **Ethernet-compatible high-speed communication port for LAN connectivity**
- Optional READYDESK™ Port Replicator ($107)

New Lower Price

$3999

*Battery life depends on application used, power management features selected and peripherals attached.

Network now with Z▪DIRECT.

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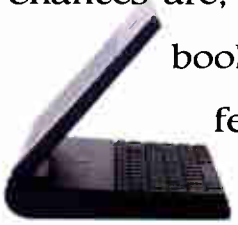
Call Z▪DIRECT for the first flyweight heavyweight.

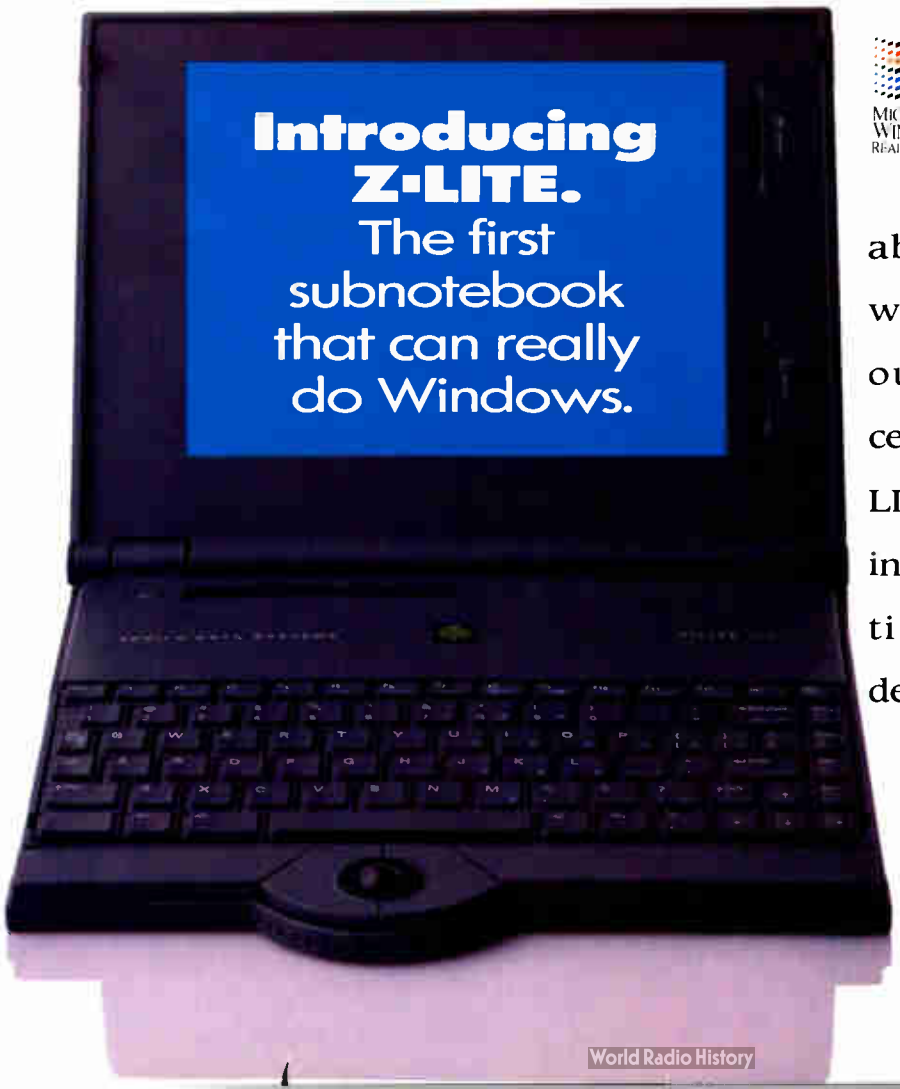


Chances are, what those new lightweight subnotebooks you're considering are light on are features and functionality. Especially if you use Microsoft Windows. So it's a good thing you've discovered new Z▪LITE 320L. Because no lightweight does Microsoft Windows like Z▪LITE. Z▪LITE combines every heavyweight feature you need to run Microsoft Windows in an ultra-lightweight PC. Like the power of Intel 386SL technology—instead of the no-name chip others foist off on you.

The first subnotebook with backlit VGA.

The first subnotebook with two PCMCIA TYPE II SLOTS.

The Z▪LITE 320L includes our energy-efficient 3.3V design. It's our newest technology breakthrough, rewarding you with extraordinary battery life and extraordinary features. We even include an "at-a-glance" battery fuel gauge.



Then there's our full size 8.4", backlit VGA display. Rather than the pint-size unreadable screen you find elsewhere. You'll enjoy handling our upfront and center, integrated LITEPOINT pointing device. Others offer a tiny control that seems designed for Lilliputians.

Microsoft™ Windows™ Ready to Run

intel inside™

The first 3.3V 386SL subnotebook.

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1993

So what more can we do for you? Z▪LITE 320L gives you flexibility and options. There's two PCMCIA card slots for accommodating high speed data/fax modems, wireless communications and more.

And to make your life easier, we've combined the external floppy disk drive and AC adapter/charger in an all-in-one design.

Z▪LITE 320L is the best of Zenith Data Systems technology, with an unbeatable Z▪DIRECT price. If lightweight is the way you want to go, Z▪LITE 320L is the route to take.

"Z▪LITE is light years ahead of the competition!"
Margie Silha,
Zenith Data
Systems

Get Z LOW PRICE, call Z▪DIRECT
1-800-289-1273

New Z▪LITE

Z▪LITE™ 320L

"Full featured subnotebook"

- Intel 20 MHz i386SL (3.3V)
- 2MB RAM user expandable to 6MB
- 60MB hard disk drive
- MS-DOS 5.0 pre-installed
- Optional 3.5" 1.44MB external floppy disk drive
- Optional LITEPOINT™ two-button detachable pointing device
- 8.5" VGA backlit black-on-white display with 64 grey scales
- Two PCMCIA type II slots
- NiCad battery pack for up to 3-hours* continuous or up to 6-hours* charge
- 7.6" x 9.9" x 1.5" sloping to 1.1"
- 3.9 lbs.

$1899

ZDS 620nl

"Entry level i386SL notebook"

- Intel 20 MHz i386SL
- 2MB RAM user expandable to 8MB
- 60MB hard disk drive
- 3.5" 1.44MB floppy disk drive
- MS-DOS 5.0 pre-installed
- 9.5" black-on-white VGA display
- 85-key full-travel keyboard
- Serial port, enhanced parallel port, video port, mouse/keyboard/keyboard port
- One internal modem socket
- NiCad battery pack for up to 3 hours* battery life
- 8.5" x 11" x 1.9" 6.5 lbs.

New Lower Price

$1449

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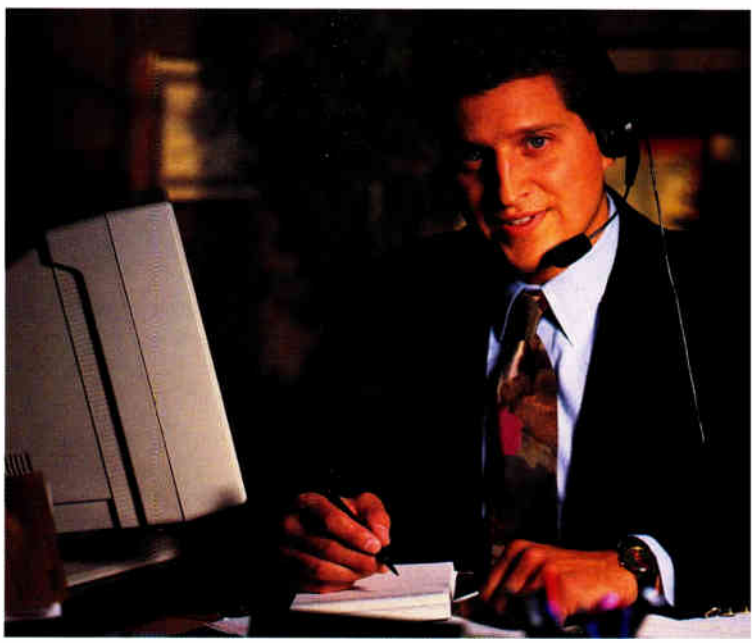
Call Z▪DIRECT for the only PCs that come with all these big names: Intel, Conner and Jeffrey Crouch.

At Zenith Data Systems we believe you deserve nothing less than blue chip components. So for our PCs, we offer names like Intel for microprocessors and Conner™ for hard drives.

And for customer assistance, we offer names like Jeffrey Crouch. Now while Jeff may not be top of mind today, one call and you'll never forget him. Because all our Z▪DIRECT customer assistance reps are more than high tech trouble shooters, they're investment counselors.



Jeffrey Crouch, Z▪DIRECT Customer Assistance Center Representative.
"I'm more than just your helpful hardware man."

They understand Z▪NOTEs and Z▪STATIONs are designed for **integrated connectivity,** with an unprecedented ease and breadth of upgradability. It's what we call **investment protection.** With so many options for upgrading your investment available on the market today, the good advice of our Customer Assistance Center can be a big help. Our Customer Assistance Center is ready to answer your questions Mon.-Fri., 7 AM to 11 PM (CST). Call **1-800-CARE-360.**

All of which brings us to our renowned Z▪CARE service. We think it's the best in the

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business. Because we offer over **400 authorized service centers** in North America and more than **2,000 service reps** around the world.

With that kind of blanket coverage, you can enjoy on-site service for all our desktops the next business day. There's 48-Hour Repair-and-Return or carry-in service for portables. And now Z•CARE offers **optional support upgrades** including network planning, start up, operation and expansion services. Even the competition finds our service exceptional. Because we're authorized to keep your network operational even if there is a variety of other PC brands or software in place. As for our competitors, they can only send you to "3rd party" service centers. But why go anywhere else when you can come to Z•DIRECT? Get *Z* series notebooks and PCs you want at a great low Z•DIRECT price—along with unrivaled Z•CARE service. That's what you can expect from the #1 name in SL portable computing!†

95%

95% of calls to the ZDS Customer Assistance Centers enjoy one call problem resolution.

Z•DIRECT Customer Assistance Center.
Not just troubleshooters, investment counselors.

JANUARY 1993

"Prices change rapidly. Call for our latest and lowest."

Z BEST service is Z•DIRECT.
1-800-289-1273

Z•433DX
"Affordable i486 performance"
- Intel 33 MHz i486DX
- 4MB RAM user expandable to 40MB
- 170MB hard disk drive with MS-DOS 5.0 and Microsoft Windows 3.1 pre-installed
- VGA color monitor, 256 colors
- 3.5" 1.44MB internal floppy disk drive
- Mouse
- 5 open 16-bit ISA slots
- One 5.25" accessible drive bay
- One-year limited warranty

$1979

Z•STATION™ 466Dh
"High performance low price"
- Intel 66 MHz i486DX (upgradable)
- 8MB RAM user expandable to 64MB
- 200MB hard disk drive pre-installed and optimized with MS-DOS 5.0, Microsoft Windows 3.1 and **Microsoft Windows for Workgroups**
- Super VGA color monitor, 1024 x 768 upgradable to 256 colors
- **Pre-installed network client software for Novell NetWare, Microsoft LAN Manager, Banyan VINES**
- **Ethernet-compatible high-speed communication port for LAN connectivity**
- 3.5" 1.44MB internal floppy disk drive upgradable to 2.88MB
- State-of-the-art modular "snap-in" system design with 4 EISA slots
- Module sockets for SCSI and WAM (Windows Accelerator Module)
- Flash ROM BIOS
- Dual password security protection
- Serial, parallel, mouse, keyboard, video ports
- Microsoft mouse
- One-year limited warranty and on-site service included with extended Z•CARE™ service available

$2999

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You can't go wrong with our **Buyer's Bill of Rights.**

Buy Z▪DIRECT for investment protection. *Z* series has unprecedented upgradability, integrated connectivity, ease of use and design. **Right** Buy Z▪DIRECT for experienced direct sales consultants. No order takers at Zenith Data Systems. **Right** Buy Z▪DIRECT for direct answers. 95% of your problems are solved in one call. **Right** **Buy Z▪DIRECT for direct, 48-hour shipment.** **Right**

If it's not Z▪DIRECT it's just not right.

Buy Z▪DIRECT for no hassle returns. No questions asked, whatever the reason. Return your PC within 30 days:** **Right** Buy Z▪DIRECT for direct technical support and a complete array of direct-to-you peripherals, accessories and software. **Right**

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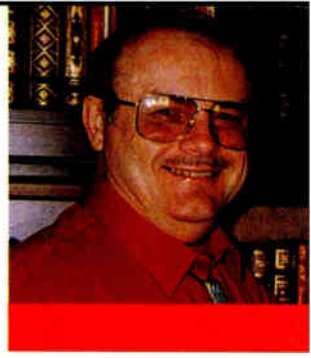

JERRY POURNELLE

THE PRINCIPLE OF PURSUIT

Every now and then, Microsoft holds a big meeting to trot out their latest stuff. It's attended by any number of journalists and financial analysts, there are receptions and cocktails and dinners, and a great time is had by all. It ends with Chairman Bill Gates telling where he thinks Microsoft is going.

This year it was called Strategy Day, and while there was a lot of talk about future products, the most significant remark was about the past. Gates said, "A few years ago I asked developers to write applications for Windows. They wouldn't do that, so I went to the Microsoft Applications Group, and they didn't have that option."

What he meant was that he bet a significant part of his company's future by investing in Windows application programs; and now that Windows has succeeded in a big way, Microsoft intends ruthlessly to exploit that decision. In military parlance, it's called the principle of pursuit. Microsoft doesn't intend to leave much when it comes to Windows applications.

The big announcement at Strategy Day was what I think should have been called Windows 4.0, but which Microsoft chooses to call Windows for Workgroups. Internally there's a great deal of 32-bit code, much of which I presume will go over seamlessly to Windows NT. WFWG is *not* just an upgraded Windows 3.1, although it's compatible with all known 3.1 applications that don't do strange things—or so Microsoft says.

WFWG has built-in peer networking and works with most network adapters, as well as with the Intel network cards that Microsoft optionally bundles with their software. WFWG's peer LAN capabilities don't take the place of sophisticated dedicated file-server software like NetWare; instead, it works neatly as a supplement. One caution: as I write this, WFWG works just fine with ARCnet cards, but it will *not* coexist with NetWare running on ARCnet. That may be fixed by the time you read this.

The networking capability of WFWG is important because it is as simple to install and use as Windows itself. And yes, I know some don't think Windows is all that simple. Anyway, from the user's point of view, the network capabilities are just more Windows applications. Moreover, the networking integrates seamlessly with other Microsoft Windows applications, as well as with DLLs and the new and improved OLE. Two users working with WFWG can exchange objects—words, spreadsheets, code, drawings, video—with simple drag-and-drop operations, and it goes surprisingly fast.

Naturally there's file sharing, and that has been done well. You can make some file directories public (anyone can get them without a password), others public but read only, yet others shared but only by those with the proper password, and so forth. Again, this is simple to set up and works right within Windows.

WFWG is aimed directly at NetWare Lite and LANtastic; and it has just enough ease-of-setup and ease-of-use features to be formidable competition.

Databases

The Microsoft juggernaut continues with new database and workgroup applications

Also shown at Strategy Day were Microsoft Access (a relational database that uses Visual Basic as its programming language) and a new version of FoxPro that uses and is compatible with Xbase languages such as dBase and Clipper. Microsoft didn't say their strategy would be to use FoxPro to beat dBase while providing a smooth path from FoxPro to Access; but it's pretty clear that is what they intend. Whether they can do it isn't as clear.

Access integrates seamlessly with WFWG, and it has the capability of getting data from a variety of formats—Paradox, dBase, Excel—while being exceedingly easy to use. Access incorporates a new concept in help files: *Cue Cards*, which remain on-screen and prompt you through whatever complex act you have requested help on. The ones that I saw were really useful.

You find data by constructing *views*. This sounds harder to do than it is. The whole point of Access is to let you use the database without programming.

During the presentation, Microsoft made a telling remark: "We believe that a relational database is the proper place to store *everything*: files and filenames, voice mail, videos, frame captures, mail, pointers to archived material, anything you keep on your computer." Assuming they meant it—and they usually do mean what they say at these dog and pony shows—the implication

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is that Microsoft intends to use Access to build something, much as Traveling Software did with their ViewLink program. ViewLink, which turned your computer into one giant relational database, was a great idea, but it was a bit before its time. Perhaps that time has come.

Microsoft clearly intends to market an integrated set of products built around WFWG; their goal is to have you do almost everything you do on a computer using a Microsoft product and store the rest in a Microsoft database.

We'll see. I don't recommend anything I don't have in use at Chaos Manor, and as I write this, the only part of the new Microsoft integrated family of products I have running is WFWG. That was easy to install, and it works well (a report next month). I have no reason to suppose the others won't also.

Think of this as an early warning. If all this stuff works as well as it demonstrates, and it all ships on time, the software development environment has changed significantly.

Support?

Microsoft has brought out a daring new product line—at a time when dealer and customer dissatisfaction with the cost and level of Microsoft support is at an all-time high. If they can't support what they have, how can they take on all these bold new products?

Microsoft is aware of the problem, of course. I was told that one out of four Microsoft employees now works in support services. (Cynics will say, "Yes, and they're all new employees who can barely look up things in a database.") There's also a bold new strategy: support costs are billed back against the product manager's profits. This gives product managers a strong incentive to make things work the first time.

Microsoft has made a bold strategic move, and I'd like to help them out. Here's a list of things I think they should do:

- Create a decent debugger for WIN.INI, a program that knows about the weird statements in that file. No one understands what's going on in WIN.INI, but at least they could give us a way to see that we're not doing something stupid.
- A deinstaller for all new software.
- Publicize the support group's fax number. Microsoft has fax-back support capability for end users, but many dealers say they have never seen the number. It's the main fax line: (206) 936-7329, and you can send in technical questions on any Microsoft product. If you haven't heard from them in a day or so, call (214) 714-6789, which is the Letter Response Group. Tell them you sent the fax and when and where you can be reached, and things can happen.
- Have a few regional phone nodes outside area code 206. An 800 number would be better. It's annoying to call long distance only to get someone who knows less about the product than you do.
- Make software smarter at determining why it won't run.
- End the Microsoft versus Microsoft interoperability problems. It was very annoying to find that Excel 3.0 didn't work properly with Windows. And MSCDEX is a hack and badly needs fixing.
- If Windows is truly an operating system, shouldn't it work with non-Microsoft products? When you call for support and are told you have to deinstall Norton Desktop, QEMM, 386Max, and just about every other third-party program, you're entitled to wonder just what's going on. If it's a proprietary operating system that supports only Microsoft applications, fine, tell us that; otherwise, test it thoroughly with some of the more common add-ons and stop having the support people tell us we have to deinstall everything before anyone will talk to us.
- Make Setup saner. Include in it a set of checksums so that once programs are decompressed, Setup can see that they're not corrupt. It's wearying in the extreme to discover that somehow there's a corrupt WIN.COM after spending half an hour installing everything.
- Provide us a suite of tests to check hardware compatibility. Let the software poll everything, and if something won't run with Windows, tell us before we spend hours installing with that lamebrained Setup program.

Competition One: WOSA

Microsoft bashers complain that Gates doesn't leave much for anyone else. It's true, in the sense that he's left little room for big companies to become giants or, for that matter, for medium-size companies to get really big. PC software developers will just have to learn how to live in a world that contains a 900-pound gorilla. Some principles apply.

Microsoft is a very large ship. It won't turn quickly. You can see where it's headed. You may be able to get there before Microsoft does.

They'll even help you. If you remotely compete with Microsoft, you should subscribe to their bimonthly newspaper on development works, *Developer Network News*. (To order it, contact Pat Bellamah, 1 Microsoft Way, Redmond, WA 98052, fax (206) 936-7329, Attn.: Developer Network. To order by credit card, call (800)

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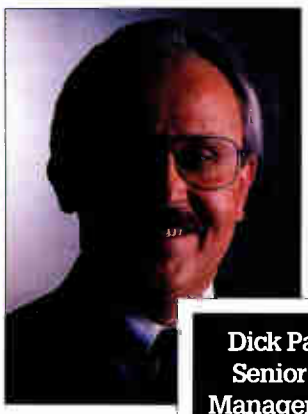
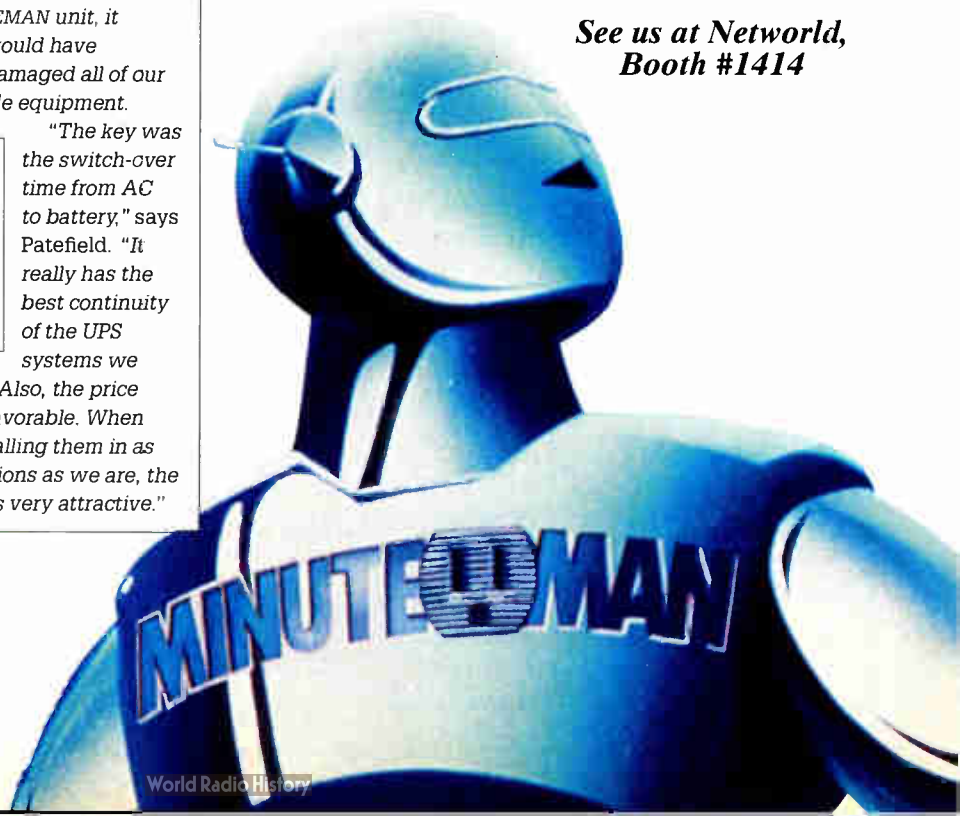


Dick Patefield, Senior Project Manager for Store Systems Support, JCPenney

Recently JCPenney Co., Inc. changed its operations from the old POS systems to the new PC-based technology, relying on PC platforms for point-of-sale and in-store support. And they back each one up with help from MINUTEMAN.

"There was a violent surge in one of our stores," says Patefield. *"If we didn't have the MINUTEMAN unit, it probably would have seriously damaged all of our point-of-sale equipment.*

"The key was the switch-over time from AC to battery," says Patefield. *"It really has the best continuity of the UPS systems we evaluated. Also, the price was very favorable. When you're installing them in as many locations as we are, the pricing was very attractive."*



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227-4679 ext. 11771.) Also get their Developer network CD-ROM (Microsoft will even offer you a discount on a drive). It's a quarterly CD-ROM filled with code, comments, help files, and technical articles on the Microsoft programming environment—all indexed and accessible.

Microsoft insists that their new policy is WOSA (Windows Open Systems Architecture) and they'll make it easy to write applications for Windows. I also know that in the past, Microsoft hasn't been very prompt in sharing interface secrets. They say that's changed, and it's early yet: not everyone in the company has got The Word.

OK, but hold their feet to the fire. If they say WOSA, make them mean WOSA, and if you can't get what you need at the product manager level, go higher. Keep the press informed. I'm not interested in random Microsoft bashing, but you have every right to know whether Microsoft is following their own policies.

Competition Two: Goals

Microsoft doesn't deliberately leave much, but there's a lot they can't handle. Take LANs: WFWG provides many capabilities, but it doesn't understand backups well, it's far from optimized for sharing resources like CD-ROMs, and, while it does a neat job of connecting three or four people into a workgroup, it's not so hot on connecting several workgroups. The thing for competitors to do is *add* to what WFWG does, rather than going head-to-head with it.

On that score: the ability to network, share files, and arrange schedules is one thing. Using that capability to increase productivity is another. It's easy to misuse networks. If everyone has to see and sign off on every thought the president has, and every notion has to go through a committee because it's easy to do that, the company ought to buy an expert system on Chapter 11 proceedings. The goal isn't connectivity and communications, it's to get more product out the door.

Because they're big, Microsoft has to be general. They can't tailor applications to particular niches. Smaller companies can.

Competition Three: Usability

One lesson Microsoft has learned: talk to real users about what they do, not what they say they want. If you ask people what features they want, they'll never stop talking. If you look to see what features they use, and how they use them, you'll probably be surprised.

Microsoft was surprised. As a result, they have yet another competitive advantage: the usability group, which actually watches naive users face up to new software. Most companies aren't large enough to have a group like this, and it shows. For that matter, it's relatively new to Microsoft, and that shows, too; but Microsoft stuff is getting easier to understand.

They've developed Wizards—a sort of tamed-down expert help system—and Cue Cards; and they're working on systems that watch what you're doing wrong so they can pop up with suggestions on where you made a wrong turn. One day, all software will have intelligent help systems.

Microsoft is still feeling their way in this area; and once again, a company as large as that moves slowly. There are plenty of chances to get ahead of them.

Indeed, if I wanted to get rich in the computer business, I'd start a firm offering usability services to small developers.

Microsoft has made a bold move toward radical changes in the PC software environment. The company is big enough that you have to take them seriously; but that very bigness leaves them vulnerable to

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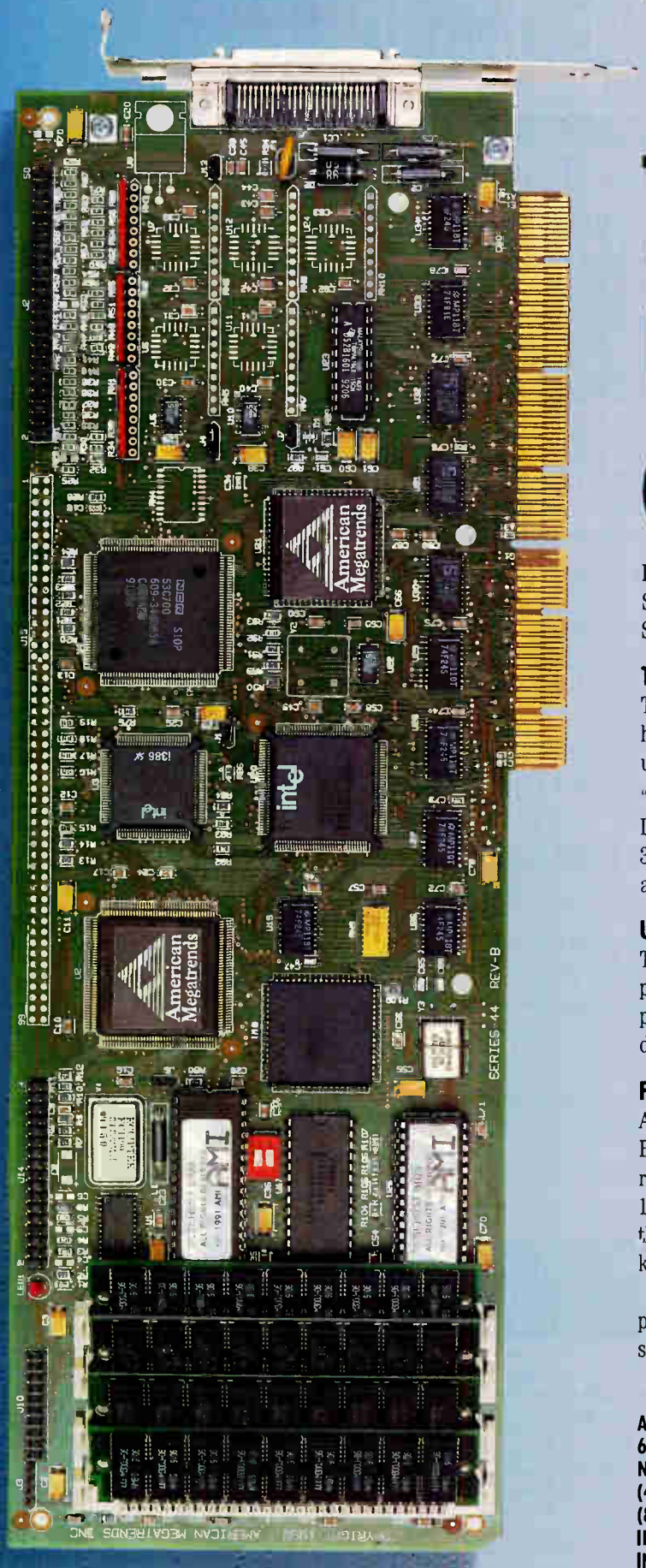

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certain kinds of smarts. I foresee interesting times....

When, When, When Will I Learn?

My big Cheetah crashed again. One minute it was working fine, the next it locked up and wouldn't reboot. Memory parity error. I turned it off and let it rest a minute and then back on. Same thing. Start-up would run through standard memory tests and then stop in the middle of the extended memory tests.

OK, thought I, bad chip; and I did a foolish thing. My Cheetah has 16 MB of memory in SIMMs. I figured that if I wrote down the location of the memory error and swapped those SIMMs around, I'd soon enough locate which one was bad; after which I could easily live with only 12 or 14 MB of memory while I got a replacement. So, I started swapping.

The first thing wrong with that scheme is that SIMMs are held in by little plastic clips, and after a couple of years, these become very brittle. They break; and once broken, there is no way to fix them short of unsoldering the SIMM holder and replacing it. That is a major job.

Fortunately, there is a temporary fix: it's possible to hold the memory in place with rubber bands. You can also use a dot of Super Glue, but of course you aren't going to do much memory swapping once the glue goes on. Duco Cement is better. I'd imagine Model Airplane Cement would work. I am told you must not use Silicone Cement, which is acetic acid–based: the acetic acid will play merry hob with the traces on your boards.

Eventually I got the memory swapped and the machine put back together with rubber bands, and of course I got the exact same error message, for the same location. This made no sense, it was late, there were deadlines, and in panic I called my son Alex's beeper number. Alex is a partner in Workman and Associates, and they specialize in recovering data off crashed disks, as well as installing new systems that won't crash in the first place.

Alex came over and decided the sensible thing to do was swap hard drives in the two Cheetahs. That is: the Cheetah 486/25 sits out in the Great Hall to be used by Larry Niven when he works here. The other, a 486/33, sits under my desk as my main machine. Clearly, if I had my old hard drive in the 486/25, that would be good enough while Alex and Barry Workman looked into the 486/33.

Swapping went easily enough. Both of the machines have large (600-MB) SCSI hard drives with caching controllers: a Distributed Processing Technology controller on one, and a Perceptive Solutions

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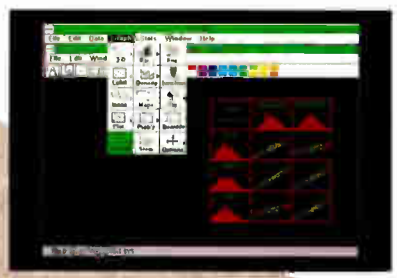

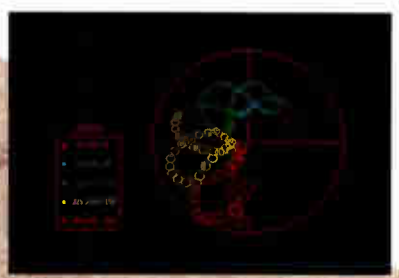

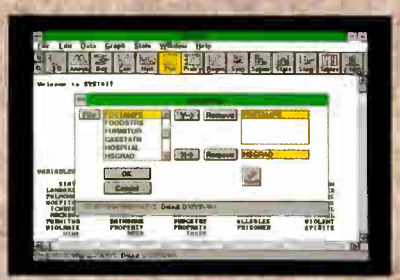

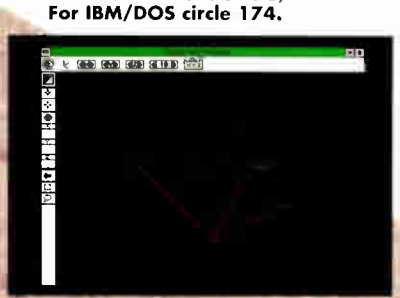

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controller on the other. I confess I haven't the foggiest notion which is faster: they are both faster than lightning and work fine. Alex swapped the hard drives only; the controllers never noticed the difference. Apparently, SCSI is like that. Then we pushed the 486/25 under my desk.

I'd gone downstairs for coffee. When I got back up, I found Alex muttering evil curses: now the 486/25 was showing essentially the same symptoms the 486/33 had. Memory error on start-up. Since it had worked fine not 5 minutes before, something was clearly screwy.

Then I remembered we'd been through this before, and it turned out to be the keyboard. Naturally when we put the 486/25 under my desk, we connected the keyboard that had been working with the 486/33. Just for luck, we swapped keyboards: and that worked just fine. Now both machines perform flawlessly, even if one is held together with rubber bands.

As to why a sour keyboard can bring down your system: when IBM designed the PC, they didn't think anyone would need many megabytes of memory. Later, they found that programmers were doing memory tricks turning address line A20 on and off. There wasn't any way to do that in the XT, so they delegated the function to the controller chip in the keyboard. This is the A20 handler; and goofy as it sounds, even in these days of 486 computers, one vital part of what's going on is done by the rather obsolete keyboard controller chip. Interestingly, if you run Unix, the speed at which the A20 gate is turned on and off can be significant, so you can actually speed up your computer by getting a better keyboard! (For more on the A20 problem, see Mark J. Minasi's "Exorcising the A20 Poltergeist," August 1992 BYTE.)

The keyboard controller chip is rather sensitive to voltages; so if you drop something conductive into your keyboard, you can get what amounts to a short that drags down the voltage as seen by the keyboard controller chip. The result will be that your machine won't boot and probably will report a memory error.

Recalling the broken SIMM clips, the moral of this story is, be sure what you're fixing is the part that's broke.

And Yet Another Instructive Tale...

Our youngest son, Richard, is now in Washington as an intern, and he wanted a portable computer for the job. Since he's been a Mac user in the past, he wanted something that would run Windows. After some thought, I let him take the NCR 3170 (formerly the AT&T Safari). This is the older model, with an integral floppy drive and no PCMCIA slot. He started using it before he left and loved it.

Then he let the batteries run down, so much so that it forgot all its Setup information. No problem, he thought. The Setup program offers an option of resetting to the default, so he chose that.

Alas, the machine didn't work right. Files had vanished. You could see the filenames and sizes, but attempts to access them failed. There were similar problems.

"I'll fix that," foolishly said I, and got out Norton Disk Doctor. NDD looked at the disk and reported all kinds of munged directories and screwiness with the FAT (file allocation table). I let it try to fix things, and after each pass I tried to delete the problem files. Many of them wouldn't delete. Finally, in despair, I had Richard take it over to Barry in Pasadena.

Barry opened the machine—not something I'd want to do with a laptop—and read off the hard disk type. "There's the problem," he said. The default disk type in Setup was for a 20-MB hard drive; but

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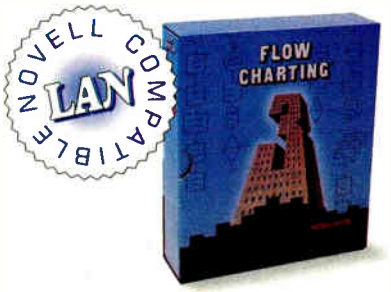

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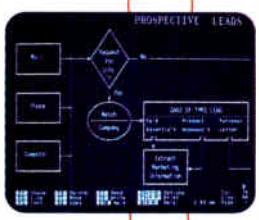

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what was really installed was a 40-MB drive. Changing that setting instantly fixed all the problems.

One moral of this story is, if you haven't written down all your Setup information, particularly your disk type, for all your machines, go do it *now*. You never know when you'll need that. The other moral is, before you have at a disk with NDD, you might give a few seconds thought to what else might be wrong.

Anyway, I'm pleased to report that Richard has the 3170 in Washington and it works just fine. He loves the built-in fax modem, and he finds the AT&T Mail program powerful and easy to use. The 3170 seems to have made a Windows convert out of a former Mac user.

A Retraction

A couple of months ago I wrote about surge protectors and said that I had two kinds that don't use MOVs (metal-oxide varistors). Apparently I misread the specifications on one of the brands; at any rate, I was wrong. The only surge protector I have that does not use MOVs is Zero Surge's ZS900.

This doesn't mean that the units that do have MOVs are bad or won't protect you; they probably will. The problem is that each surge that goes through the MOV damages it, not much, but some; if there's enough damage, it won't do the job properly. There is no test available that can determine just how safe the MOVs in your protector might be; thus, some experts advise you to replace MOV protector units at regular intervals, say, every couple of years.

Zero Surge units don't have MOVs. As far as I can determine, they aren't damaged at all by any surge that doesn't actually destroy the unit. They cost more, but you don't have to replace them. Me, I like the peace of mind.

I also have a suggestion to those making MOV-based surge protectors: ever thought of putting those in a removable cartridge? That way, a nervous user could replace them annually.

EDOS

If you like to play with Windows and you run a lot of DOS programs, you probably want this. It lets you allocate and deallocate Windows memory for DOS sessions; and it will create Really Big DOS Windows, above 700 KB in size. There are other neat features, like the CLIPBOARD command that will tell you if there's any text in the Clipboard and if so how much, and lets you examine or print what's there. There are time-slice controls, status information, a way to tell how long a DOS session has been running, and what percentage of your computer's CPU that DOS window has eaten.

Fair warning: I've used this without problems, and so have others, but when I mentioned to a Microsoft Windows programmer/manager that EDOS let you have 700-KB DOS sessions under Windows, he shuddered. That hasn't caused me to take EDOS off my machine. It really is useful. However, understand that I save both programming and text work early and often; and be aware that EDOS does things Microsoft doesn't believe possible.

Mystat and Systat

Mystat comes with a foreword from Leland Wilkinson, the president of Systat, and is an introductory course and tutorial on statistics using Systat. The package is designed for use by educators. No statistics training program is all that easy for people

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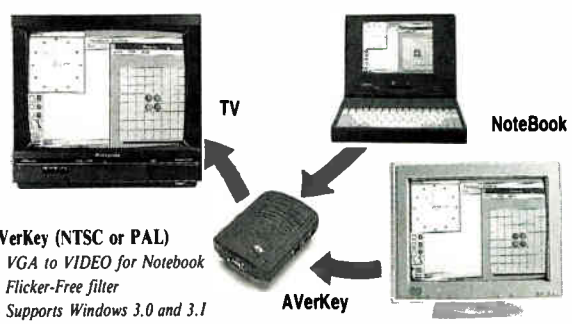

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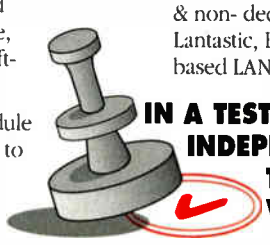

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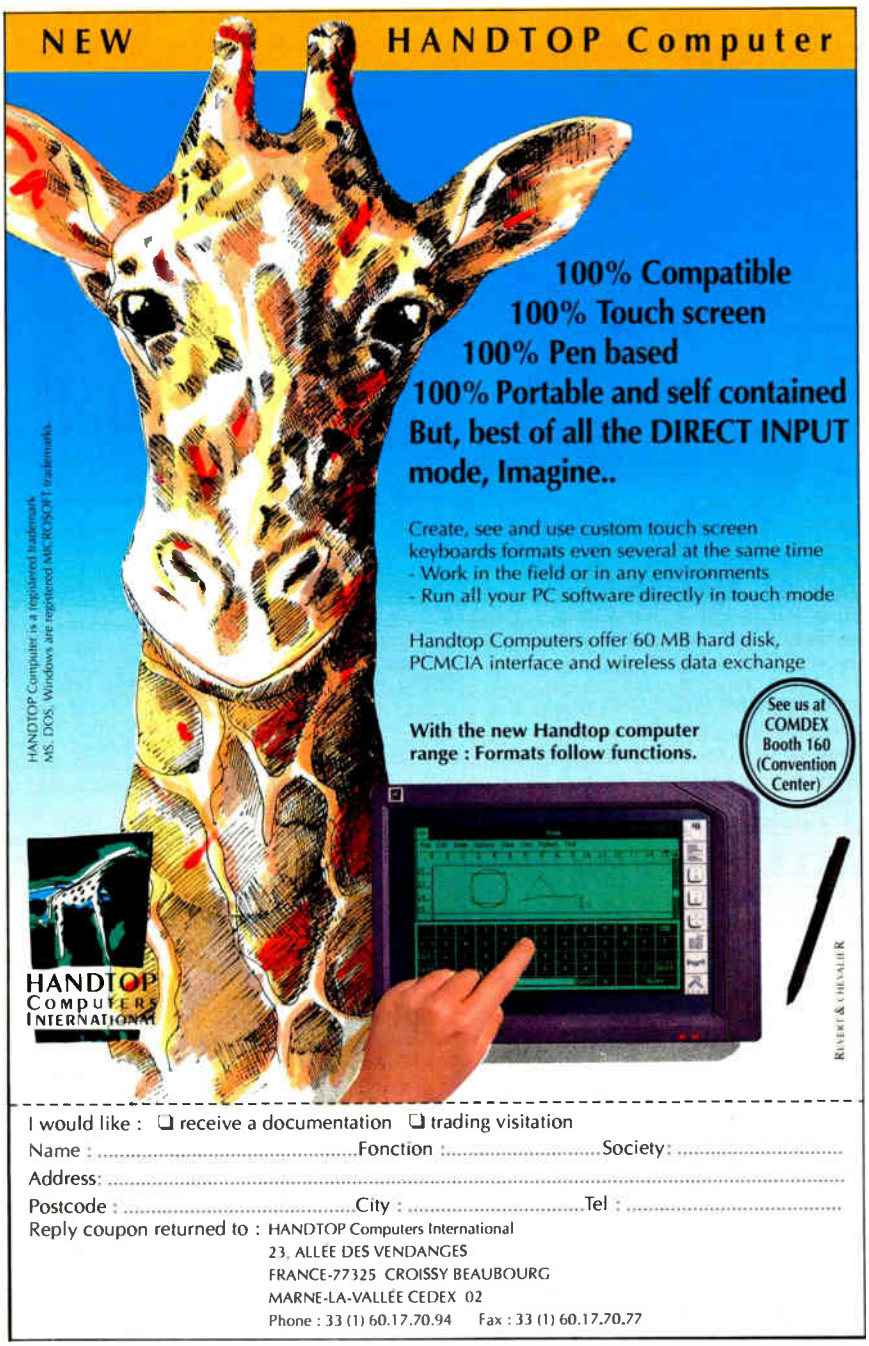
who don't understand statistics, but Mystat is relatively painless. In my judgment, you can't really operate in the modern business world without understanding something about statistical inference. You may not need to know how to do statistical tests of advertising copy, or sales pitches, or to analyze masses of incomplete data, but you sure had better be aware of what's possible; and if you hire experts, you certainly will want to know enough to avoid being snowed.

Most college introductory statistics courses are absurd: they teach cookbook methods for calculating means and standard deviations and conduct "Student's T" tests; but they don't give you any real understanding of what statistics is about. I don't say working your way through this book/course will make you a statistician, but it's my judgment that it will teach you more than any of the statistics courses for education majors I've seen. Moreover, when you've finished, you'll have a good idea of what Systat can do. Mystat is recommended.



Info Select for Windows

Info Select for Windows is a free-form database program in which you can collect all those notes that pile up on your desk, and it really is neat. Moreover, the Windows version is an improvement over the DOS program without taking away the simplicity that made it easy to use.

Info Select organizes things the way I do, into small notes that I can stack into related piles. You can also use it to display information or do queries. A neat feature lets you find out what city and time zone correspond to a given area code, and looking at how they did that suggests similar things you could do.

There are other features (e.g., a phone dialer and calendar) that I don't use because those are built into FranklinQuest's Ascend time management system, but they work. Mostly, though, if you get into the habit of using Info Select, you may cure yourself of scribbling phone numbers on the backs of old envelopes and then finding they're lost when you need them, or making notes on Post-its and sticking them all over your monitor until you can't see the screen. Recommended.

Fotoman

Fotoman is a digital camera from Logitech. I've written about digital cameras before. They're a quick way to get monochrome images into your portable (or desktop) computer. Image formats include TIFF, PCX, and BMP. From there, you can paste them into documents for printing or sharing over a WFWG network, or you can use them in image-aware databases like Thinx. Alas, there's no way I know of to paste one into Info Select, which is a pity because that might be a good way to organize the photo images.

Fotoman works. The image quality isn't all that high, and even when fully charged, the camera takes several seconds to get ready to take the next picture. The resolution (256 gray levels, 376 by 240 pixels, meaning 75 dots per inch in a 3½- by 5-inch photo) isn't good enough to do what I would like, which is to take it to the library and use it as a kind of scanner to make notes from books, but the pictures aren't bad.

There are limits to what you can do with a single battery charge. If you take a full load of 32 pictures with flash on every picture, you'll have about 24 hours to either recharge the camera or get your pictures transferred to your computer.

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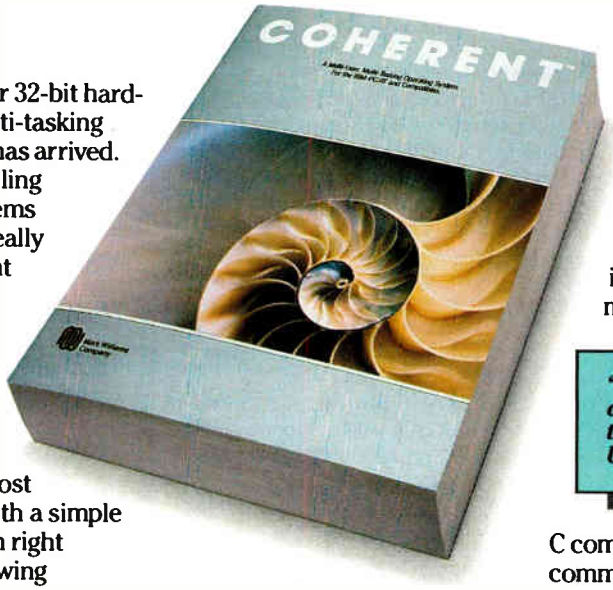

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this will do the job. Taking an image out of the camera and squirting it into the computer through a serial port is slow—about a minute per picture—but it's painless, and once the image is in the machine, you can manipulate it in various ways.

Fotoman is a pretty good deal for real estate companies and other outfits that use a lot of pictures and need speed and convenience rather than high resolution and detail. It can save a bundle on film.

Pascal Returns

Windows is written in C, and for a while it looked like the only way to write Windows applications was to learn C programming. Microsoft released Visual Basic, which in my judgment is far preferable to C, but there's a widespread belief that real programmers don't write in BASIC.

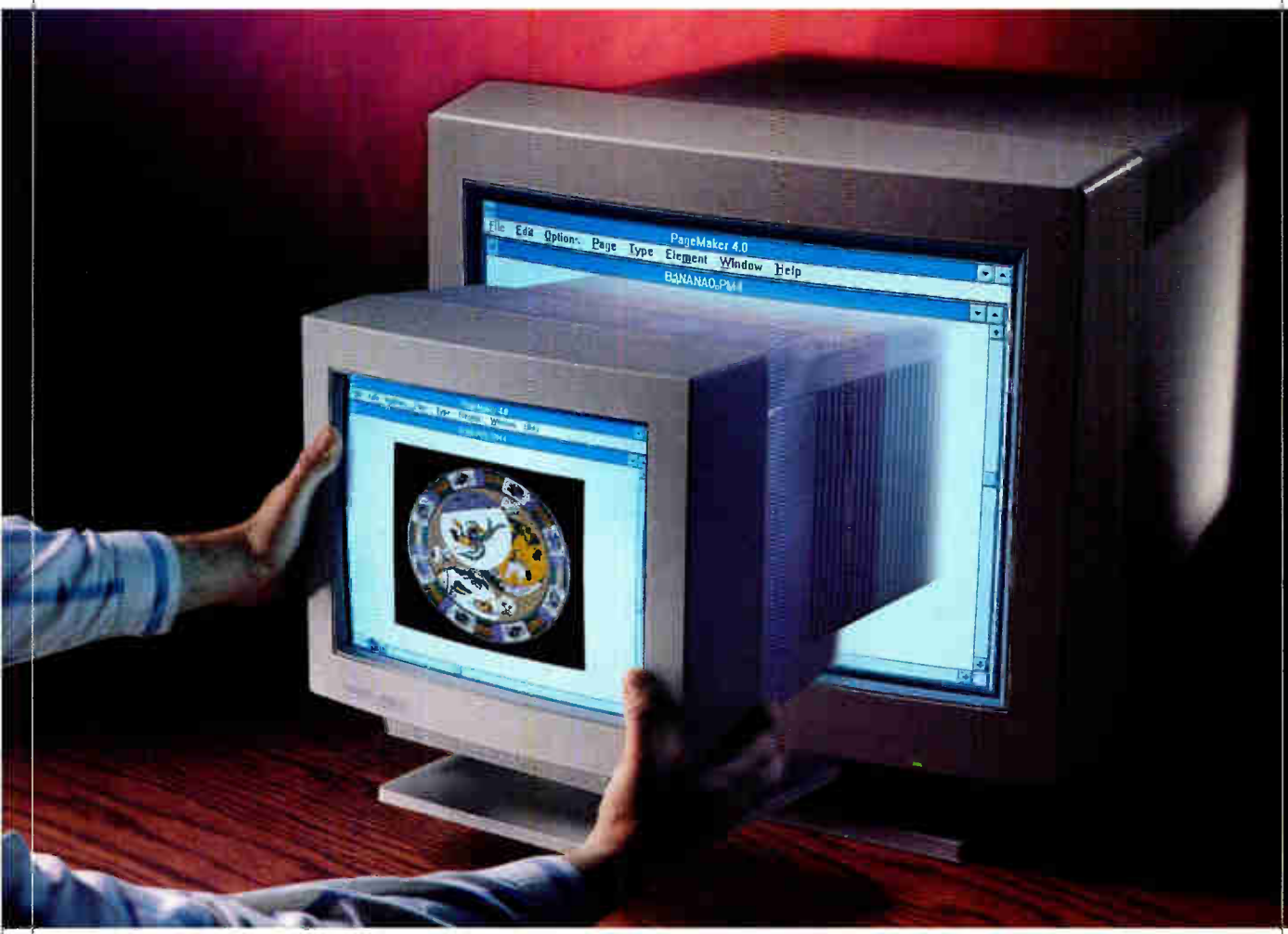
Comes now two new Borland Pascals. Turbo Pascal 7.0 is the introductory level. The real news is Borland Pascal with Objects, a complete package that contains Object Vision, Turbo Assembler, Turbo Debugger, the new Pascal compiler, and DLLs that let you write code for DOS or Windows.

You can also do DOS DLLs for Windows. Not even Microsoft has a compiler that will do that. Borland Pascal uses the same DOS memory extensions that power Borland Paradox, meaning that it's a very proven engine, and you can write DOS programs as large as 16 MB if you like.

Recall what I said about competition with Microsoft. You probably don't want to write a 35,000-line program in any kind of BASIC; and writing something that big in C may take decades. Borland Pascal compiles fast, has tons of productivity tools, and makes efficient code. As an example, Generic CADD is written in Turbo Pascal; the new Borland Pascal is even more efficient and is backward-compatible with Turbo Pascal. My guess is that both Windows and DOS applications written in Borland Pascal will ship months before the same application written in C or C++. More next month after I have the final-release product, but I find it exciting that Pascal has come back in a big way.

Learn About Counting

Generally Roberta looks at educational software, much of which can only be described as bloody awful; but of Learn About Counting with the Berenstain Bears, she says: "This is worth putting under some little one's Christmas tree. It comes with sound and is for children as young as 4. It's a snap to install, unlike some educational software designed for kids with a rocket scientist in the family. The user gets to choose whether Brother or Sister



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Bear will take the kiddies on a colorful trip. The program uses the integral speaker to prompt the user, and if there's an error, the designer walks the student through the why of the correct answer. It doesn't just give you the lame 'Try again' you see too often.

"They even throw in some finger puppets. Many kids will enjoy their mom or dad starting them on this package, and after a bit, the youngster can work independently to play the eight different games."

Winding Down

We have the new Kyocera Ecosys printer that doesn't use cartridges, and we like it. The learning tool of the month is *Learn Programming Today with Turbo Pascal* from Borland; this is a videotape, workbook, and compiler that starts at the beginning and moves rapidly to complex programs. If you're just beginning to learn programming, or if like me you got out of the habit of Pascal and want to get back in, this is an excellent tool.

Two computer books this month: Michael Young's *Visual Basic: Game Programming in Windows* (Microsoft Press, 1992). This is intermediate level. Games use a lot of programming techniques, including sound and animation. It has plenty of examples. The second book is Peter Fink's *PostScript Screening* (Adobe Press, 1992). It's the best introduction to the whole subject of visual screening, halftones, and so forth, that I have yet seen; I sure learned a lot from it.

Another book I learned much from is Stephen Bigelow's *Understanding Telephone Electronics* (Sams, 1992). This will tell you as much—more, probably—as you want to know about telephones, from the handset to the central switchboard. It includes faxes and wireless phones.

The book of the month is Robert Heinlein's *Take Back Your Government* (Baen Books, 1992). I wrote the introduction and some notes, but I don't get royalties. This was written years ago, when the structure of U.S. politics was quite different; and, as I say in my introduction, a time when, in my judgment, citizens had more control of their government. We could do worse than go back to such times.

The game of the month is Darklands from MicroProse. The game was released too early (although way behind schedule) and the first versions had serious bugs, but that ought to be fixed by the time you read this. It's a new twist on role-playing games, set in the Holy Roman Empire as it believed itself to be.

I am installing NetWare, as well as working with WFWG. I continue to look at operating systems: Windows, OS/2, and NextStep for the 486. Networks and operating systems, along with development languages, will be major themes during the next year. The computer revolution continues. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

ITEMS DISCUSSED

Borland Pascal with Objects $495
Learn Programming Today with Turbo Pascal.....$59.95
Turbo Pascal 7.0 .....$149.95
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1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95067
(800) 331-0877
(408) 438-8400
fax: (408) 439-9344
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Darklands.....$69.95
MicroProse Software, Inc.
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(301) 771-1151
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EDOS.....$39.95
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Wilsonville, OR 97070
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Fotoman.....$799
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Fremont, CA 94555
(800) 231-7717
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Info Select for Windows.....$149.95
Micro Logic Corp.
P.O. Box 70
Hackensack, NJ 07602
(800) 342-5930
(201) 342-6518
fax: (201) 342-0370
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Learn About Counting.....$24.95
Comptons New Media
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Mystat.....$18.95
Course Technology
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NCR 3170 .....$3999
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ZS900.....$149
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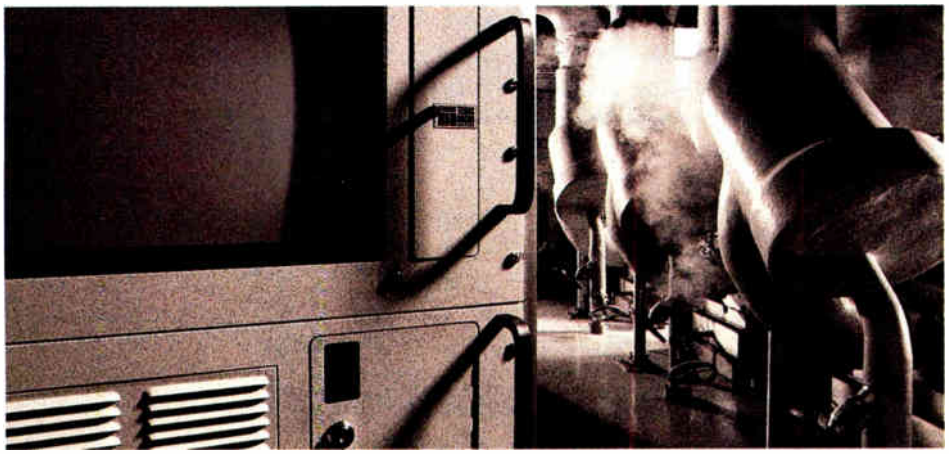

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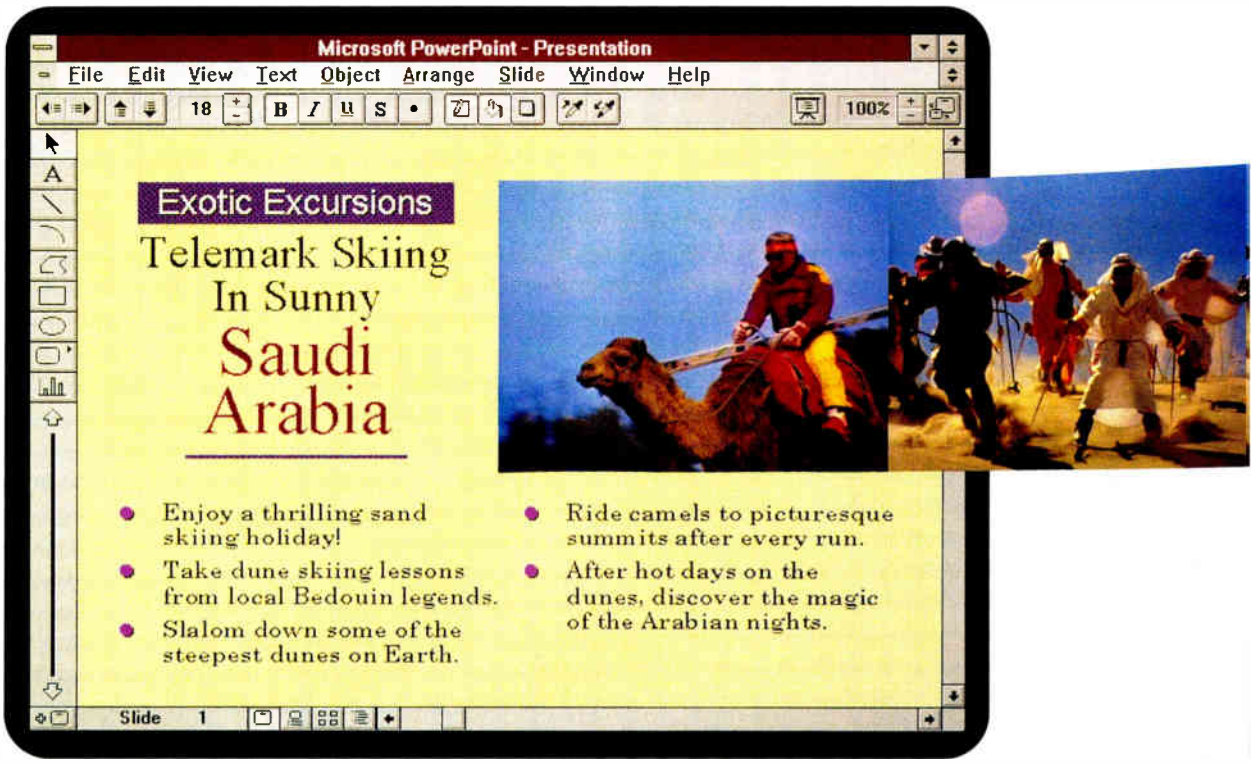

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1992 The BYTE Awards

The world's best for 1992 sets new standards for excellence

MICHAEL NADEAU

Every fall, BYTE selects the best products, technologies, and standards of the past year for special recognition. Editors and BYTE licensees around the world nominate and vote for candidates that, in their judgment, represent the most significant developments in terms of innovation, performance, and price. (For a description of the selection process, see the text box "How BYTE Selected the Best" on page 122.)

While the economy may have been in the dumpster in 1992, the computer industry still managed to turn out a record number of innovative products, standards, and technologies. The 109 BYTE Award winners—25 more than last year—are important not just for what they did in 1992, but also for the direction they will provide for 1993.

For example, users will crave yet more power in the coming year. As software products such as Award of Excellence winners Adobe Premiere 2.0, CorelDraw 3.0, FrameMaker for Windows, and Microsoft Windows for Workgroups establish themselves, users will discover that these programs work best on high-performance hardware. But not to worry—other Award of Excellence winners have this angle covered. Intel's 486DX/2, the Radius RocketShare, and the VL-Bus standard all provide significant performance boosts to their respective platforms.

The PC price war of 1992 has led users to expect to pay less for products, and many of the award winners were chosen in part because of their ability to deliver quality at a lower cost. Kyocera's Ecosys aSi laser printer, which won an Award of Excellence, is reasonably priced and features a low cost per copy. Artisoft continues to set the price standard for peer LANs with its Award of Distinction winner LANtastic 4.1. Another Award of Distinction winner, Compaq's ProLinea PC line, should remain both a price and volume leader through 1993.

A Big Year for Windows

The Windows juggernaut continues this year, as 30 Windows-specific products—nearly twice as many as last year—won awards, including three of the top five vote-getters. Of the three new versions of Windows that Microsoft launched in 1992, two—Windows for Workgroups and Windows 3.1—placed second and third, respectively, in the overall voting. (The third, Windows NT, was not eligible because it was not expected to ship in 1992.)

Software products accounted for 27 of the Windows winners, and several popular software packages made their Windows debut in 1992. They include Award of Excellence winner Quattro Pro for Windows and Award of Merit winners LANtastic for Windows, Mathcad 3.1 for Windows, Mathematica for Windows, Procomm Plus for Windows, and Quicken 2.0 for Windows.

Award of Distinction winner Approach for Windows 2.0 and Award of Merit winner FileMaker Pro 2.0 for Windows helped fill a significant need for Windows database managers. Two other Windows database managers announced in 1992,

AWARDS GRAPHIC: ROGER GOODE © 1993

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Borland's Paradox for Windows and Microsoft Access, were not eligible for awards because of uncertainty over whether they would be commercially available in 1992.

Clearly, Windows' strong showing in this year's awards reflects the growing number of companies jumping on the Windows bandwagon. The decline in the number of winners among DOS, Macintosh, and Unix software is evidence that developers are devoting most of their efforts to the platform with the highest installed base. The number of DOS software winners dropped from 13 to nine, Mac software winners dropped from 12 to eight, and Unix software winners dropped from three to one (see the figure).

New Categories, New Uses

Some of the most exciting winners are products that represent new categories. The Philips CDD521 CD-ROM recorder, for instance, makes it possible for even small organizations to publish data on CD-ROM in-house. The Kodak DCS 200ci Digital Camera lets you take photographs digitally for fast, easy insertion into electronic documents.

The Mobidem from Ericsson GE Mobile Communications brings wireless mobile communications to a hand-held form factor using a packet-radio link. And although we are not quite sure what the most important practical application of the Gryphon Morph image-morphing software will be, it's a hoot to use.

Hewlett-Packard shrank the hard drive to 1.3 inches with the Kittyhawk. In the process, HP made the drive more energy efficient and less susceptible to shock. With hard drives this small, it is now feasible to use rotating media in devices such as hand-held PCs and cellular phones.

Pens Are Getting Mightier

Last year, some pen PCs and Go Corp.'s PenPoint operating system won awards. This year, two pen-based applications made the cut. PenMagic's Numero, a spreadsheet-like math package, and PenSoft's Perspective, an innovative personal information manager, both won Awards of Distinction. In addition, the Slate PenApps applications development tool was given an Award of Merit.

Fujitsu's PoqetPad and the Grid PalmPad won an Award of Merit and an Award of Distinction, respectively. Both are small, hand-held devices, unlike the larger tablet systems that won last year. Also, Pi Systems' Infolio pen tablet was an Award of Merit winner.

Predictions

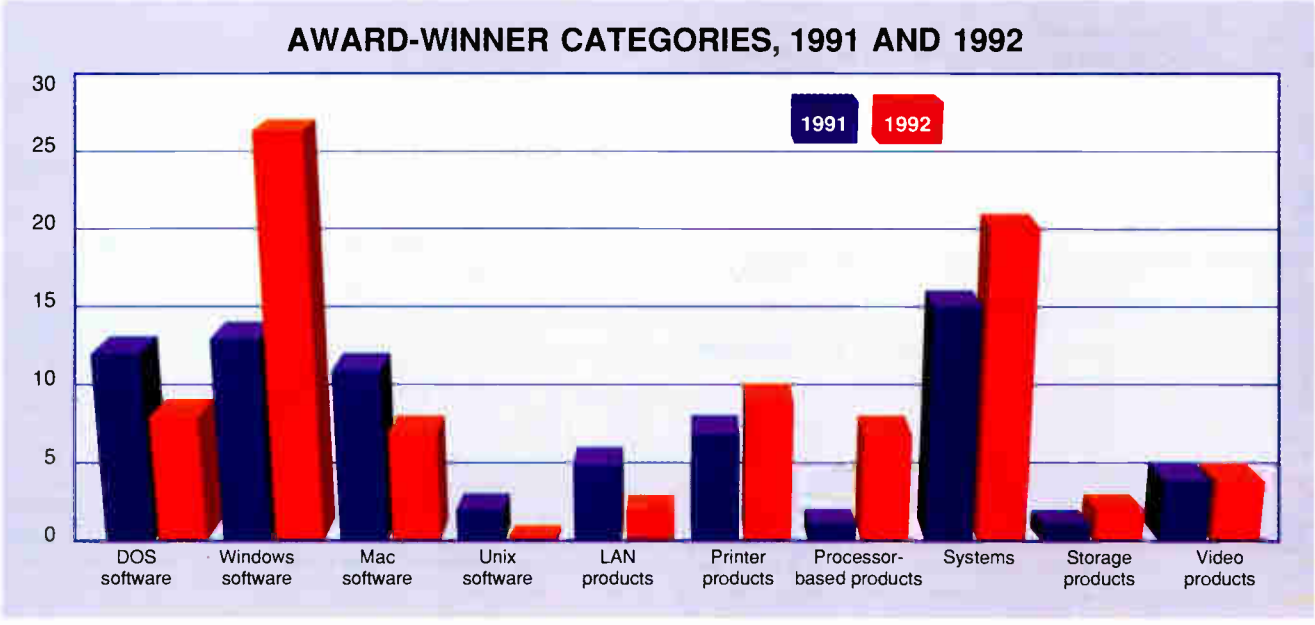
The trends of this year's BYTE Awards give us a clue to what 1993 may hold. Windows will continue to dominate, as new versions of the operating system target specialized areas such as workgroups. With the investment that software and hardware developers have in Windows 3.0 and 3.1, it is safe to assume that many of these developers will support Windows in all its incarnations.

The drop in Mac software winners may be deceiving. Apple garnered four awards for its systems, ranging from the high-performance Quadra 950 to the popular PowerBook 180 to the low-cost Performa 600. With hardware of this caliber, Apple stands a good chance of gaining market share and, more important, the attention of developers. You could see more Mac winners next year.

Potential winners of next year's BYTE Awards are already starting to surface. Microsoft's Windows NT and Access database manager barely missed being eligible for awards in 1992. Borland's Paradox for Windows has received praise from beta testers. Intel's Pentium is slated to appear this spring. Apple will introduce a new crop of Macs. And a new generation of notebooks and subnotebooks will have been announced by the time you read this. We are entering another exciting year of new computer developments.

Michael Nadeau is a BYTE senior editor. You can reach him on BIX as "miken."

continued



The biggest difference between the 1992 BYTE Award winners and the 1991 winners is the big jump in the number of Windows-based products—almost twice as many. There was a small decline in the number of winners in the DOS and Mac software categories.

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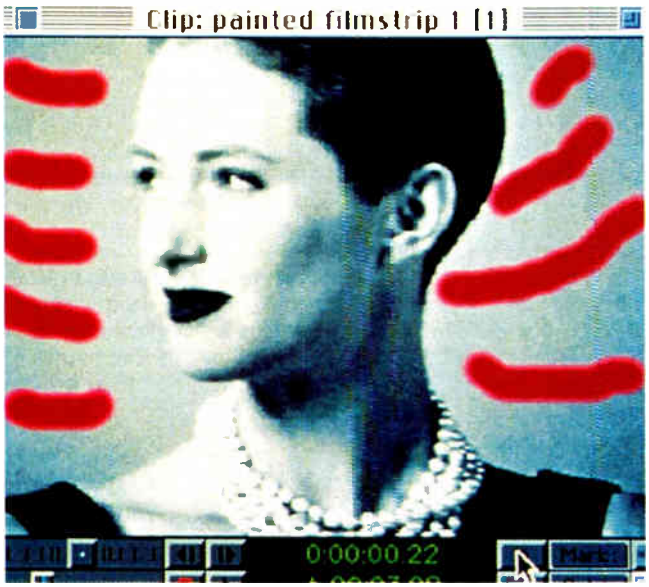
1992 BYTE AWARDS

Excellence



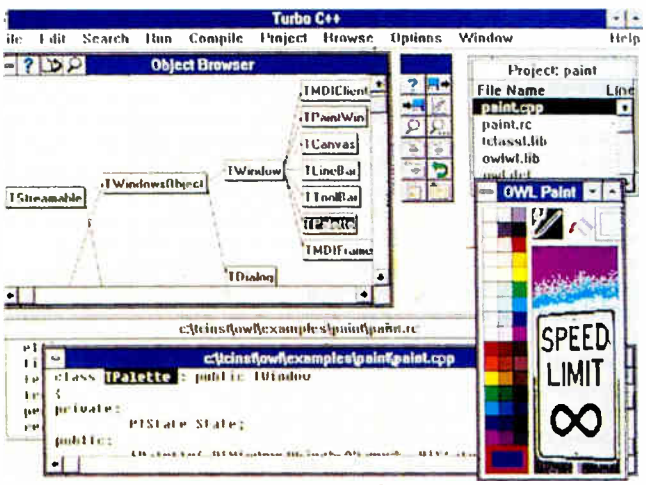
Adobe Premiere 2.0

Adobe Premiere 2.0, *Adobe Systems*
This electronic storyboard/video editor got even better with version 2.0. It now supports external device control, 16-bit 44-kHz sound, SMPTE time-coding, and edit-decision lists. Thus, a Premiere 2.0 storyboard made with clips from high-end videotapes can control the equipment you use to edit and create broadcast-quality output.

Mac PowerBook 180

Cx486SLC

Borland C++ 3.1



Borland C++ 3.1, *Borland International*
Borland's Windows-hosted C++ compiler is simply a joy to use: user-friendly, capable, and blazing fast. Color syntax highlighting, an integrated resource compiler, new 386 and C++ optimizations, and support for the Windows 3.1 extensions top the list of new features that make what had already been the premier Windows compiler even better. The compiler's application frameworks—OWL (ObjectWindows Library) and TurboVision—continue to demonstrate Borland's excellent grasp of object-oriented principles.

CorelDraw 3.0 for Windows, *Corel Systems*
In one $595 package, CorelDraw 3.0 for Windows delivers nearly all the graphics applications you could ask for, including illustration, an image tracer, an image editor, charting, a slide-show feature, and a visual catalog. The program's ease of use, coupled with its power, has users singing its praises. At press time, Corel was expecting to release a 32-bit version of CorelDraw for OS/2 2.0 and was developing a Mac version as well.

Cx486SLC and Cx486DLC, *Cyrix*
A lot of factors fed the PC price wars of 1992, and the 25-MHz SLC and 33-MHz DLC from Cyrix played important roles. Cyrix's new CPUs support the instruction set of the i486, but with different pin-outs, a smaller cache, and no built-in FPU. Their performance falls between that of the 386DX and that of the 486SX. Pricing for the Cx486SLC, which includes a separate math coprocessor, allowed vendors such as CompuAdd to market desktop systems for under $2000 and was a catalyst for other CPU vendors to lower prices.

DEC Alpha, *DEC*
Workstations keep getting faster and faster, and DEC's scalable Alpha RISC CPU will help ensure this rising performance curve for the foreseeable future. This 64-bit CPU is rated at 200 MHz, for which DEC claims a theoretical rating of 400 MIPS. At that speed, other RISC chip vendors will have to pedal faster to keep up.

Ecosys aSi, *Kyocera Electronics*
The Kyocera Ecosys printer is extremely cost-effective. It uses an amorphous silicon drum and microfine ceramics toner to produce copy at high speeds, with no necessary maintenance beyond toner replenishment and minor cleaning every 5000 copies. There are no cartridges to replace. Installation and maintenance, including memory expansion, are easy tasks for the average user.

Excel 4.0, *Microsoft*
The Windows spreadsheet that set the standard keeps getting even better with successive releases. Excel 4.0 aims to be smarter about how users work, automating common actions and making clever guesses about what users want to do. New "Wizards" walk you through the procedures for charting and report generation, greatly improving Excel's ease of use.

FrameMaker for Windows, *Frame Technology*
FrameMaker helps legitimize Windows 3.1 as a platform for serious high-end applications. Developed for Unix and previously ported to the Mac, FrameMaker boasts cross-platform capability at its best, allowing you to ship files directly from one platform to the next. Its main strength is in handling book-length documents and technical publications. With support for OLE and the Multiple Document Interface, FrameMaker is a true Windows application with the power to handle the biggest jobs.

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i486DX/2, *Intel*

The cornerstone of Intel's aggressive product rollout strategy in 1992, this so-called clock doubler gives PC users a simple, inexpensive (about $600) performance upgrade, eliminating or postponing the need to purchase a whole new system. The 50- and 60-MHz DX/2s run on 25- and 33-MHz motherboards, respectively, so systems designers can deliver the benefits of the faster speeds without additional design costs. A sign that the faster CPUs did not require heavy reworking: Scores of vendors, including Hewlett-Packard, Gateway, and Dell, had systems ready for shipment on the day of Intel's chip introduction.

i486SL, *Intel*

With the i486SL, Intel has performed a rare feat in CPU development: It has created a new generation that is more powerful and more highly integrated but requires much less energy to operate than its predecessors. The i486SL is a 3.3-volt device designed for use in notebook and subnotebook PCs. With its low-power operation and 486 power, it could make 386-based notebooks obsolete.

Kittyhawk, *Hewlett-Packard*

Only 1.3 inches wide, the 21-MB Kittyhawk hard drive might be mistaken for a book of matches. It's also rugged, able to withstand a 100-g shock while operating, according to HP. AT&T Microelectronics worked with HP to develop the highly integrated drive circuitry, while Citizen uses its watch-making experience to manufacture the drive.

The Kittyhawk's size and durability make it an ideal candidate for use in hand-held PCs, cellular phones, laser printers, and pen PCs—applications where the use of rotating media has up to now been clumsy or impossible.

Kodak DCS 200ci Digital Camera, *Eastman Kodak*

The Kodak DCS 200ci shares a lineage with Kodak's original electronic camera, but some important advances distinguish it. Its price comes in at under $10,000, yet it provides the same resolution and quality as its $25,000 stablemate in a smaller, consumer-oriented package. Pictures are stored on an internal hard drive and downloaded directly to a PC or a Mac. Operating costs are virtually eliminated: There's no film to buy and no need for a high-quality scanner. Results are almost instantaneous, and in an ecology-conscious world, there's no film or chemical waste to worry about.

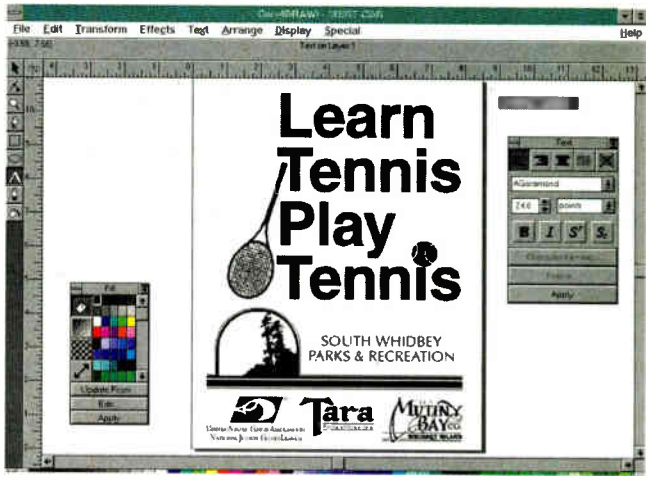
Mac PowerBook 180, *Apple Computer*

Like its predecessor, the Mac PowerBook 170, the Mac PowerBook 180 weighs just 6.8 pounds. But Apple has based the PowerBook 180 on a 33-MHz 68030 instead of the 170's 25-MHz processor, with a 68882 FPU and 70-nanosecond pseudostatic RAM. The maximum RAM in the 180 has been extended to 14 MB (an increase of 6 MB over the 170), letting you tax System 7.1's multitasking capabilities even further. The 120-MB SCSI hard drive option lets you pack even more files onto your portable system. As long as Apple keeps churning out portables like this, office workers may never go back to the desktop.

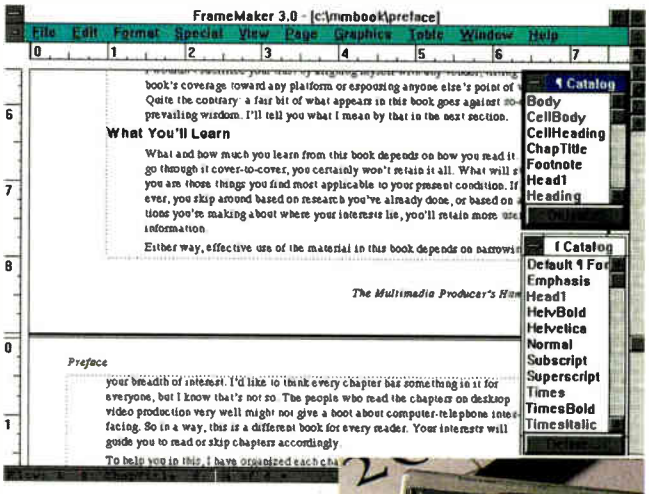
Microsoft Windows 3.1, *Microsoft*

Version 3.1 makes Windows faster, stabler, and easier to use. It also brings a slew of new and improved technologies, including TrueType, OLE, multimedia and pen extensions, better file management, more robust DOS support, faster disk access, and smarter printing. Taken together, these improvements add up to much more than a simple point release. Version 3.1 shows that Windows' modular DLL-based architecture supports the rapid evolution necessary to satisfy the escalating demands placed on it by applications and users. For developers, Windows 3.1 presents a more solid base on which to build applications.

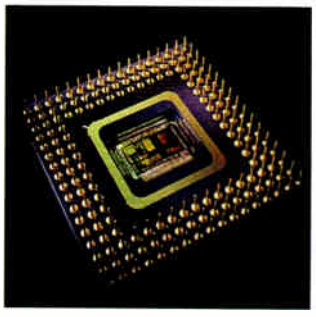
continued



CorelDraw 3.0 for Windows



FrameMaker for Windows



i486DX/2

Kittyhawk

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Actually, we'd say impossible to beat. And so will you.

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You'll see why *Computer Shopper* (8/92) said the Express 325NXL was "...destined to be the power accessory of the future." Why *Computer Buying World* (8/92) praised its "small, light, attractive and reasonably priced package." Why *PC Magazine* (8/92) said the 325NXL is the notebook made for "those looking for a good value at the $2,000 price point."

And why there should be no question which notebook computer to buy.

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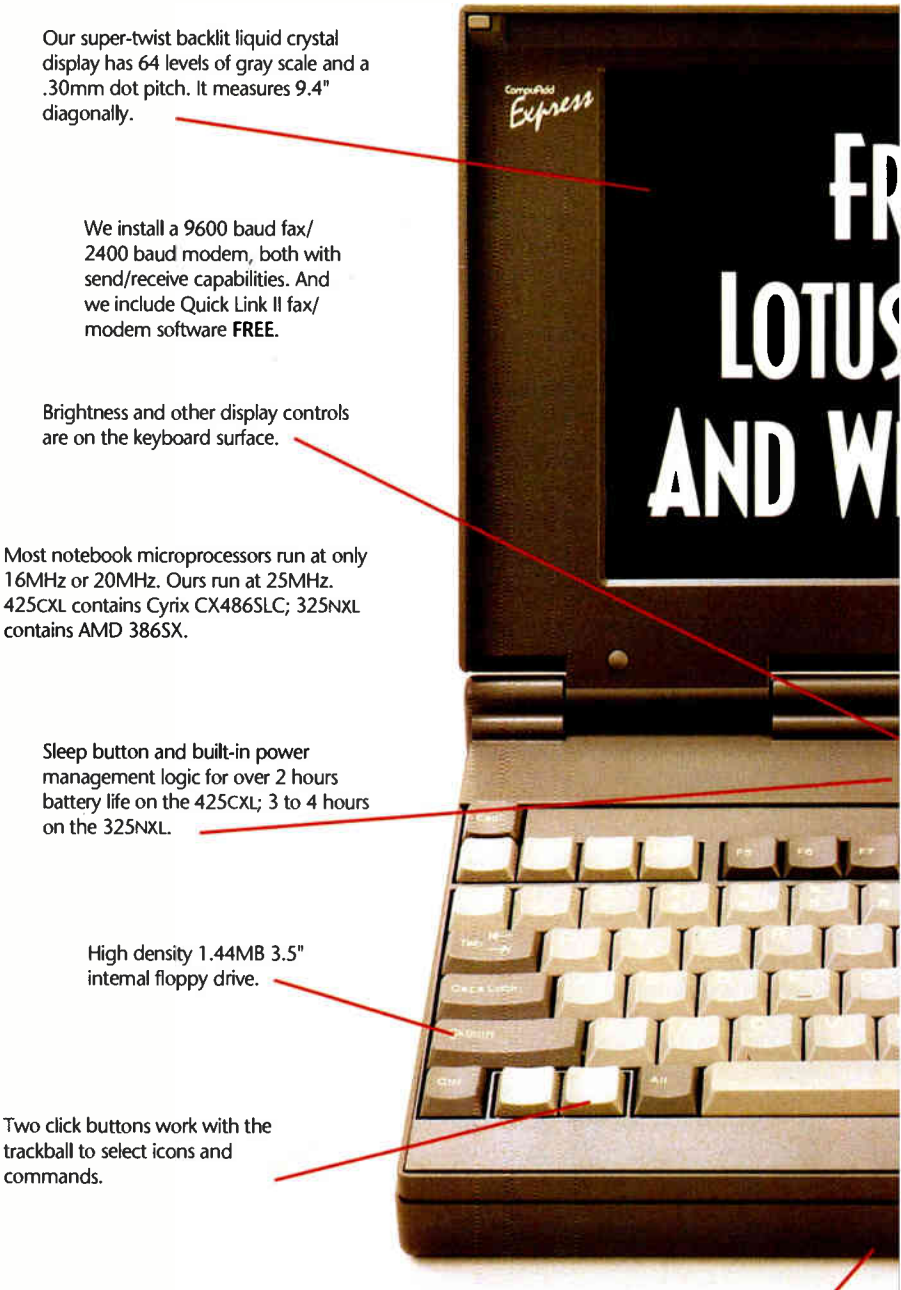
PC Magazine, August 1992

These are the notebooks you've been waiting for — whether you need a 25MHz 386SX like our 325NXL or a 25MHz 486 like our 425CXL. As *Computer Buying World* said, "CompuAdd Express' 325NXL has most of the extras every notebook should have." So does the 425CXL. And they've got performance, too. *PC Magazine* gave the 325NXL high marks on video and graphics benchmarks and on battery life tests — "the third-highest score of the 70 systems tested."



See For Yourself. Express Has The Most Features

	Express 325NXL	Dell 325N	Compudyne 386SXL/25	Gateway 325SXL	Austin 386SX/25	PC Brand 386SX/25
MSDOS/WIN	Yes	Yes	Yes	Yes	No	Yes
HD SIZE	80	60	60	80	60	60
WT w/ADAPTER	6.6 LBS	7.6LBS	7.6LBS	7.1LBS	8.7LBS	8.8LBS
RAM	4MB	4MB	2MB	2MB	1MB	2MB
FAX/MODEM	Yes	Option	Option	Option	Option	Option
GRAY SCALE	64	32	64	64	32	32
ZDIGIT RUNDN	5hr 28min	5hr 12min	3hr 26min	5hr 41min	4hr 48min	2hr 45min
BLT N TKBALL	Yes	No	Yes	No	No	No
PRICE	$2,095	$2,698	$1,806	$2,095	$2,293	$1,944

Based on *PC Magazine* Survey. August 1992

"The clear winner... with its terrific balance of performance and extras."
Computer Buying World, August 1992

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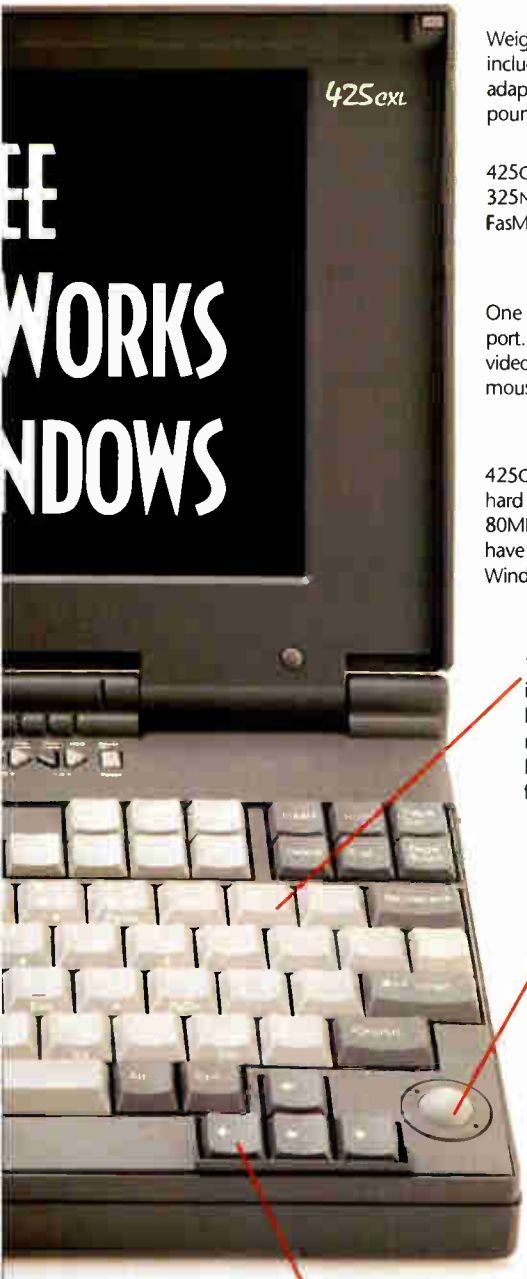
PRICE — REALLY TOUGH TO BEAT."

Computer Shopper, August 1992



Weighs only 5.3 pounds, even including the battery. Add the AC adapter, and it still weighs only 6.6 pounds.

425CXL includes a math coprocessor; 325NXL contains socket for Cyrix FasMath™ 83S87 math coprocessor

One serial port, one parallel port. External 800x600 VGA video, PS/2 keyboard and PS/2 mouse connectors.

425CXL has a 120MB or an 80MB hard drive. The 325NXL has an 80MB or a 60MB hard drive. Both have 4MB of RAM — so big Windows programs run great!

101-key function keyboard implemented with 84-key layout has an IBM "feel" because it's made by Lexmark, formerly IBM's keyboard division. Fullsize function keys, too!

Built-in trackball with 200dpi for accurate pointing.

Our **FREE** carrying case has a shoulder strap and pockets so you can pack adapters, diskettes and other supplies.

Inverted "T" arrow keys are in the lower right hand corner, where they belong.

Express 325NXL Everybody loves our notebooks' features. *Computer Shopper* wrote that "The built-in 2,400bps fax/modem is snazzy" and called the keyboard, sliding door covering ports and general design "an admirable piece of work." *PC Magazine* wrote: "The Lexmark keyboard is comfortable to use. Large and prominent function keys are ranged along the top, and the cursor keys are in an inverted-T layout just left of the trackball." *Computer Buying World* also praised the keyboard, which it said "is remarkably well laid out."

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80MB Hard Drive
Lease for only $70/mo

$1,695
60MB Hard Drive*
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Express 425CXL The 425CXL has all the terrific features that made its 386 partner so popular. But it has extra speed, thanks to its Cyrix CX486SLC microprocessor.

This processor is smaller than other 486 chips, so it fits easily into a portable computer. It uses less power than other 486 chips, so you're less likely to run out of juice in the middle of a big job. Yet it has a built-in cache. And the 425CXL contains a math coprocessor, so applications that use floating point instructions are swift indeed.

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How BYTE Selected the Best

As they have always been, the BYTE Award winners were selected this year through a democratic process. All BYTE editors participate, including the 42 staff editors, 13 consulting editors, and three contributing editors. BYTE has 14 licensees around the world who reprint BYTE editorial in the native language of their respective countries. This year, six licensees chose to participate: *RAM* in Greece, *Nikkei BYTE* in Japan, *BYTE Brazil*, *0-1 BYTE* in Taiwan, *Microsystemes* in France, and *BAJT* in Czechoslovakia.

The process begins with nominations. To be eligible, a product or technology must have been introduced since the previous year's award process ended (early October) and must be likely to ship to users by the end of the current calendar year. We judge the likelihood of a nominee's shipping based on the vendor's announced shipping date and the apparent maturity of the product or technology. Nominated products must have been covered previously or have planned coverage in BYTE or its licensees' publications.

A nominated product should be one that breaks new ground in terms of new technology, performance, price, or innovative use of existing technology. An editor can nominate only products that he or she has had some hands-on experience with or those that BYTE editors are reasonably sure will perform as advertised.

After the nomination process, every editor and licensee receives a ballot listing all the eligible products and technologies. Each voter then selects what he or she believes to be the 10 most significant ones for the year; a voter may pick fewer than 10.

Awards of Excellence, Distinction, and Merit are assigned based on the number of votes received. Cutoff points for each award are determined according to how the votes are distributed along a curve.

Microsoft Windows for Workgroups, *Microsoft*

This long-rumored Windows peer LAN, with its bundled E-mail and group-scheduling applications, brings groupware into the mainstream. It also allows users to send documents back and forth via Windows for Workgroups' networked Clipboard function.

Innovative features such as automatic network card detection make installation about as painless as it can get. New protected-mode protocol stacks save a great deal of precious real-mode RAM, enabling pockets of Windows for Workgroups stations to coexist painlessly and peacefully on NetWare LANs.

Paradox 4.0, *Borland International*

Borland has successfully revamped Paradox, giving it a new interface without sacrificing its compatibility with older versions. Paradox 4.0 is faster, and the enhanced PAL (Paradox Application Language) has support for event-driven programming.

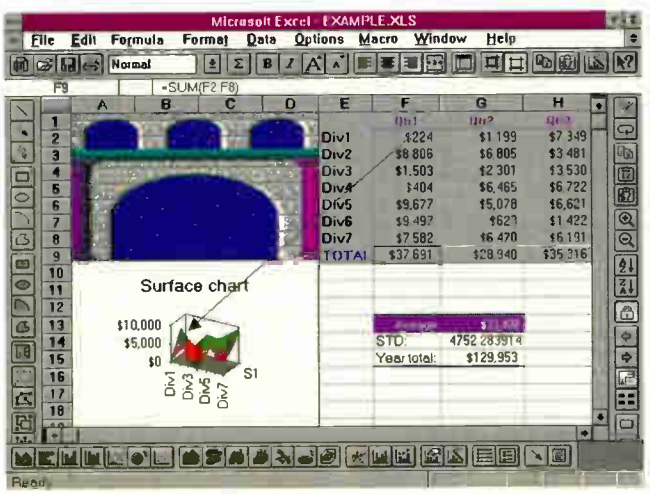
Philips CDD521, *Philips Consumer Electronics*

The $7995 Philips CDD521 CD-ROM recorder will help revolutionize CD-ROM publishing. For the first time, businesspeople can now create discs in-house for prototyping, demonstrations, and even small-scale distribution. Bundled software converts the assembled data from your hard disk to the CD's ISO 9660 format. You can then ship the finished product directly to a mass-production facility for duplication. The double-speed CDD521 CD-ROM recorder can write 600 MB in a half hour. CD-ROM publishing on the desktop has arrived.

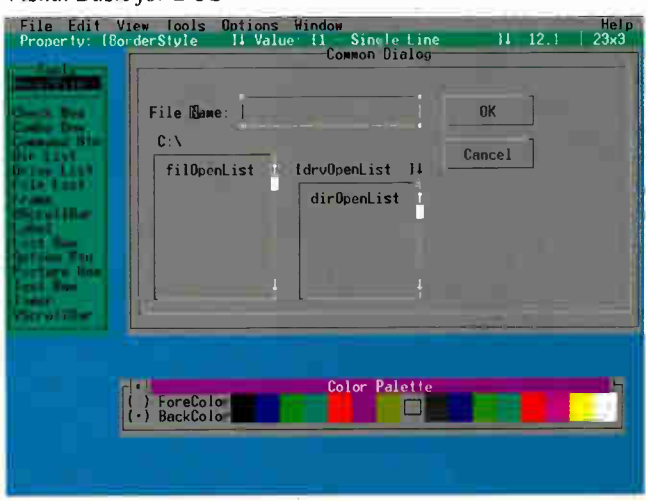
Quattro Pro for Windows, *Borland International*

The long-anticipated Windows spreadsheet from Borland is finally here, and it was worth the wait. Quattro Pro for Windows tackles the problem of

Excel 4.0



Visual Basic for DOS



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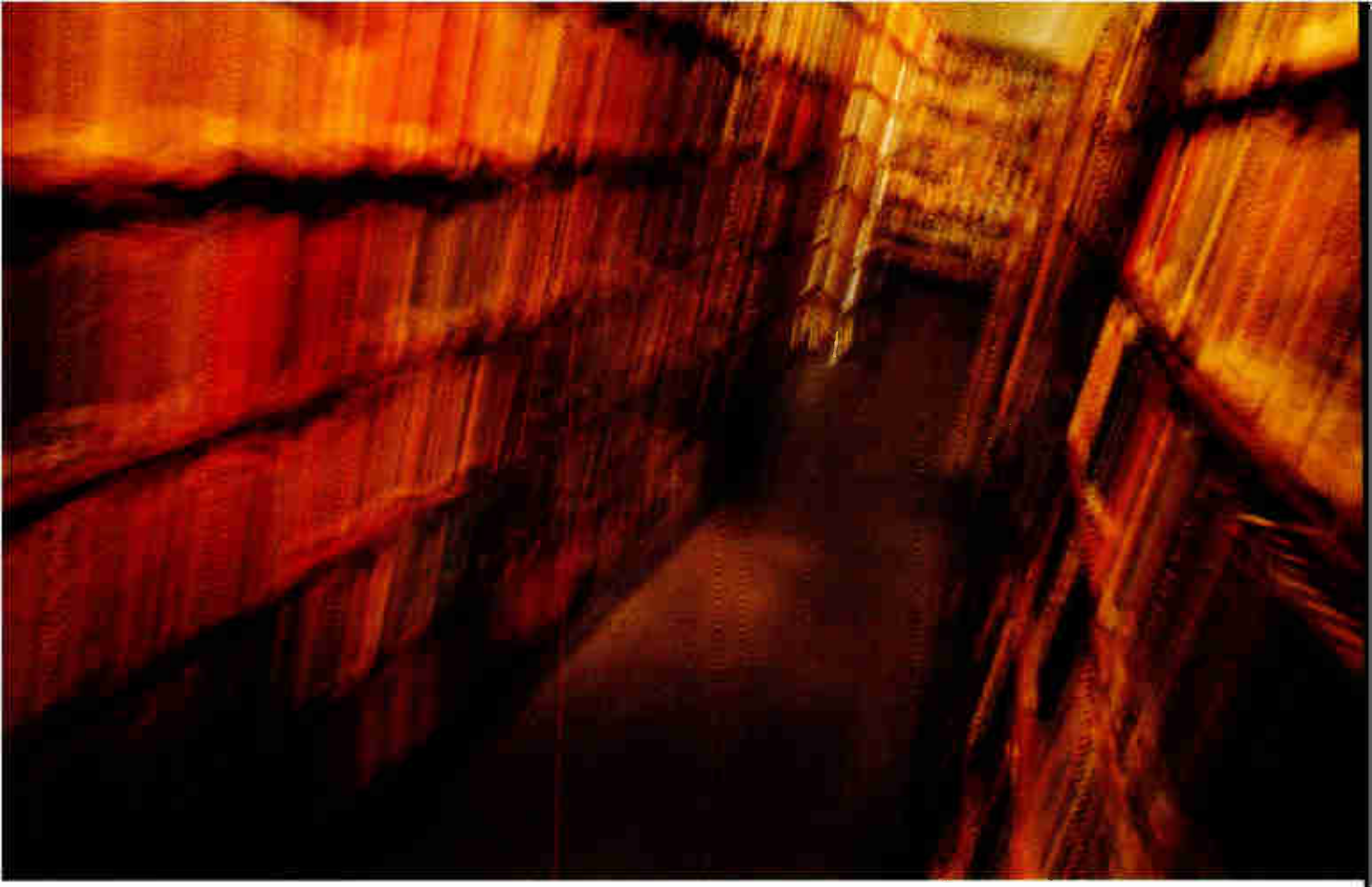

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multipage spreadsheets with an innovative "notebook" metaphor that tags each page with a tab. It also offers Borland's Menus on Demand, an elegant object-properties inspector.

RocketShare, *Radius*

What's better than one 33-MHz 68040 Rocket accelerator board in your Mac? How about two or more Rockets, each working in tandem on your toughest jobs? RocketShare is software that implements point-and-click simplicity to Mac multiprocessing. You assign applications to one or more Rocket boards and let them operate separately or tackle shared data together.

Toshiba T4400SXC80, *Toshiba America Information Systems*

What sets the T4400SXC80 apart from other color notebooks is its fantastic video and 486SX CPU. Toshiba uses a custom graphics chip set to provide color gradations that are smoother than those of its competitors, most of which use 386-class CPUs in their color systems. The T4400SXC80's excellent keyboard and full range of options are simply icing on the cake.

TWAIN scanner standard

Interfacing scanners, digital cameras, and other imaging equipment to PCs has never been a job for the faint of heart: Each device typically required its own driver and sometimes produced files in a unique format. In 1991, a group composed of Aldus, Caere, Hewlett-Packard, Kodak, and Logitech agreed on a standard for imaging peripherals that lets compliant devices be addressed with a common driver. Just as emulation of popular Epson and HP printers helped standardize output formats, the TWAIN (which stands for "toolkit without an important name") API codifies input, letting you add images to documents by simply selecting an option from a menu.

VideoSpigot, *SuperMac Technology*

This is the board that launched a thousand video clips. Apple's QuickTime enabled Macs to handle time-variant data such as digital video, but it was the VideoSpigot that supplied the video data. VideoSpigot is a NuBus board that converts on-the-fly live video and audio signals into a QuickTime movie that's continuously saved onto a disk file. VideoSpigot supports both NTSC and PAL video, and 24-bit-deep frames can be captured up to 30 times per second, depending on the Mac used. A supplied application lets you view and edit the stored movies, and several compressor/decompressors let you compress and view the movie files.

Visual Basic for DOS, *Microsoft*

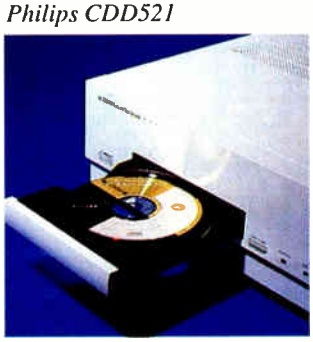
Marry the strong compiler and debugger technology in Microsoft's BASIC 7.0 Professional Development System with the wildly popular Visual Basic development system, and you've got a sure winner. Windows is hot, but there's a lot of life yet in character mode. VB DOS handles many of the same widgets as does its Windows cousin, using the same event model. And its mature optimizing compiler churns out really fast programs. Portability between DOS and Windows and a radically simplified model for developing custom controls make VB DOS a very attractive tool.

VL-Bus, *Video Electronics Standards Association*

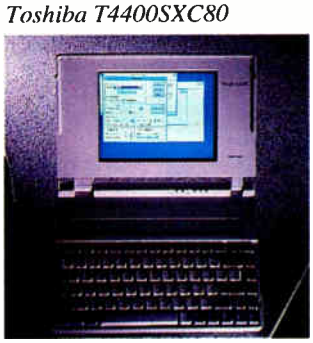
Before VL-Bus, no standard for local-bus slots existed. This meant that if you wanted the higher-performance video or storage that local-bus architecture provides, you had to accept an expensive, proprietary design. VL-Bus provides a common interface that will encourage third-party development of less expensive local-bus video boards and hard drive controllers. Since it builds on the existing PC architecture and is relatively easy for PC vendors to implement, VL-Bus has met with early acceptance. Companies such as Gateway 2000, Micronics, and ATI Technologies have already announced VL-Bus products.

continued

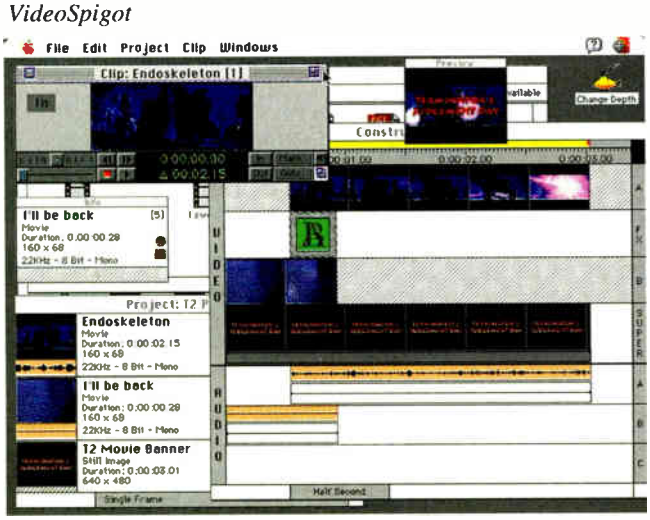
Philips CDD521



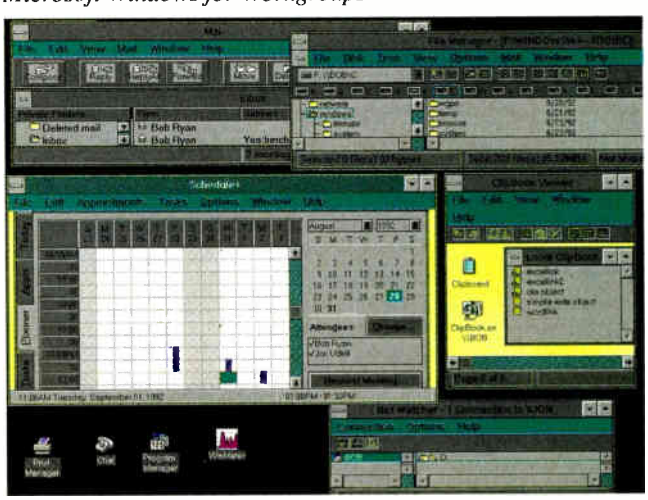
Toshiba T4400SXC80



VideoSpigot



Microsoft Windows for Workgroups



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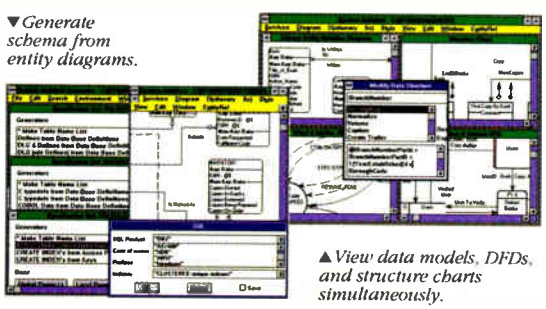
▼*Generate schema from entity diagrams.*



▲*View data models, DFDs, and structure charts simultaneously.*

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System Architect works with multiple methodologies: Yourdon/DeMarco, Gane & Sarson, Ward & Mellor (real-time), Booch, Shlaer/Mellor (OO), Coad/Yourdon, Information Engineering and SSADM. And diagram types and charts including: DFDs, Entity Relation diagrams, Decomposition diagrams, State Transition diagrams, Structure Charts, and Flow Charts.

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1992 BYTE AWARDS

Distinction

AcerPac 150, *Acer America*
Perhaps the first true "infotainment" appliance, the AcerPac 150 sets a standard for multimedia PCs. The MPC-compatible system comes complete with a 20-MHz 386SX; 4 MB of RAM; a 130-MB hard drive; a CD-ROM drive; Windows; and built-in audio, fax, and telephone hardware. An AM/FM radio is also part of the package. Acer sweetens the deal with bundled software that includes Microsoft Bookshelf, QuickBasic, Windows Entertainment Pack, and Compton's Multimedia Encyclopedia.

Adobe Illustrator 4.0 for Windows, *Adobe Systems*
This is a much-needed upgrade for Adobe's object-based drawing package for the PC. Its new features include 24-bit graphics, direct entry of text, preview-mode editing, and selective magnification. With the ability to open and edit files made by versions of Illustrator on both the Next computer and the Mac, Illustrator 4.0 provides a cross-platform solution for quality graphics.

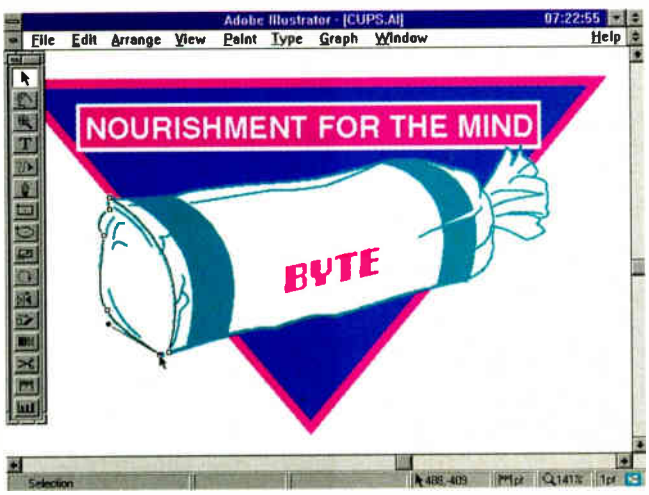
Adobe Multiple Master, *Adobe Systems*
Got the right typeface, but it just doesn't fit in your layout? Multiple Master fonts let you tweak a typeface's weight, size, width, and style while preserving its visual fidelity.

Approach for Windows 2.0, *Approach Software*
Approach for Windows brings ease of use to Windows database management. The product shines brightest as a front end to dBase, Paradox, SQL Server, FoxPro, DB2, or Oracle SQL files. Designing your databases is a breeze with Approach, making it an ideal product for novices. Its PicturePlus fields allow you to store image files and sound as part of the database.

Canon CJ10, *Canon USA*
The CJ10 combines a 400-dot-per-inch color ink-jet printer, a color copier, a fax machine, and a 24-bit color scanner into a single, compact unit. The CJ10 is noteworthy simply for its excellent color output. Its four-color BubbleJet technology produces vivid color prints. Add the other components, and you have a one-stop graphics-imaging solution.

Compaq ProLinea series, *Compaq Computer*
Compaq may not have started the PC price war of 1992, but it certainly fired the loudest shot with its ProLinea line of PCs. Starting at less than $1000 (without a monitor), the ProLineas do not sacrifice traditional Compaq quality. Compaq did sacrifice some expansion capability, but it used its engineering prowess to produce a powerful, cost-effective PC that meets the needs of most users.

Adobe Illustrator 4.0 for Windows



Mac Performa 600

Dell 320SLi, *Dell Computer*
The 3½-pound Dell 320SLi is a bold move to provide a lightweight machine without skimping on performance or usability. The keyboard is full size, the nonbacklit VGA LCD is easy to read and requires no metal frame, and the external floppy drive fits snugly into a jacket pocket.

Desqview/X, *Quarterdeck Office Systems*
DOS-to-Unix interoperability is a key advantage of Desqview/X, but what really sets it apart is its ability to make X Window System–style distributed computing happen on pure-DOS networks. Decoupling an application from its display makes for a powerful computing model. Implementing that model for DOS, over standard PC network protocols, is a major achievement.

Epson ES-300C, *Epson America*
The Epson ES-300C is a 300-dot-per-inch scanner that reaches 600-dpi quality via software. The Epson scanner collects its RGB color information in a single pass, unlike the three-pass method common to most 24-bit color scanners. The ES-300C earns its award by virtue of its outstanding color-scan quality alone.

Gateway 2000 HandBook, *Gateway 2000*
The $1295 HandBook is arguably the best subnotebook to date. It manages to cram most of the standard notebook amenities, including a 40-MB hard drive, a full complement of external ports, and a reasonably good keyboard, into a 2¾-pound package. Despite its CGA video and 286-class CPU, the HandBook is a good choice for those who like to travel light without sacrificing capabilities.

Compaq ProLinea

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Grid PalmPad, *Grid Systems*

This ruggedly made pen PC straps on your wrist and weighs less than 3 pounds. The PalmPad is intended for use in environments where up to now computers have not been practical. The power-line repairperson, for example, can use the PalmPad while working in the field. The warehouse worker can keep track of inventory more conveniently. The PalmPad's durability and use of the established PenRight development system make it a reliable choice for custom pen applications in the field.

Gryphon Morph, *Gryphon Software*

Morph brings the ability to do Terminator 2–style effects (i.e., where an android smoothly metamorphoses from one person to another) from high-end workstations to the Mac. You simply pick starting and ending images, designate common reference points on both images, pick the number of iterations, and let Morph work its magic. The output quality is good, and the price ($149) is terrific.

HP Vectra 486u, *Hewlett-Packard*

The first PC to use Intel's 66-MHz 486DX/2 CPU, the Vectra 486u is a well-engineered and very fast system. It gives you easy access to all the major components without using tools; upgrading is a cinch. A local bus provides speedy video to complement the system's performance.

Iris Indigo XS, *Silicon Graphics*

Silicon Graphics has taken the very successful Unix-based Indigo graphics workstation, improved its performance, and lowered the price to $13,000. Overall graphics speed gets a boost from a proprietary graphics processor, and the Indigo XS now supports true 24-bit graphics.

LANtastic 4.1, *Artisoft*

Artisoft has boosted the performance of its peer-LAN operating-system leader, LANtastic, without sacrificing ease of use or making it more expensive. New features include automatic log-in, improved print handling, and an improved System Manager.

Lotus Ami Pro 3.0, *Lotus Development*

Lotus Ami Pro 3.0 is a high-end Windows word processing program. It's high-end because it has many of the features found in full-blown desktop publishing packages. Many of the new features added to version 3.0 are in response to the latest upgrade of its major competitor, Word for Windows. But most of the features, like its "fast format" ability, make Ami Pro 3.0 a leader in its field.

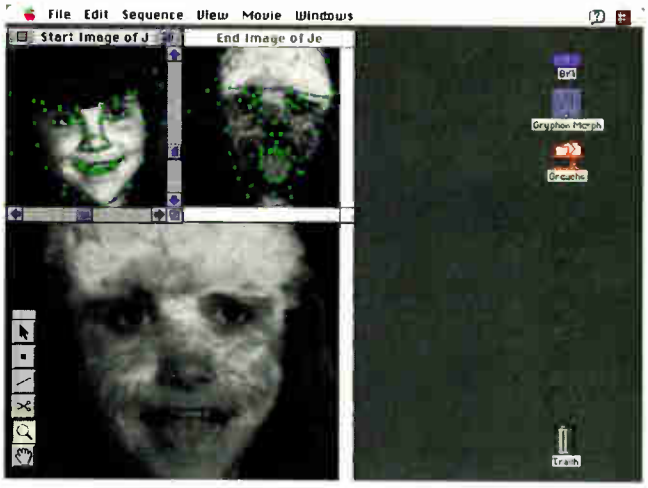
Lotus Organizer, *Lotus Development*

This well-conceived, $149 personal information manager makes consistent use of the notebook metaphor for all six of its modules: calendar, to-do list, planner, address book, notebook, and anniversary tracking. This consistency improves ease of use. The modules all work exceptionally well together.

Mac Performa 600, *Apple Computer*

The Mac Performas are Apple's line of home computers sold through mass-market channels. The line includes the low-end 200, the midrange 400, and the high-end 600. Priced at about $2500, the 600 is the only model that is totally new. Its 68030 processor is clocked at 31.33 MHz on a 32-bit bus. It comes with 4 MB of RAM soldered to the main logic board, and it can be expanded to 68 MB.

Apple made the right move with the pricing of these systems, even if the Performa 200 and 400 are actually the Mac Classic II and LC II.



Gryphon Morph

Mac PowerBook Duo 230, *Apple Computer*

Apple's innovative docking unit/notebook computer combination weighs in at an impressive 4.2 pounds and sports a 33-MHz 68030 CPU. The intelligently designed docking units come in two varieties. The large Duo Dock houses the PowerBook with its two NuBus slots, additional hard drive slot, math coprocessor, and SIMM slots for extra video RAM. The MiniDock clips onto the back of the PowerBook and provides all the standard Mac external ports.

Mac Quadra 950, *Apple Computer*

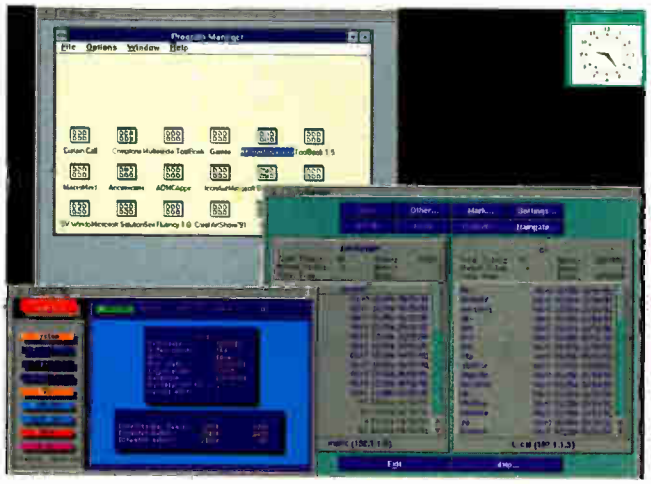
Apple's high-end 68040-based Mac, the Quadra 900, has been revamped to run even faster as the new Quadra 950. The engineers ratcheted the 950's processor clock from 25 to 33 MHz and boosted the I/O bus clock from 16 to 25 MHz. The fast, built-in 24-bit video supports bigger monitors plus a new 16-bit-deep mode that's ideal for handling digital video.

Microsoft Sound System, *Microsoft*

Compared to Macs, PCs have always lacked good-quality audio and standards for sound output. With its enormous standard-setting capability, Microsoft may have cured that problem in a single stroke. The Microsoft Sound System not only offers exemplary Windows-compatible audio but also adds exciting speech-recognition features, overdue in the PC arena, for less than $300.

continued

Desqview/X



World Radio History

1992 BYTE AWARDS

Distinction

Microsoft Video for Windows, *Microsoft*
Video for Windows serves a purpose similar to that of Apple's QuickTime for the Mac. It is both an architecture and a set of tools for creating, editing, and playing back digital video images under Windows 3.1. It is important because it allows any Windows-capable system to play digital video files.

Microsoft Word for Macintosh 5.0, *Microsoft*
Word for the Mac is more than a word processor. It includes a spelling checker, a grammar checker, a thesaurus, and a graphics editor. But perhaps most important is that it is file compatible with Word for Windows and DOS, two of the most popular word processing packages.

Microsoft Word for Windows and Bookshelf, Multimedia Edition, *Microsoft*
Microsoft has packaged Word for Windows 2.00 and the 1992 edition of Bookshelf onto one CD-ROM disc, making it one of the best arguments yet to buy a CD-ROM drive. The two integrated applications render Bookshelf's reference works accessible through Word's toolbar.

Mobidem, *Ericsson GE Mobile Communications*
The Mobidem is one of the first entries in what promises to be a rush of wireless mobile communication devices. Used in conjunction with a hand-held PC, the Mobidem connects you to E-mail and other broadcast data services through a packet radio network.

MultiSync FG series, *NEC Technologies*
The FG line continues NEC's important role as a desktop monitor standard-maker. The FGs introduced NEC's flat-panel display and its crisp images. The FG line ranges in size from 14 inches to 21 inches, and all but one model include an innovative color-calibration system that helps you fine-tune on-screen colors.

Numero, *PenMagic Software*
PenMagic calls Numero a "financial work processor," and the name fits. Loosely based on a spreadsheet model, Numero lets you do a wide range of financial calculations by taking advantage of the pen interface. This unique product runs under Go Corp.'s PenPoint operating system.

Olivetti Quaderno, *Olivetti Advanced Tech*
This 16-MHz NEC V30HL–based 2¼-pound subnotebook features a built-in digital signal processor, providing speech support. You can expect to get about 10 continuous hours of battery operation from the Quaderno. Its small size (8 inches by 5 inches by 1 inch), DOS 5.0 in ROM, and good performance make it an outstanding small system.

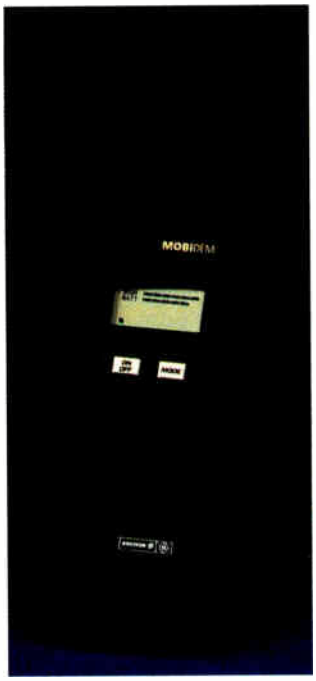
Oxford English Dictionary, Second Edition, *Electronic Publishing, Oxford University Press*
This CD-ROM-based product is the ultimate guide to the English language. Its cross-referencing capabilities make it much more useful than the paper version, allowing you to, for example, quickly jump to related words. In addition, the CD-ROM version of the OED is less expensive and consumes less shelf space than its more primitive predecessor. It's also fun to use.

PaintJet XL 300, *Hewlett-Packard*
HP has fooled a color ink-jet printer into thinking it's a laser printer. The XL 300 produces 300-dot-per-inch output in bright, solid, 24-bit color, and it uses the color version of HP's PCL 5 printer-control language. The printer accepts the same memory and network interface cards as the HP LaserJet III.

Perspective, *PenSoft*
Pen-based computers may find acceptance among executive users as electronic substitutes for the traditional appointment book. Perspective is a personal information manager for PenPoint that harnesses computer power to simplify a chore faced by every busy manager. Its intuitive approach sets an example of how software can adapt to people instead of the other way around.

POET, *BKS Software*
Persistent object storage is a hot topic in OOP (object-oriented programming) circles these days. Expensive object database systems married to languages such as Smalltalk have been available for several years, but they haven't met the needs of developers at the low end. POET, which stands for Persistent Objects and Extended Database Technology, works with the Microsoft and Borland C++ compilers and is also available for several versions of Unix, including Next's.

In POET's integrated development environment, you specify and refine systems of C++ objects. A precompiler converts these descriptions into definitions of classes whose data members are persistent—that is, automatically and transparently swappable between memory and disk storage. POET tracks multiple versions of class definitions; code that uses a newer definition will adapt dynamically to data written under an older definition. POET has generated a lot of excitement in the OOP community, and we look forward to a forthcoming multiuser version.



Mobidem

RangeLAN, *Proxim*
Wireless networking got a boost last year from the Proxim RangeLAN, a PC-based spread-spectrum-radio LAN that costs less than $500 per node. RangeLAN operates at speeds comparable to those of AppleTalk—more than fast enough for the small workgroups it's aimed at—and yet costs only half as much as some competing wireless solutions.

Rocket 33, *Radius*
Do you lust after the processing power of a 33-MHz Quadra 950, but you're stuck with an old Mac II? The Rocket 33 is a NuBus accelerator board with a 33-MHz 68040 processor that is sure to rejuvenate your old workhorse. Installation is plug-and-play, with no scary yanking of chips or trace-cutting. For certain applications, the Rocket 33 delivers a 60 percent performance boost when installed in a Mac Quadra 900.

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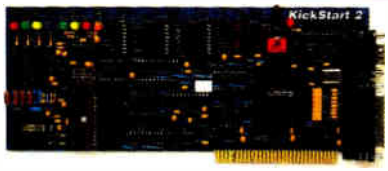

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Rich Santalesa, Computer Shopper

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Distinction

Satisfaxtion 400E, *Intel*
More than a fax modem, Intel's Satisfaxtion 400E also directs calls when voice, modem, and fax populate a single line. Other innovations include a PCL 5 emulation (for converting output, fonts and all to fax) and downloadable firmware updates—plus the original Satisfaxtion's 16-MHz 80186 processor and 512-KB buffer.

S3 86C911 GUI accelerator, *S3*
By taking over the processing chores of key Windows graphics functions, this chip speeds up the overhead operations demanded by Microsoft's interface. Because of low chip prices, users can buy accelerator boards with 32,000-color RAMDACs and noninterlaced resolutions of up to 1024 by 768 pixels for the cost of standard VGA adapters.

Tek Phaser IISD, *Tektronix*
Other vendors offer dye-sublimation printers for just under $10,000. At the same price, the Phaser IISD comes to the party with 300-dot-per-inch resolution, a RISC-based PostScript Level 2 interpreter, 16 MB of RAM, and an edge-enhancing technology that makes this dye-sublimation printer suitable for high-quality artwork as well as scanned images. Of the very few available 300-dpi dye-sublimation printers, the Phaser IISD has the best feature set and the lowest initial and operating costs.

Tek Phaser IISD

Video Machine, *Fast Electronic U.S.*
For $4000, the Video Machine multimedia expansion board turns your 386 PC or Mac II into a high-quality video editing and mixing system.

Worldport Palmtop Fax/Data Modem, *USRobotics*
USRobotics has built the first fax modem designed specifically for palmtops or personal organizers, which just don't have the CPU speed (or the RAM) to successfully run fax software on their own. The WorldPort Palmtop Fax/Data Modem uses the Hayes AT command set for data transmission and comes with extensions that support fax operation.

XVT Portability Toolkit 3.0, *XVT Software*
When we gave XVT an Award of Distinction in 1989, we said it was "clearly the right way to bring order to the chaos of competing GUI systems." Last July, we rated version 2.12 the best of its breed in a review of cross-platform development systems. Then in December we noted further improvements in version 3.0: better support for specific operating-system features (e.g., Apple events and common Windows dialog boxes), an optional C++ library, and an application prototyping tool. XVT was a good idea to start with, and it keeps getting better.

Z-Note 325L, *Zenith Data Systems*
If looks were everything, the Z-Note would have been the top vote-getter. It's not just a pretty face, though. The Z-Note has a built-in Ethernet LAN connector. Its edgelit monochrome triple-supertwist nematic LCD video is among the best we've seen, and you can expect over 4 continuous hours of battery operation from this 386SL-based notebook. An optional Port Replicator allows you to plug in all the cables you use for the desktop.

continued

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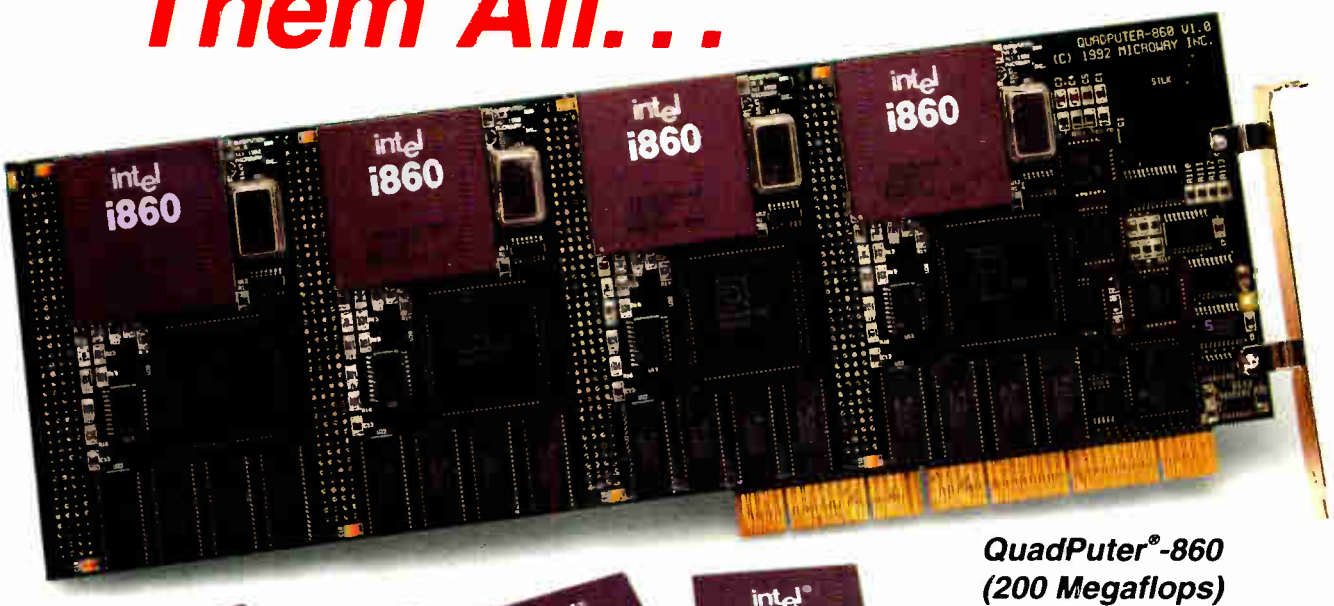
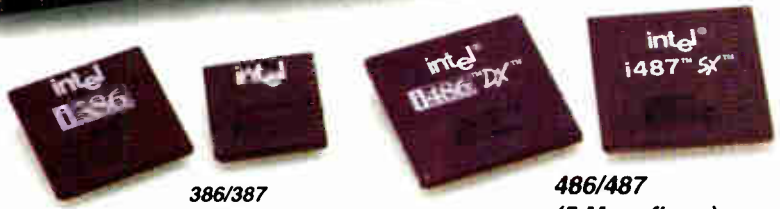


QuadPuter®-860 (200 Megaflops)



386/387 (1 Megaflop)

486/487 (5 Megaflops)

intel inside

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NDP Fortran has been the leading 32-bit PC Fortran since its introduction in 1987. It produces the highest quality numeric code and supports virtually all x86 operating systems, processors and numeric devices. These are just a few of the reasons it was used by hundreds of ISVs to port their 3090, VAX and Cray codes to the 386. NDP Fortran is required to run packages from IBM, Aspen Technologies and Fluid Dynamics. IBM chose it to port their Optimization Subroutine Library to DOS and more recently OS/2. Aspen Plus, the world's leading thermo/chemical-process control software package, is the standard employed by corporations like DuPont. Every copy of Aspen Plus for the PC ships with NDP Fortran-486!

One reason NDP Fortran is still the 32-bit leader is tools. It runs with native tools on UNIX, OS/2 and NT. For DOS, Microway created 32-bit tools that were tuned to the needs of our customers. These include efficient demand paged virtual memory for our Extender and a linker that could handle a 20-megabyte library without going to sleep. We are the only vendor that provides a variety of numeric runtime libraries that make it possible to tune speed against precision and error recovery. The correct choice of a library vs inline intrinsics can result in a factor of three increase in speed for some applications. Then there is the issue of numeric code quality. NDP compilers are not only globally optimized, but take good advantage of the Intel 387/487 stack, use advanced numeric optimizations and schedule instructions - all of which favor fast numeric and RISC devices like the 860 and 586.

Finally, Microway customizes its compilers to the environment. Our DOS 386/486 product includes over 1,000 pages of documentation, 300 of which are devoted to our GREX™ graphics extensions. The 200 megaflops of our QuadPuter-860 are optimally harnessed using NDP Fortran-860, libraries from IMSL, NAG and KAP and the PSR Vectorizer. Microway can build you a gigaflop NFS computational server using five QuadPuters housed in our industrial grade 486-B' for just $50K - massive power without massive price. **If you plan to use a 386, 486, 586 or 860 and require portability, numeric speed, precision and technical support, then NDP Fortran, C | C++ or Pascal is the only solution.**

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Merit

Ascend, *Franklin Quest*
It organizes your busy schedule paperlessly in Windows.

AST Bravo series, *AST Research*
A well-engineered, low-cost desktop line.

AST Bravo

AutoCAD release 12, *Autodesk*
The latest version of the venerable market-leading CAD program.

ColorFrame, *Envisio*
A flat-panel LCD that brings vivid color to your portable or desktop Mac.

Compaq PageMarq 15 and PageMarq 20, *Compaq Computer*
Compaq enters the network printer market with two feature-rich offerings.

Connectix CPU PowerBook Utilities, *Connectix*
A grab bag of necessary utilities for your Mac PowerBook.

DE-809TP Hub, *D-Link Systems*
A compact network hub that supports eight nodes for about $450.

DeScribe Word Processor 3.0, *DeScribe*
A powerful WYSIWYG word processor for either Windows or OS/2.

Doc.It, *Okidata*
A printer, scanner, fax machine, and copier all in one in a well-thought-out design for under $4000.

FileMaker Pro 2.0 for Windows, *Claris*
The Mac's most popular flat-file database manager comes to Windows.

GammaFax MLCP-4/AEB, *GammaLink*
It allows you to create voice/fax response applications for multiple lines using a single PC slot.

HP LaserJet 4, *Hewlett-Packard*
A standard-setting 600-dot-per-inch laser printer.

Image Pals, *U-Lead Systems*
First-rate image file conversion software for Windows.

Infolio, *Pi Systems*
A lightweight pen tablet for custom-designed applications.

Intel PCI bus standard, *Intel*
A local bus implemented on the motherboard that updates the aging PC architecture.

JetFax 8000-D, *JetFax*
A laser fax printer for the LAN that also allows PCs to send faxes.

LanRover/L, *Shiva*
A plug-in device for Mac PowerBooks that permits remote log-in to an AppleTalk network.

LANtastic for Windows, *Artisoft*
The most popular peer LAN for the best-selling GUI.

Lotus Freelance Graphics for Windows, *Lotus Development*
Freelance Graphics features SmartMaster templates that simplify the creation of presentations.

Mathcad 3.1 for Windows, *MathSoft*
Engineering software that features OLE, color surface plotting, and formula publishing.

Mathematica for Windows, *Wolfram Research*
The Windows version of the best-known mathematics software gets faster and less RAM-hungry.

Micromaster 486/33, *Aox*
Breathe new life into your PC with this superfast upgrade board.

Microsoft C/C++ 7.0, *Microsoft*
The latest C and C++ compiler from Microsoft for both DOS and Windows software development.

NCR 3170, *NCR*
This good-looking notebook is loaded with features.

NetModem/E 1.1, *Shiva*
The best LAN modem for mixed-LAN and AppleTalk support.

NewWave 4.0, *Hewlett-Packard*
Object-oriented desktop management for Windows.

Norton Desktop for DOS, *Symantec*
A file manager, disk manager, and utilities set rolled into one.

Now Utilities 4.0, *Now Software*
A greatly improved revision of the popular $149 utility package for the Macintosh.

Picture Publisher 3.1, *Micrografx*
A top-notch editor for color bit maps and scanned images under Windows.

PoqetPad, *Fujitsu Personal Systems*
The PoqetPad proves that "low-cost pen system" is not an oxymoron.

PowerPort Gold, *Global Village Communications*
High-speed data communications and faxing come to the Mac PowerBook.

Primax Colormobile SC-424A Scanner, *Primax Electronics*
A color hand scanner that drives itself over the image.

Procomm Plus for Windows, *Datastorm Technologies*
The popular DOS communications package gets the Windows interface.

Iris Crimson

QMS-PS 815MR, *QMS*
PostScript printing in a small, easy-to-use desktop unit.

QMS-PS 1700, *QMS*
High-quality 600-dot-per-inch PostScript printing at 17 pages per minute.

QuarkXPress 3.1, *Quark*
A Mac-based desktop publishing package that keeps getting better.

Quicken 2.0 for Windows, *Intuit*
Personal accounting at its best moves to Windows.

Silicon Graphics Iris Crimson, *Silicon Graphics*
The first Mips R4000–based workstation.

Slate PenApps, *Slate*
Easy applications development under Go Corp.'s PenPoint pen operating system.

Spectator Real-Time Recorder, *Rock Ridge Enterprises*
A Mac screen recorder that stores images as QuickTime movies.

ThinkPad Model 700C, *IBM*
IBM's first pen system hits the mark.

Toshiba Dynanote, *Toshiba Japan*
A powerful 3-pound pen tablet that supports both PenPoint and Windows.

Unix System V release 4.2, *Unix System Laboratories*
Unix slims down and rallies under one standard to remain competitive.

UserLand Frontier, *UserLand Software*
This scripting utility brings batch files to the Mac, with the ability to reach inside compliant applications and manipulate them. ■

continued

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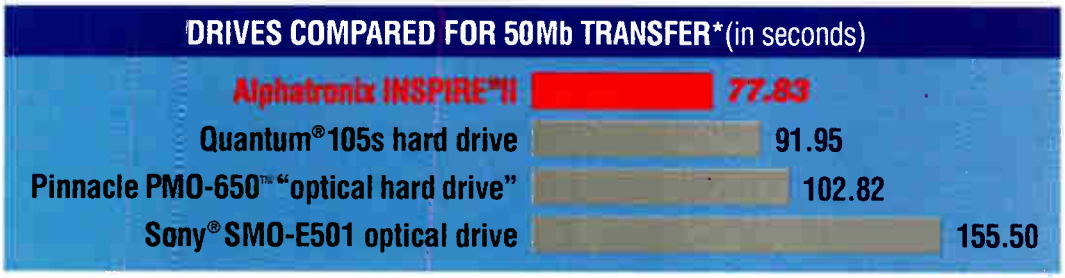
Who's Really The Fastest?



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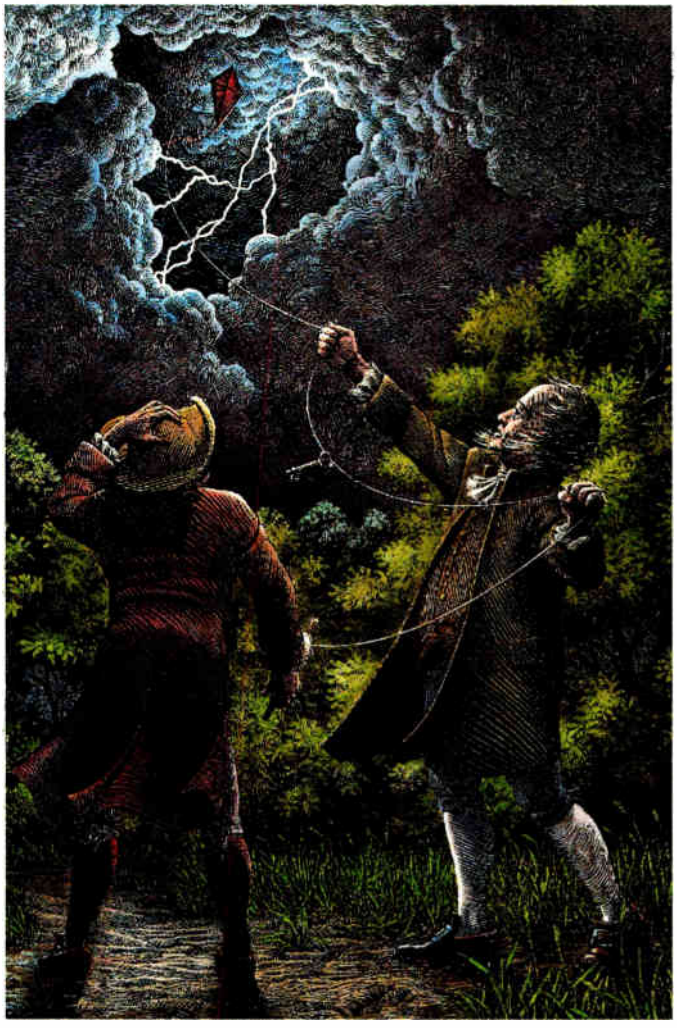

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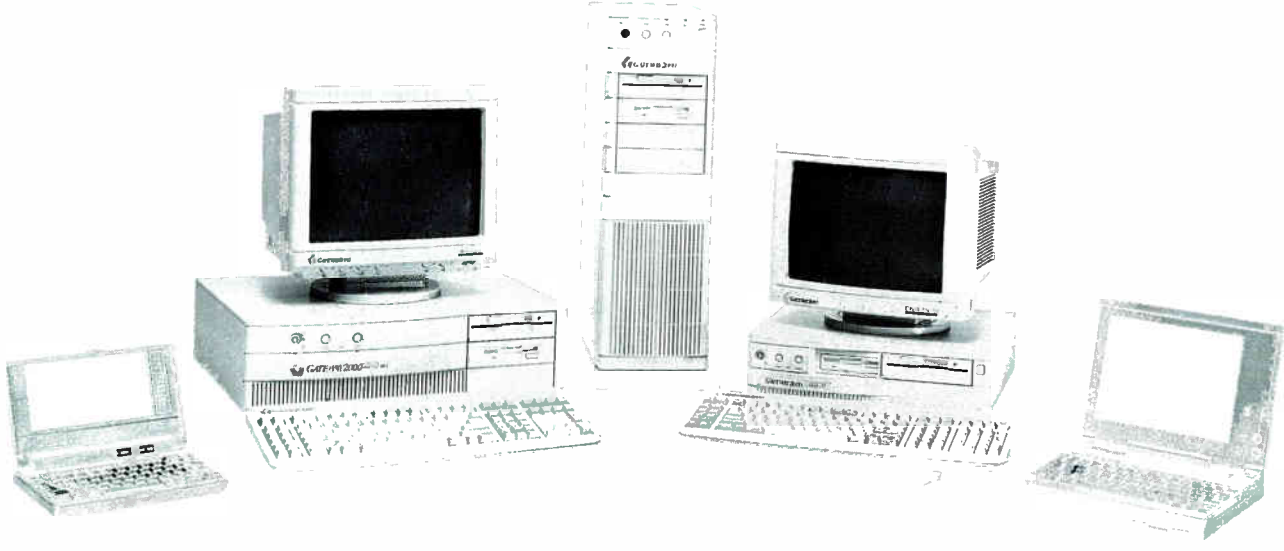

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FEATURE

Computing Without Clocks

Asynchronous operation could signal a new era in portable, low-power computing

DICK POUNTAIN

MANCHESTER, ENGLAND—In recent years, clock speed has become *the* signifier of computing machismo, possibly because it's the only feature that distinguishes otherwise seemingly identical PC clones. In view of this symbolic importance, computing *without* a clock might seem inconceivable, but that is precisely what Steve Furber of Manchester University and his team are working toward. Their goal is the world's first asynchronous implementation of a commercial microprocessor.

Asynchronous logic is relatively unfamiliar in the computer industry, which for decades now has relied on clocked circuits. Most parts of your PC—CPU, memory, disk subsystem, even the serial port—work in lockstep with the master system clock, just as Roman galley slaves rowed to the beat of the overseer's drum. Asynchronous or self-timed logic runs at its own speed, governed by local timers and the availability of data to work on. It's hard even to imagine an asynchronous processor because there is no simple metaphor, such as slaves rowing or soldiers marching, that helps you grasp the way the different parts work together. This difficulty is just as real for VLSI designers; clocked logic has become so popular precisely because it is easier to design with than asynchronous logic.

The Power Factor

So why would anyone want to design an asynchronous processor? The main reason is to save power. Power consumption has suddenly become a hot issue, partly because of the new interest in battery-powered portable computing devices (see "The PC Gets More Personal," July 1992 BYTE) but also for less apparent reasons. As VLSI feature sizes shrink to the 0.5-micron level and below, you'll be able to buy chips that contain tens of millions and then hundreds of millions of transistors. Given that heat dissipation is a serious problem with current generation technology, chips of these densities will aggravate the problem enormously.

There are many tricks designers can use to save power, the most popular being to employ a static CMOS fabrication process so that the system can slow or even stop the clock when the computer is idle. A static CMOS process can help, but the fact remains that clocked CPUs are intrinsically wasteful of power. Even when those "soldiers" aren't doing anything useful, the clock forces them to "run in place" and use energy.

The Clockless Advantage

An asynchronous CPU running under maximum load would use the same amount of energy as a standard CPU, but in PC

ILLUSTRATION: DAVE LAFLEUR © 1993

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Inside Micropipelines

Clocked computer components use two voltage levels (normally 5 and 0 volts DC) called "high" and "low" to distinguish logical true and false. Ivan Sutherland's micropipelines abandon this scheme in favor of transition signaling, where the absolute voltage levels are ignored and only the change between two voltages is recognized as a signaling "event." Response to transition signals is edge-triggered, with rising and falling edges considered to be identical events. (Some magnetic and optical recording schemes employ such an edge-triggered logic.) Transition signaling is potentially twice as fast as clocking—and more energy efficient—because it uses both signal edges rather than just one. Only the control circuits of micropipelines employ transition signaling; the data is still represented using high and low voltage states for Boolean true and false.

Timing in the event-driven world of micropipelines is controlled by a simple handshaking protocol called the two-phase bundled-data convention (see figure A). Two wires, called Request and Acknowledge, connect the sender and receiver, as do an arbitrary number of data lines. In phase 1, a sender places a value on its data lines and then (when the data is stable) produces an event on its request line.

In phase 2, the receiver accepts the data and then replies with an event on its acknowledge line. Request and acknowledge events can be either rising or falling transitions in different cycles, and the three actions—assert new data, request, and acknowledge—alternate in a strict cyclic order. This protocol is somewhat simpler than that used in the most popular two-phase clocked logic, which has five events per cycle. More significantly, this protocol permits its two phases to be of different and variable duration; in other words, it's an asynchronous protocol.

Unlike some purer asynchronous approaches, the bundled-data protocol is not entirely insensitive to delays: The delay in transmitting data from sender to receiver *must* be less than the delay in transmitting request events; otherwise, the request could arrive before data is valid. For this reason, VLSI designers must treat the control wires and the data wires as a single bundle for timing purposes—hence the name two-phase bundled-data convention.

It turns out that you can't process events using just the standard set of Boolean logic gates (conceptually, NOT, AND, OR, and XOR gates; in practice, NAND and NOR gates and inverters). The conventional XOR gate works for events, but it actually computes OR. To perform an AND on events, a device has to remember its previous inputs, which purely Boolean devices cannot do. Sutherland employs the Muller C-element (named after its inventor, David Muller), which contains a 1-bit memory cell. The C-element outputs an event only when both

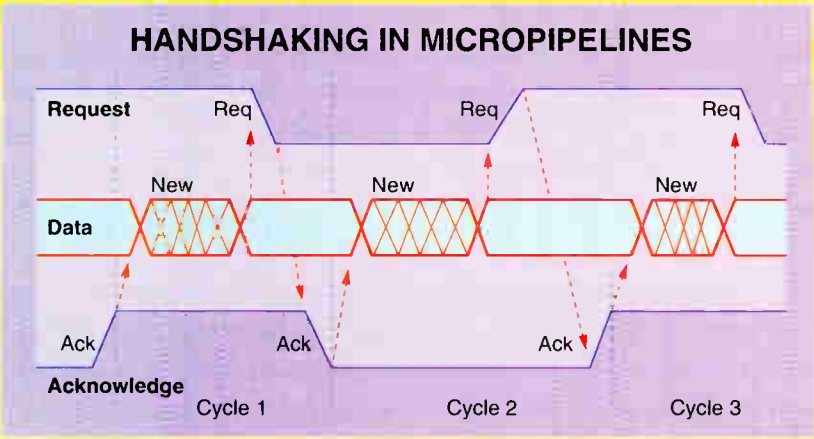

Figure A: *The first phase of the bundled-data convention (red arrows) is initiated by the sender. The second phase, initiated by the receiver, is in green. The convention is said to be "bundled" because the request, acknowledge, and data lines must be treated together when factoring in circuit delays.*

applications the CPU is very rarely loaded to the maximum. An asynchronous CPU running under partial load expends only as much energy as it has to; any circuit on the chip (e.g., the adder or the multiplier) not used by the current instruction is quiescent and effectively consumes zero power. A quiescent circuit is not switched off, however, and is ready to begin processing with minimal delay as soon as data arrives.

The metaphor that I find useful to describe asynchronous operation is a taxi service, where cabs depart not at fixed times but only when they are carrying passengers. Trying to achieve this fine-grained level of economy in a clocked processor would involve such complex sensing and switching of circuits that the exercise would be counterproductive.

Another advantage of asynchronous operation is that it avoids the problems of propagating ever-faster global clock signals around a system. Clock skew is a serious problem for the fastest CPUs; witness DEC's Alpha, where more than a quarter of the silicon is devoted to clock logic.

A more esoteric advantage of asynchronous logic is that it offers VLSI engineers the opportunity to design better circuits. For example, the operating speed of an adder circuit varies, depending on how many carries are needed to process different operands. In a clocked processor, the adder design must be a compromise that accommodates the worst (i.e., slowest) cases, because every-

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its inputs enter the same logic state, after both have received an event. In logic diagrams, the Muller C-element is represented by an AND gate symbol with a C inside it.

The other element you need to make micropipelines is an event-driven storage device. You can make such an element using three latches and three inverters, the event-driven equivalent of a D flip-flop. This storage element has two event inputs called PASS (which renders it transparent) and CAPTURE (which latches a 1-bit data value). You can assemble these devices in parallel, just like flip-flops, to build byte- and word-wide storage registers. The simplest micropipelined FIFO would contain one such register per stage. Empty pipeline stages are completely transparent, with a direct path from input to output.

Figure B shows the control logic for a section of a simple micropipelined FIFO, built only from inverters, Muller C-elements, and latches; the data lines run through the latches in the middle. Each stage is a loop around which control events flow, obeying the following state rule:

IF predecessor and successor differ in state
THEN copy predecessor's state
ELSE hold present state

This circuit is stable when all the stages are in the same state (an empty pipeline) or when alternate stages are in opposite states (a full pipeline). The state rule is actually equivalent to a digital description of wave motion: in unstable states, control events will propagate down the micropipeline like waves, and the data values will "surf" along with them.

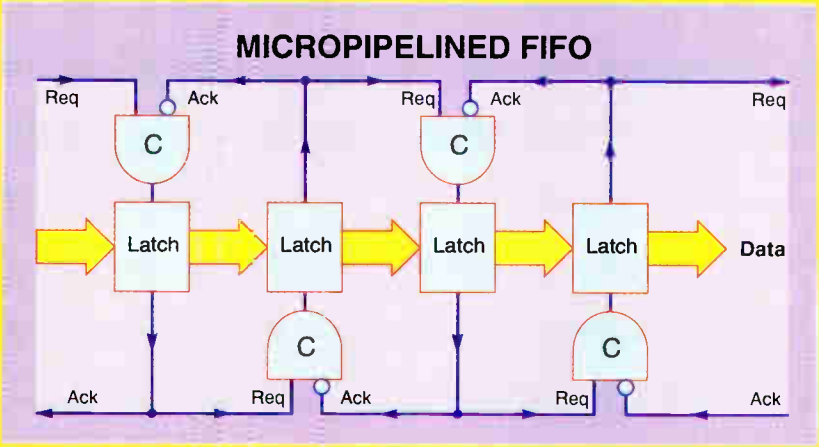

Figure B: *Data moves through the pipeline in waves, depending on the state of the inputs at each stage. The bubbles on the acknowledge inputs of the Muller C-elements represent inverters.*

It's often easier to think about event logic dynamically, in terms of event streams. From this viewpoint, the XOR gate performs the operation MERGE on two streams, while the Muller C-element performs RENDEZVOUS (i.e., don't proceed until all the events have arrived).

There are several other useful primitive-event-logic operations, all of which can be implemented by 10 to 100 transistors. TOGGLE steers events alternately to each of its two outputs; SELECT steers events according to the value of a second Boolean input; CALL triggers another process and then returns a "done" event to its caller; and ARBITER decides which of two events arrived first. CALL and ARBITER connected together act like a semaphore, thus permitting two or more asynchronous processes to share a single resource.

You may be struck by the similarities between these elements and high-level-language constructs (e.g., SELECT behaves like IF...THEN...ELSE). Using these circuits as building blocks, digital designers can make micropipelines that fork and rejoin, insert or delete values from the middle of a pipeline, and even set up a counterflow of data back up the pipeline.

thing must keep in step with the clock. For an asynchronous processor, you design the fastest adder you know how, and the fact that it will run slower for the rarest operands doesn't matter.

Given these advantages, it's not surprising that asynchronous operation is beginning to command more than passing interest from VLSI designers. In fact, a team at Caltech (Pasadena, CA) has produced an experimental 16-bit asynchronous CPU (see reference 1). At Manchester University, the Amulet project, headed by Steve Furber, means to create a fully asynchronous implementation of a "real-life" commercial architecture—the ARM6 RISC architecture (see "A Call to ARM" in the November 1992 BYTE).

In the Pipeline

To understand how a clockless ARM (Advanced RISC Machine) might work, you must first understand the asynchronous logic framework that Furber has adopted, namely Ivan Sutherland's micropipelines (see the text box "Inside Micropipelines" above).

A pipeline is a linear array of processing elements that work concurrently on a stream of data values passed from one to the next like a Detroit production line. Pipelines don't reduce the time required to process a single element (the *latency* of the process), but by overlapping operations in time, they process more elements per second, thereby increasing the *throughput* of the operation. Sutherland's micropipelines are elastic, event-driven

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pipelines that operate solely using locally generated timing signals (see reference 2).

In this context, *elastic* means that the number of elements in a pipeline can vary up to a maximum number, so a pipeline can be empty, full, or anything in between (a bit like strings in Turbo Pascal). *Event-driven* means that the micropipeline is triggered by the availability of data items rather than by global clock signals, and an individual pipeline element gets control information only from its immediate neighbors. Each element waits for new data to arrive at its inputs and passes it on only when the next element is ready to receive it. Therefore, every element works at its own pace. This requires a timing protocol quite unlike that for clocked circuits. The simplest micropipeline is a FIFO (first-in/first-out) buffer, which, because it has no processing elements, passes data through unchanged.

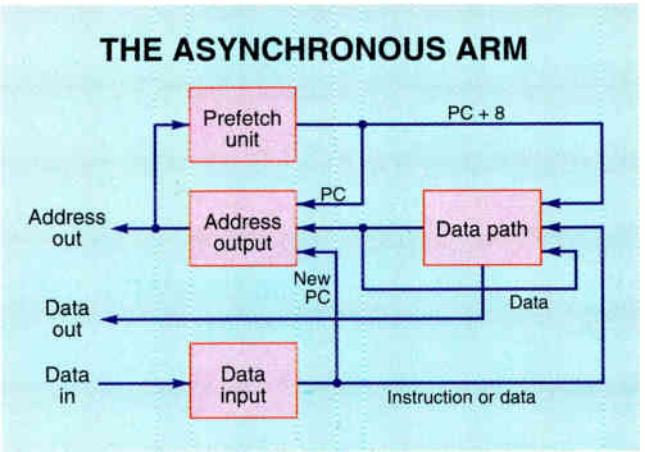

Figure 1: *The asynchronous ARM processor is a micropipeline made up of smaller micropipelines. It takes data and instruction inputs and spits out addresses and data.* PC *stands for the "program counter."*

A micropipelined FIFO can inherently tolerate different data rates at its input and output ends, an ability that requires very complex arbitration logic in a clocked FIFO. If the input arrives faster than the output for too long, the micropipeline becomes full and new data must wait. Conversely, if the output is faster than the input, the micropipeline empties and the output must wait. This "patient" behavior has important consequences when you design with micropipelines.

Designing for Tolerance

Because the timing of clocked circuits is highly context-dependent, chip designers almost always have to redesign the whole chip to make a change in even a minor part. Micropipelines, on the contrary, are timing-tolerant, so modules of widely differing speeds will work together, with throughput limited to that of the slowest module. This is Sutherland's strongest claim for micropipelines: They bring the concepts of modularity and composability so familiar to software engineers into hardware design. Micropipelines compose like procedures in high-level languages, whereas clocked circuits are more like machine code subroutines.

For example, if one day you discover how to make a micropipelined adder circuit twice as fast, you can pop it into the next iteration of your CPU with the assurance that the rest of the processor will still work as before and that operations that were limited by the speed of the adder will automatically speed up. Such a stepwise refinement process has the potential to revolutionize VLSI engineering.

The Asynchronous CPU

Using the basics of asynchronous logic, the Amulet team has designed a full simulation of the asynchronous ARM6 architecture and has successfully run an ARM validation suite that tests all the major instruction types used in the architecture. Silicon layout is under way.

Obviously, the asynchronous ARM has to be fully instruction-compatible with its clocked equivalents, and in principle you should not be able to tell whether the chip in your system is clocked or not. But this first iteration of the design treats external memory as if it too were micropipelined—an improbability, because no one makes asynchronous RAM. To use the asynchronous ARM in real-life systems, you'd need an interface converter between the internal two-phase bundled-data convention and the external clocked RAM. The eventual goal is for the asynchronous ARM CPU to become a *macrocell*—a self-contained gate layout that a fabricator can drop into any chip—with a micropipelined memory manager and cache memory on the same chip to isolate it from the external RAM. Thus, it makes good sense to treat the asynchronous/clocked memory interface as a peripheral rather than part of the core design.

Considered at the highest level, the asynchronous ARM is one big micropipeline that takes in a stream of data and instructions and outputs a stream of addresses and processed results (see figure 1). Internally, many of the ARM's subunits also behave as micropipelines; for example, the whole cycle of address generation, instruction fetch, instruction decode, and execution is pipelined, just as in most modern RISC CPUs. The difference is that here the pipeline is elastic and the number of prefetched instructions varies from time to time. After a branch, some instructions in the micropipeline may become invalid, and these are discarded by comparing a 1-bit parity flag attached to each instruction with a similar flag in the ALU that gets toggled every time a branch is taken. (This is an entirely separate issue from the "conditional execution" property shared by all ARM instructions.)

The data path is itself a three-stage micropipeline containing the register bank, the shifter/multiplier, and the ALU. The register bank offers a nice illustration of the problems an asynchronous designer faces.

Banking on Registers

Executing a typical ARM instruction involves three registers: the two operands (A and B) and the result register (W). In an asynchronous implementation, a new instruction can start executing as soon as A and B have been read by the previous instruction. This raises the possibility that the instruction might try to read W before the result of the previous instruction has been written to it. This could happen with a pair of calculations such as the following:

R1 := R2 × R3
R4 := R1 + R5

where the addition would be completed well before the slower multiplication has finished. To avoid such a disaster, all attempts to read registers have to be delayed until the correct value is available—a process called *register locking*.

The asynchronous ARM tackles this problem by incorporating a lock FIFO, a

Asynchronous Logic Advantages

- low-power operation
- no clock skew
- design flexibility
- fewer heat problems

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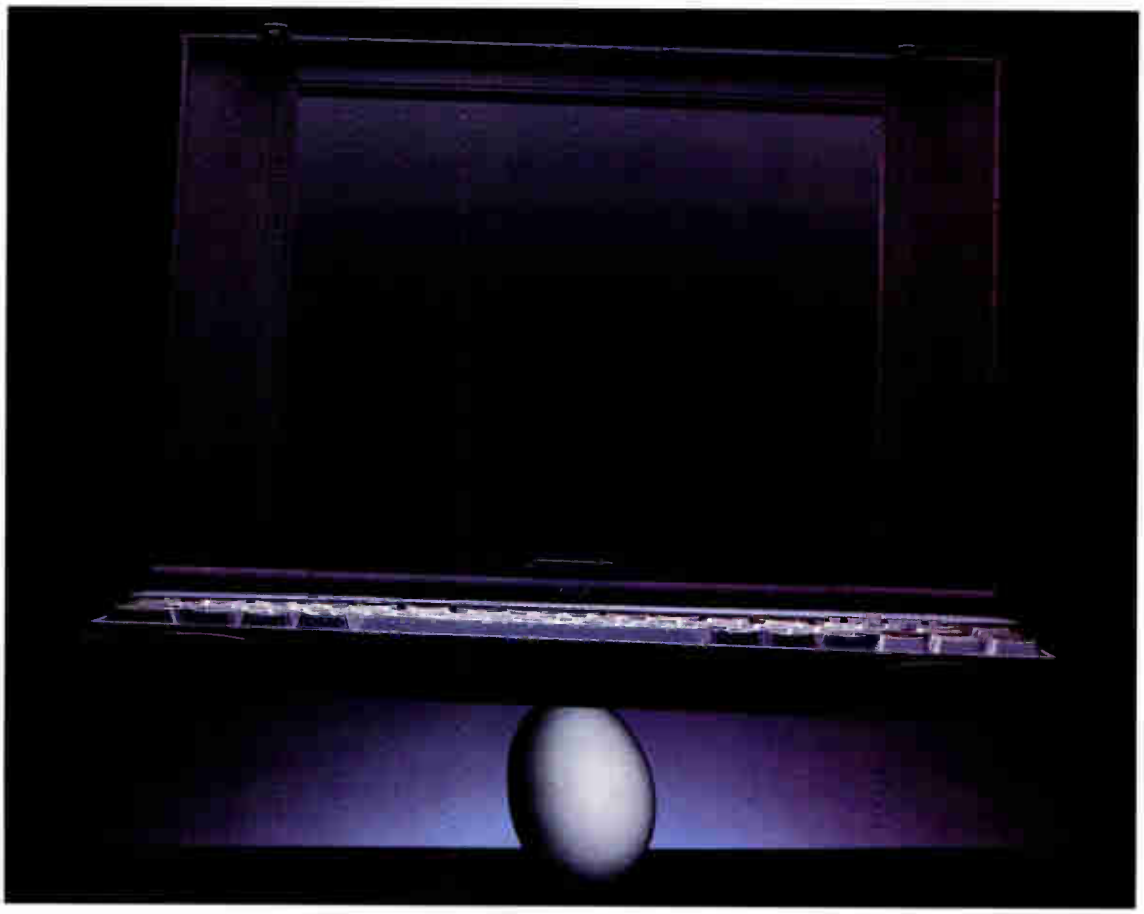

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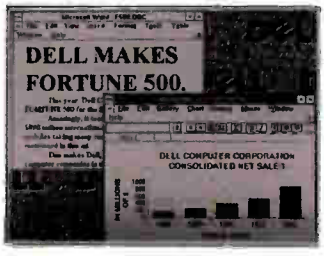

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special micropipeline that stores the addresses of locked registers. In addition, this FIFO queue enforces the correct writing sequence. Before any instruction can read a register, it must first check the contents of the FIFO to see if the register is locked. If it is, the read operation is suspended until the lock is cleared. To make this lookup as efficient as possible, the FIFO holds register addresses as unary numbers (i.e., bit masks where 1 bit corresponds to each possible register). The ARM has 31 registers, but R15, the program counter, is addressed via wholly different circuits, so lock addresses need only be 30-bit words with exactly one bit set. In the above example, the FIFO would contain

00000000000000000000000010000 (R4)
00000000000000000000000000010 (R1)

To check whether a particular register is locked, you perform an OR on all the bits in the column representing that register's number. In hardware terms, the FIFO has an output for each column that indicates if a bit is set anywhere in that column. Register write operations use the register address in the last stage of the FIFO directly to enable the next register to be written, which removes the need for a separate write-decode register. This lock FIFO mechanism will work correctly given three conditions:

- Bits must be copied from one stage to the next in such a way that the value appears in the second stage *before* it's removed from the first (otherwise a 1 bit could be missed if the FIFO were checked while it was "in transit"). This is an innate property of Sutherland micropipelines.
- Empty FIFO stages must present all 0s so as not to mess up the bitwise OR. This is achieved just by holding the FIFO's data inputs at 0 whenever addresses are not being inserted; the transparent property of empty micropipeline stages does the rest.
- Nothing should be inserted into the FIFO while it is being checked. This condition is met by forcing all instructions to read their operand registers before locking their destination register so that the FIFO cannot be updated during register reads.

You can see how the properties of micropipelines help to achieve a simple and elegant solution to the register-locking problem, and the ARM contains several other examples that I don't have space to describe.

Off the Drawing Board

A commercial asynchronous processor would be a boon to designers of portable, low-power systems. Although one is not yet in silicon, Steve Furber is confident not only that the asynchronous ARM will work, but that it will offer significantly higher performance than the clocked version for lower power-consumption benefits that Apple's Newton project may one day reap.

The Amulet project is keen to demonstrate that asynchronous logic is sufficiently mature to move out of the laboratory into real-world systems. If successful, it will pave the way toward a new era of portable computing. ■

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MACHINE TRANSLATION

Translating the languages of the world on a desktop computer comes of age

MURIEL VASCONCELLOS

The process of converting information from one language to another with a computer, MT (machine translation), is an increasingly important technology. International economic and political stability and well-being are dependent on shared information. Never before in history has there been a more urgent need to topple the linguistic barriers that divide the people of the world.

New common markets and stepped-up trade throughout the world have created overwhelming demands for linguistic support. Just communicating in the nine official languages of the European Community means translating in 72 different directions.

A thorough translation meticulously captures all the nuances of the original text. Sometimes, though, a rough translation is all that is needed. Most translations are still performed by people, but computers are shouldering part of the burden (see the text box "An International Network" on page 156).

Interpreters—translators who deal only with spoken language—don't have to worry about problems with input and output. But translators who must produce written output need a way of transferring their results to hard copy. Whether they use a dictating machine, a typewriter, or a word processing program, the process is slow and costly. Computers can take on much of the drudgery of this process and free the human translator for the more creative aspects of the task.

MT: What Is It?

MT comes under the generic heading of NLP (natural-language processing). At the same time, because the technology involves many complex tasks, it's often seen as a category unto itself. MT's special status may also stem from the fact that it was the earliest kind of NLP. The first translation machines were designed in the early 1930s, and serious efforts to develop MT were under way soon after the ENIAC (Electronic Numerical Integrator and Calculator) made its debut in 1946.

Unlike software that merely looks up words, MT analyzes the text in the original language (the source language) and automatically generates sentences in the target language in which you want the translation. Input to a computer for translation is machine-readable text written in the source language. Output consists of text in the target language, which may be displayed on-screen or printed. Hard copy often shows the source and target texts side by side (see "How MT Works" on page 167).

MT can involve human assistance, but it shouldn't be confused with MAT (machine-assisted translation), a related but different mode. In MAT, a human translator prepares the target version using a word processing program and musters the aid of automatic terminology managers, on-line multilingual term banks, text-critiquing software, repetitions processing, and other computer-based tools that help to boost productivity.

The difference between MT and MAT is becoming less clear. Innovative systems in the research stage are blurring the distinction between the two by providing pieces of text that can serve as translation building blocks. Computer-based tools have become standard components of the translator's workstation, which may include full MT as well.

What Does It Do?

The dream is to build the equivalent of the babblefish of Douglas Adams' book *The Hitchhiker's Guide to the Galaxy*—a wearable device

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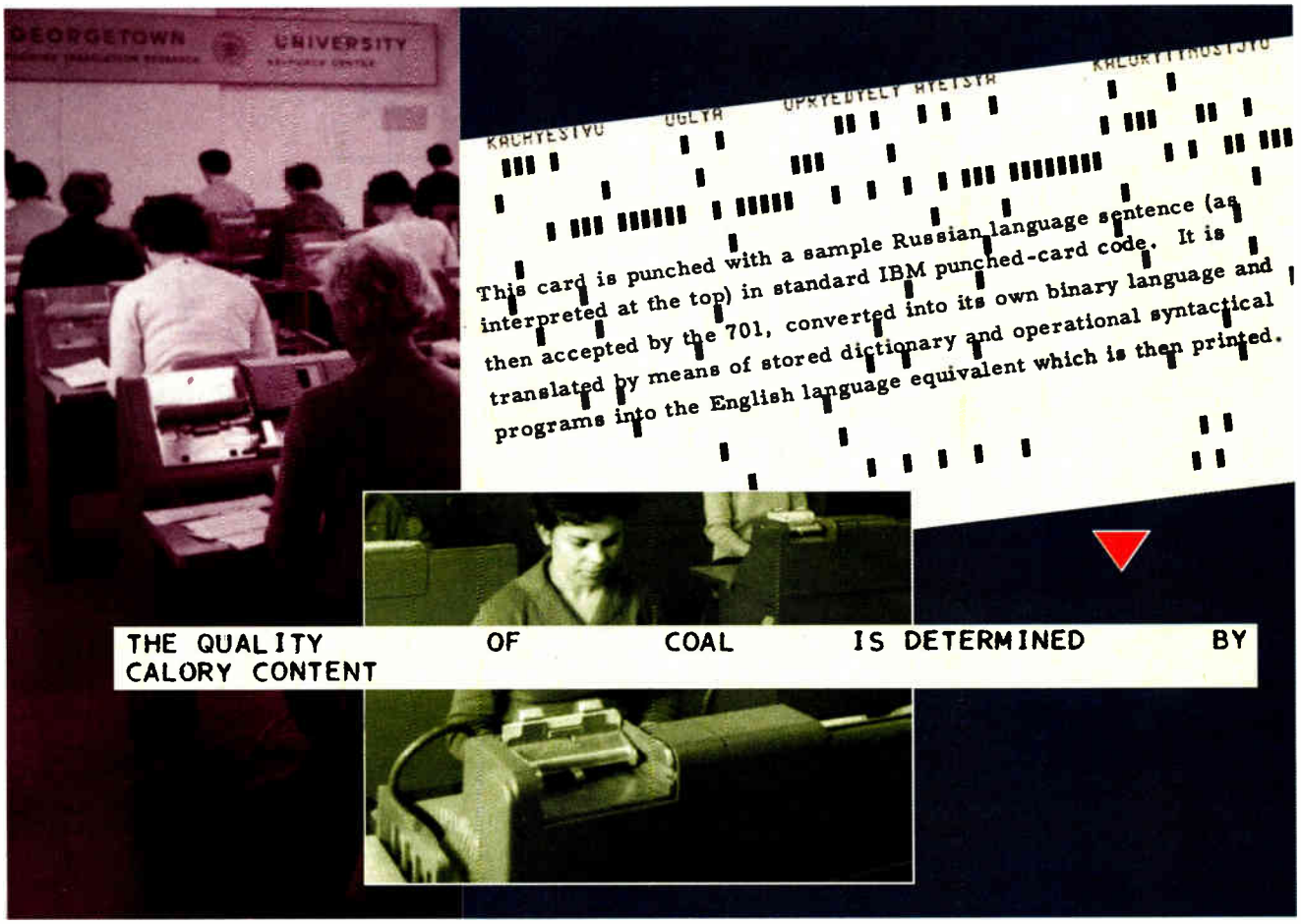

Photo 1: *The first known trial of MT took place in January 1954. Shown here are a card punched with a sentence in Russian and a printout of the translation in English.*

that simultaneously interprets from and into any language of the world. This concept sounds like science fiction, but in reality, speech-to-speech technology, in limited forms, is already in the wings. In the meantime, MT of written text is proving its mettle in a respectable range of settings.

MT works best if the subject matter is specific or restricted (e.g., maintenance manuals). The results are even better when the original text is straightforward and devoid of ambiguities.

Car manuals, for example, are consistent in style and vocabulary. Peter Wheeler of Antler Translation Services (Sparta, NJ) uses MT to translate automobile manuals from English to French for General Motors. "Automobile manuals are ideal MT texts—very dry, very objective, very factual, extremely repetitive, and very boring. That's not the sort of stuff a human translator works with well. With MT, I've achieved a threefold increase in throughput."

Progress in MT is measured by a system's ability to gradually handle more difficult text types and language combinations, with as little human assistance as possible. Another key goal is to be able to translate between European languages and languages that have non-Roman alphabets and structures (e.g., Japanese, Korean, Chinese, and Arabic). Finally, progress in the field is also gauged by how flexibly the system fits into the user's operation.

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Future Enhancements

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- add more applications

Two key factors have come together to make MT easier to use. For a long time, the primary obstacle to more widespread use of MT was the cost and difficulty of getting text into the computer (see photo 1). Now there are large volumes of text in electronic files ready to serve as fodder for MT.

But the most dramatic difference is that personal computers and workstations now offer enough processing power to take on the MT functions that have been mainframe-dependent for nearly 40 years. Downsizing from the Goliaths to the Davids of computing has produced a new generation of devices that will soon be able to perform MT applications on the fly.

MT systems spend a lot of time looking at the various ways in which a sentence can be parsed and considering the roles and meanings that each word can have. Most of this time is spent mulling over possible choices. For example, the mainframe-based Systran system from Systran Translation Systems (La Jolla, CA) processes about 10,000 rules per second. If

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you are performing MT on a desktop system and your document has many pages, the process may tie up your computer for quite a while.

Junior Babel-Busters

As the technology gravitates to smaller and more personalized computers, MT is becoming accessible to a larger public. The first personal computer–based system—the MicroCAT (which is no longer produced)—appeared in 1983. Today, the Sun Microsystem Sparcstation and other midrange Unix workstations are host to many commercial MT systems, as are virtually all the laboratory prototypes (see "Babelware for the Desktop" on page 177). Unix workstations, 386 and 486 PCs, and high-end Macs all provide sufficient power on the desktop to run the biggest MT systems. The challenge is to adapt the software to the new environments.

A recent example of a system designed for the capabilities of the 386 is the Engspan, which was developed by the Pan American Health Organization in Washington, D.C. In late 1992, this system, which translates from English to Spanish, was ported from a mainframe computer and runs efficiently on a 33-MHz 386 with DOS, 2 MB of RAM, and an 80-MB hard disk.

MT on Your Desktop

Being able to tap into MT from your desktop has several advantages. For example, you can use OCR (optical character recognition), CD-ROM, and internal modems and faxes to capture text and graphics, download databases, and exchange electronic files with clients anywhere in the world. Many databases offer information in languages other than English. For example, you might search other countries' patents or a body of legal decisions or update your client on the latest Japanese advances in superconductivity.

With database management tools for retrieving terminology and previously translated text, style checkers, and desktop publishing software, you have everything you need to set up your own multilingual operation. Executive Communication Systems (Provo, UT) makes MT ToolKit, which enables you to create your own dictionaries, write your own linguistic rules, and customize the basic architecture of an MT system. It has been used to develop systems for Korean and Norwegian translation.

LANs offer large groups of users the potential to centralize some of the more time-consuming tasks. You can farm out a CPU-intensive translation to a less-used machine and receive the results back as a file on a server. You can store the large main lexicon and specialized glossaries in one location and make them available to all. Use of a centralized dictionary makes it possible for managers and terminologists to control the introduction of updates.

You can also incorporate MT into the desktop publishing process. By the time it reaches the MT phase, input text will have already been tagged with the publisher's markup codes. Here MT can offer considerable savings, because the reintroduction of markup codes can double the cost of translating a text.

Graphics and tables, which are expensive and painstaking to translate by hand, can be reproduced exactly as they appear in the original. MT can not only speed up the task but also prevent errors that could slip in if the data were rekeyed. These savings, of course, are multiplied by the number of target versions generated.

An alternative way of bringing MT to the average personal computer user is through a dial-up service. From your computer, you can send a file by modem to a mainframe host. In the U.S., you can call up Systran and access a smorgasbord of languages. In France, you can get Systran translations through the nationwide network Minitel. And in Japan, you have a choice of Fujitsu's Atlas-II on NiftyServe or NEC's Pivot on PC-VAN, another large network. CompuServe will soon be offering similar services.

How MT Works

The philosopher I.A. Richards once wrote that translation is "probably the most complex type of event yet produced in the evolution of the cosmos." It's no wonder, then, that the architectures of MT systems vary in seemingly infinite ways. Certain elements, however, are common to the process.

In any MT system, the computer uses three sets of data: the input text, the translation program (including I/O routines), and the permanent resident knowledge sources. The most essential of the knowledge sources is the dictionary—a file of records containing the words and phrases of the source language against which the input text must be matched. Knowledge sources also include the sets of rules that are fired at various points in the translation process. Finally, many systems store a bank of information about the concepts invoked by the dictionary.

The largest MT systems work with dictionaries containing several hundred thousand words. For each word, a record holds formalized representations of information about how the word functions. Even when condensed, the record for each word can be as much as 100 bytes long. With a heavy-duty system, the dictionary is measured in tens of megabytes.

The first task of any MT system is to match the words of the input text against those stored in the dictionary. It can use either a binary or hash search strategy. When it needs to look up a word, it first goes to the index residing in memory and locates the appropriate page of memory. For each word that it matches, it retrieves a complete record that includes information about the possible functions of the word

An International Network

MT users and would-be users, as well as researchers and commercial developers, have recently joined in a common endeavor to improve and promote the technology as well as share information about MT. They have formed the IAMT (International Association for Machine Translation) and, within its overall framework, the AMTA (Association for Machine Translation in the Americas).

IAMT and AMTA publish *MT News International* every four months and the *MT Yellow Pages* once a year. In November 1992, IAMT/AMTA held a workshop that evaluated MT technologies and provided a showcase of MT systems.

For further information, write to the Association for Machine Translation in the Americas, 655 15th St. NW, Suite 310, Washington, D.C. 20005.

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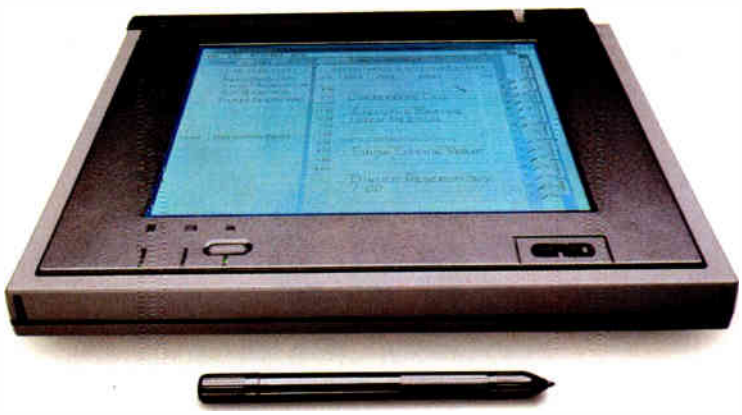

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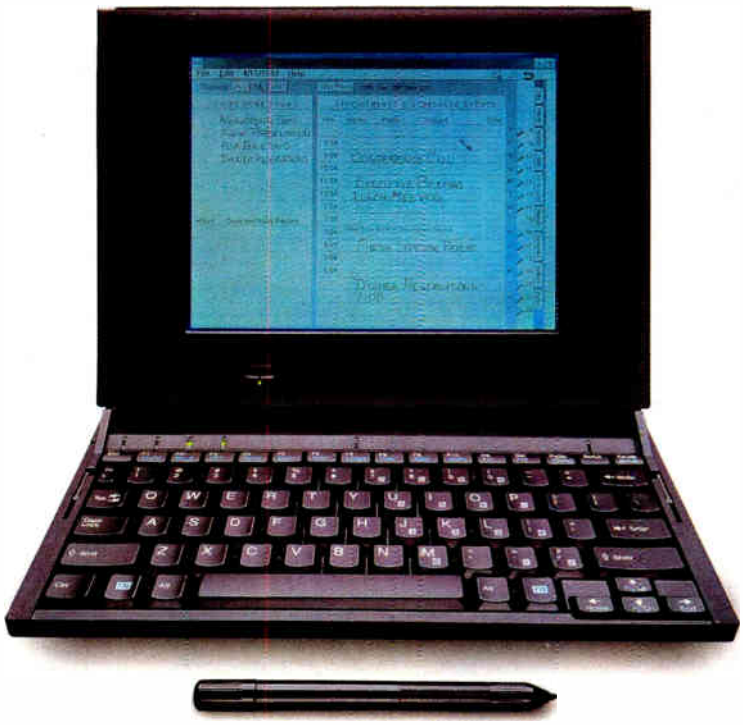

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MT at Your Service

EDUARD HOVY

Perhaps within a decade, MT (machine translation) will appear in your life in several ways—translating telephones, multilingual E-mail, and machines that scan and translate letters and articles written in foreign languages. You may be buying toys over the phone from a sales agent in Japan with the telephone doing the translating. And when you travel to a foreign country, you'll be able to get the same bargain rates that the natives do with your trusty PET (Portable Electronic Translator).

Several technologies will make such scenarios possible: automated speech recognition, speech generation, OCR (optical character recognition), and machine translation. Although PETs are years away, intermediate tools are already available, either as research prototypes or as commercial products.

From "Mushi-Mushi" to "Hello"

One of the most complex component technologies is speech recognition. After about 30 years of research, systems can recognize limited amounts of speech without first having been trained on specific voice patterns. Systems have error rates of only a few percent when the domain (i.e., a vocabulary specific to a certain environment or discipline) is limited to a few thousand words.

Most speech-translation efforts are taking place in Japan. Researchers at the ATR Laboratories (Advanced Telecommunications Research Institute International, Kyoto, Japan) have been working on a translating-telephone project for about six years. Working in English and Japanese, the prototype system, SL-TRANS, will translate inquiries about conference registrations. The company's goal is for the system, using a vocabulary of 1500 words, to be able to translate anyone's speech without the system being tailored to specific voice patterns.

Speech-recognition systems combine hardware (e.g., microphones) with statistically based software to match incoming phonemes (i.e., sounds) against stored phoneme patterns and to produce strings of text. The best experimental systems using standard workstations operate at well over 90 percent accuracy on domains of a few thousand words. An NEC system can recognize a 5000-word vocabulary of isolated words or a 1500-word vocabulary of fluid speech.

Photo A: *The Passport combines digital photography and character-recognition technologies with bilingual dictionaries on chips. Using this hand-held device, you can capture an image of something you'd like translated and see the translation of the words or symbols. (Courtesy of Carnegie Mellon University)*

A consortium of 10 universities and companies in Germany is planning an ambitious speech-translation project. Personnel associated with the Verbmobil project will build a portable device to help translate languages for business discussions. Because it's easier to understand a foreign language than to speak one, the project personnel say, the system will use English as a kind of interlingua.

The Bibliothèque Nationale

Multilingual information-retrieval systems are closer to becoming commercially available than speech-recognition systems are. With retrieval systems, you'll be able to get information on your favorite topic by giving a collection of keywords or a few relevant paragraphs.

Researchers at Fujitsu Laboratories (Tokyo, Japan) have built a multilingual information-retrieval system that translates query words in German or English into Japanese. It retrieves relevant articles; translates their titles into German or English; and, on request, translates the article as well.

E-Mail from A to Z

Computing environments are becoming increasingly dependent on networks. Communications are more electronic and less paper-based than they were in the past. Thus, people have a greater need for inexpensive technology that offers browsing-quality translation assistance of E-mail messages.

Although most of the technology for this application already exists, no products are on the market yet. Fujitsu has demonstrated a prototype, and Dragon Systems (Boston, MA) is developing a PC-based product that will handle Japanese, Spanish, and English translations.

Future Applications

In a competition sponsored by Apple's Advanced Technologies Group, students at Carnegie Mellon University's School of Design offered several innovative ideas. One prizewinner was the Illumina, an MT machine that stands in an office or library next to the printer and photocopy machine. Combining optical-scanning and OCR technology with personal computer–based MT, the Illumina translates whatever text you place on its faceplate. Given the high character-recognition rate available in commercial systems, this type of system may start appearing as soon as more general-domain MT systems develop out of the prototype stage—perhaps by the end of the decade.

Carnegie Mellon students have also

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developed the Passport, a hand-held word-translation device that uses photography to input text (see photo A). For example, on your travels, you spot graffiti on a wall. After photographing the slogan onto the Passport's display, you circle the words you're interested in, and the Passport's bilingual dictionary chip provides a translation on an LCD. Granted, for a few hundred dollars you can buy systems that will translate the foreign words that you type in, with a separate chip for each language pair, but try typing in a few Chinese characters.

A third Carnegie Mellon project addresses the needs of hearing-impaired people. The Signspeak System is intended to translate American Sign Language and spoken English (see photo B). Its design calls for a glove with sensors and an attachment to track arm position and hand motion. These sensors feed their signals to a personal computer, which converts them into English words and uses voice-synthesis software to convert the reply to text, which is displayed on the computer's screen.

Several neural-network and connectionist project developers are also working toward future MT applications. Carnegie Mellon and the University of Karlsrule in Germany are jointly developing the C-Star System. In this system, trained connectionist networks recognize English text, create internal data structure patterns, and generate Chinese text as output. A set of neural-network programs called ANN (Architecture for Neural Networks), developed at the Huntsville Achievement School (Huntsville, AL), follows a similar approach with English and Russian.

These applications are but the vanguard of the MT revolution. More have yet to come. Over the past few years, fax machines have quietly changed our lives. In a few decades, automated MT systems will be doing the same. Thanks to the innovative use of MT and related technology, speech and writing in a multitude of languages will become easier to find, read, and understand.

Photo B: *To help hearing-impaired people communicate with those who don't use American Sign Language, students at Carnegie Mellon developed this prototype translator. The design uses gloves with sensors to send hand- and arm-movement information to a personal computer. Software converts the signals into English words, which are synthesized and output over a loudspeaker. (Courtesy of Carnegie Mellon University)*

Eduard Hovy is a project leader at the Information Sciences Institute of the University of Southern California in Los Angeles. He is the author and co-editor of two books on automated language generation. You can reach him on BIX c/o "editors" or on the Internet at hovy@isi.edu.

and its relationship to words that may occur with it.

Translation Quality

Translation quality generally improves as the systems acquire more rules and larger and more detailed lexicons. But there is a trade-off.

In the long run, systems that have robust dictionaries and rule bases demand less human intervention, but they are more costly to develop or tailor to a particular environment. On the other hand, systems that do not have these resources require more human labor to turn out a finished product.

Other factors of consideration are the structural proximity of the two languages, the domain, and the type of text. Most important, the quality required of the translation depends on how it will be used. Can the raw output be delivered without further polishing? How much human intervention is needed to make it acceptable to the client?

The quality of MT is also closely tied to the amount of human assistance the user is willing and able to provide. The raw MT product—direct from the machine—may be usable for certain purposes, but some human participation is usually involved.

You can intervene at any point along the way: before, during, or after the automatic translation process. People's time costs more than that of computers. The idea is to keep the number of human steps to a minimum by choosing the form of intervention that offers the best mileage for the application.

When to Edit

If the operator intervenes before a source text is translated, the step is called *preediting*. The idea is to eliminate lexical and structural ambiguities before a translation program takes over.

Preediting comes in two flavors. In the first instance, you revise a text that already exists. Sometimes, there is easy-to-use interactive software to help you with the task. For instance, The Smart Expert Editor by Smart Communications (New York, NY) is designed to serve as MT preprocessing software.

In the second kind of preediting, you prepare the text for the machine. It may be a new version of an existing text, or it may be a text that was drafted for the purpose, according to preestablished rules and vocabulary.

Although preediting makes the job easier for the machine, you often have to edit the output. Preediting is worthwhile when you are translating from one language to many, because it reduces the need for

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human assistance downstream. This step can also be justified when the source language poses major linguistic problems at the input level.

When an operator responds to questions posed by the computer during the translation, the mode is called *interactive editing*. The operator is asked to resolve ambiguities that the program has identified. The computer offers various alternatives, and the operator clicks on the most appropriate choices.

By making these decisions before the target-generation phase, interactive editing reduces the manual editing required after the translation. An early product that offered interactive editing was Transactive by Alpnet (Provo, UT). And making its debut is the Augmentor, developed at Carnegie Mellon University (Pittsburgh, PA). Carnegie Mellon hopes that the combination of a rich interlingua, a domain-specific application, and an interactive interrogation component will eliminate manual preediting or postediting.

The most common form of human assistance is *postediting*. In this mode, you add the finishing touches to the machine-translated output after the computer has finished its job. Postediting is more labor-intensive than the other forms of editing, but it gives you control over the quality of the text. You can rarely avoid this stage when the translation is intended for a large number of readers.

In most situations, the posteditor, who is ordinarily a professional translator, thoroughly reviews the output and makes any necessary changes. The standards and purposes of the user will affect how long the process takes.

Typically the posteditor works at the computer, using an off-the-shelf word processing package. Macros designed for MT can speed up the process. Depending on the text, posteditors can double the output of traditional human translation, turning out between 3000 and 10,000 words in an 8-hour day.

Gathering vs. Disseminating Data

How you use MT depends on whether you want to gather or disseminate information. When gathering information, you translate text from a foreign language into your own. When you disseminate information, you translate it from your language into another.

Often, the usefulness of the information you gather is time-dependent (e.g., weather reports, job listings, and patent information). And at times, only a few people will see an information-only translation. For this reason, the quality doesn't have to be perfect. Because you can rarely predict what the style and subject matter of source text will be like, you need an MT system that is robust enough to deal with whatever it encounters. This is known as a general-purpose system.

The demands of general-purpose MT place a heavy burden on the system's analysis component: The grammar must cover a broad range of situations, and the dictionaries and knowledge sources must be large and detailed. Even with the best linguistic preparation, however, the quality of the output will not be as smooth as that produced by a system tailored to a specific domain.

In information-gathering operations, the input documents usually come from a wide range of sources and are available only in hard copy. The cost of converting the input into an electronic file may be prohibitive. And the use of OCR in combination with automatic postprocessing and human monitoring might not make enough of a difference to warrant the introduction

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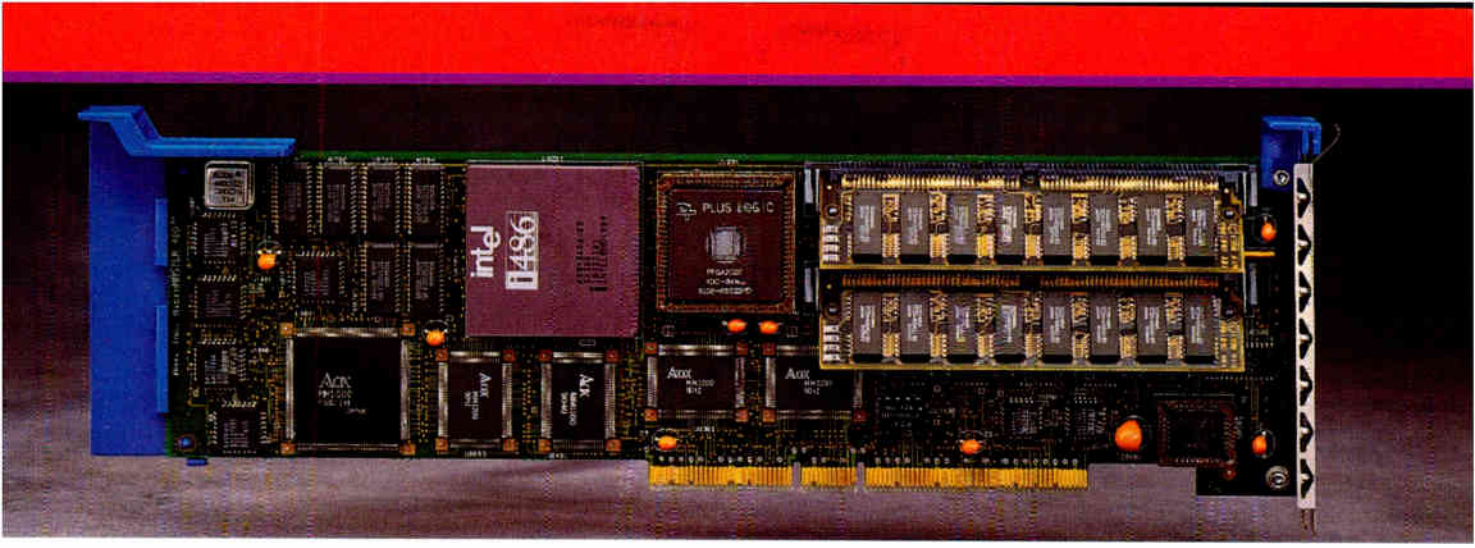

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of MT. However, what is making MT more feasible for information-gathering purposes is the widespread availability of text in digital form.

General-purpose MT systems can speed up the work of in-house translators who have to produce publication-quality copy in various subject areas. For example, the Logos system, developed by Logos (Mt. Arlington, NJ), supports translators that perform this kind of work in the Canadian Department of the Secretary of State and in a number of translation service bureaus. Similarly, the translation team at the Union Bank of Switzerland uses Metal, marketed in the Americas by SieTech of Siemens Nixdorf (Munich, Germany).

The most widespread use of MT is in the translation of texts in limited domains (e.g., customer support manuals). This application allows companies to launch their products in several countries simultaneously. Here the users call the shots: They reduce input ambiguity by having a single domain, and they can predict, and even control, the style of the source text (see the text box "Is MT Right for You?" on page 180). In these applications, MT also helps to keep the terminology consistent throughout a firm's branches—an important feature in large projects, where product manuals can be thousands of pages long.

Now What?

The written-text MT systems of today will give way to the voice-based systems of tomorrow. Soon special-purpose, speaker-dependent applications will begin to emerge (see the text box "MT at Your Service" on page 160). Progress in this area will depend not only on advances in the MT environment but also on breakthroughs in speech-recognition technology.

On a broader scale, the research that has gone into developing knowledge sources and internal representations for MT is useful in other areas. Progress in MT foreshadows a bigger step toward the general availability of NLP applications. Natural-language analyzers and text generators—key components of MT systems—will be standard software.

The results of MT research are also being used to explore better ways of capturing, representing, and storing knowledge. The basic step that must taken before anyone can use text is to parse it. As general-purpose parsers become available, it will be possible for computers to parse the entire body of knowledge that is stored in the world's libraries. The establishment of an archive holding parsed information available to all would be a boon to scientists who build large knowledge bases—and ultimately to you.

MT has never enjoyed greater public awareness or a more favorable climate of opinion than it does today. If you can't conquer Babel, at least, thanks to MT, you can have a better idea of the knowledge that's available in the world and how you can tap into it. ■

ACKNOWLEDGMENT

Cris A. Fitch, vice president of engineering for Systran Translation Systems; Marjorie León, of the Pan American Health Organization; and Mark Clarkson, a freelance science writer from Wichita, Kansas, contributed to this article.

Muriel Vasconcellos is president of the Association for Machine Translation in the Americas and is a Washington, D.C.–based consultant in translation and machine translation. You can reach her on BIX c/o "editors" or on CompuServe at 71024,123.

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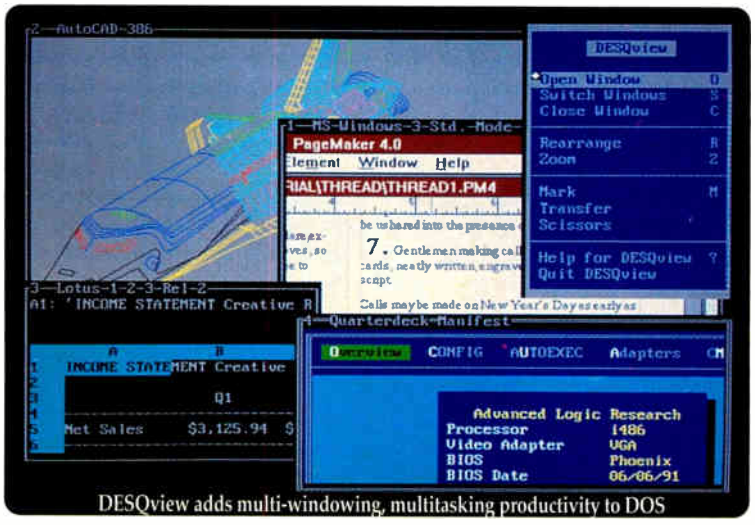
The death of DOS Has been greatly exaggerated

DOS is still the preferred operating system on over 80% of the PCs in Fortune 1,000 companies, according to recent studies.



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* DESQview makes multitasking and windowing available to users of 286-class machines with similar memory efficiencies through QEMM-50/60 for IBM™ PS/@ 50 and 60 users and QRAM for other 286 users.

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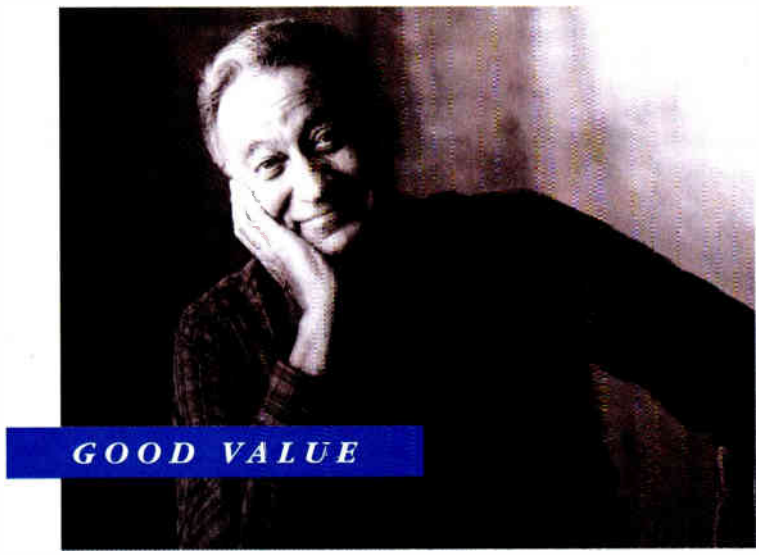
"Sure, I remember my first modem...



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HOW MT WORKS

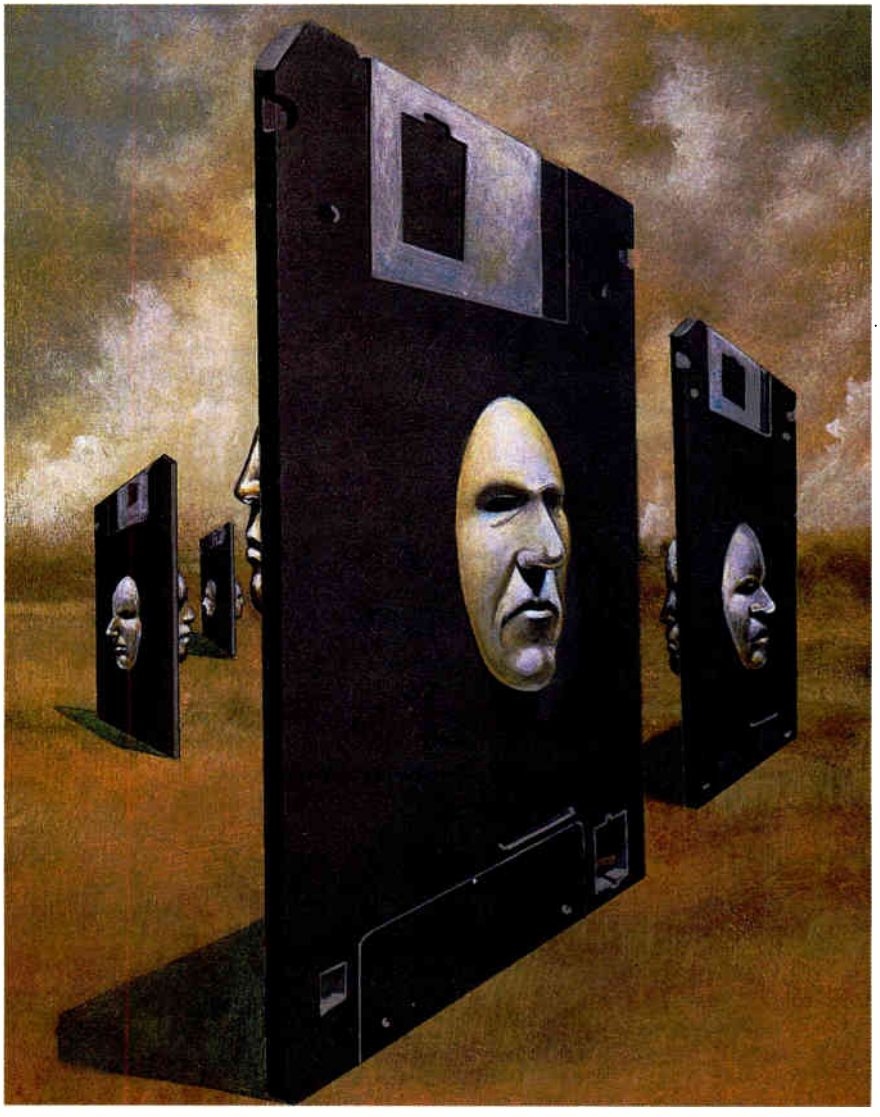
MT systems tackle translation in several ways—each has its own benefits and trade-offs

EDUARD HOVY

Languages are complicated, and this makes translation a formidable challenge. Each language is unique, with elements that make it colorful and special. But that's precisely what makes languages difficult to translate, whether a human or a machine does the job.

For example, the Dani people of New Guinea have only two words to describe color: *mili* for dark cool and *mola* for light warm. How would you tell a Dani store owner, "I prefer the strawberry-red shirt over the pink one"? Fortunately, automated translation is feasible, because some applications (e.g., technical documents) are straightforward. As MT (machine translation) systems evolve, they will take on the challenge of general translation.

MT systems become more complex as you move from the simplest *direct* systems to *transfer* systems to the most complex *interlingual* systems. You can also categorize MT systems another way: those whose knowledge bases are built by humans and those that collect their rules statistically.



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Direct-Translation Systems

Software that translates languages by replacing source-language words with target-language words is called a direct-translation system. Such a translation system is appropriate for applications where you translate text that has a limited vocabulary and a defined style. Direct MT systems contain *correspondence lexicons*, or lists of typical patterns of words and phrases in a source language and the corresponding target-language words and phrases. Depending on the size of the system's correspondence lexicon and on how cleverly the replacement patterns are defined, the

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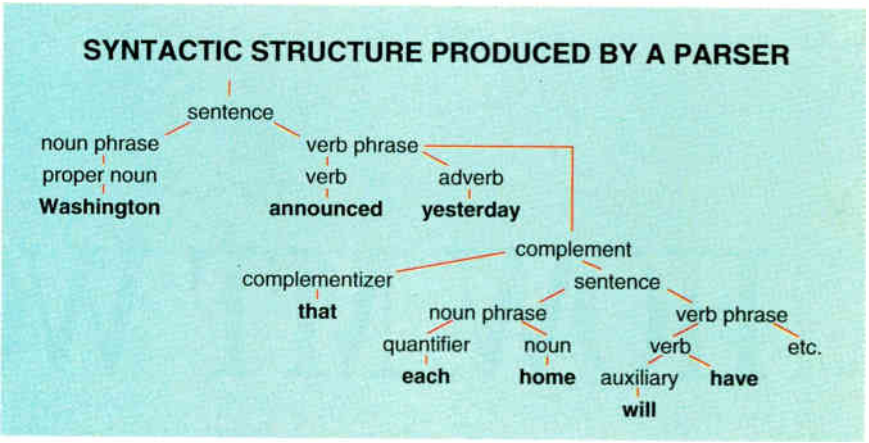

Figure 1: *Part of the syntactic structure produced by the parser for the sample sentence. In the tree, all nonleaf nodes are syntactic categories.*

resulting text is more or less readable in the target language.

Let's say you want to translate the following sentence into German: *Washington announced yesterday that each home will contain an MT system by the end of the decade.* Assume that the system builder hasn't defined *Washington*, *home*, or *MT system* in the lexicon. When the MT system translates this sentence, it places these words unaltered into the target-language sentence. The lexicon produces the German equivalent for the words and phrases that have been defined, substituting *ankündigte* for *announced*, *gestern* for *yesterday*, and *bis zum Ende des Jahrzehnts* for *by the end of the decade*. Untranslated words are bracketed by the system.

The result looks like this: *[Washington] ankündigte gestern dass jeder [home] wird haben ein [MT system] bis zum Ende des Jahrzehnts.* Although the result is horrible German, the sentence is understandable. Most German-speaking people would not have a problem rearranging the words and changing the inflection to come up with a better version: *Washington kündigte gestern an, dass bis zum Ende des Jahrzehnts jeder Haushalt ein MÜ-System haben würde.*

Direct MT systems handle substitution from English to German relatively well, but they have a problem handling other languages. For instance, Japanese requires the addition of several preposition-like particles that indicate the role of each part of the sentence (e.g., subject, object, and cause). The Australian aboriginals combine all the parts of their sentences, including separate markers for tense and number, to form one long sentence-word.

Another problem with direct MT systems is the need for massive lexicons of specific words and phrases. As the systems grow, the lexicons become more cumbersome. It's redundant, for example, to store separate entries for *announced*, *announces*, and *announce*. This problem plagued early direct MT systems, such as Georgetown University's system in the 1950s and the first versions of the Systran from Systran Translation Systems (La Jolla, CA) in the 1960s.

Usually, system builders try to factor out commonalities by creating a root form and rules for variations, but then they must create additional routines to handle the inflection. Most direct MT systems include some analysis of word form and structure. By doing so, they take the first step toward the more sophisticated technology of transfer systems.

Four MT Approaches

- direct translations
- syntactic transfer
- statistical
- interlingual

Syntactic Transfer Systems

Transfer systems use software to analyze the input sentence and then apply linguistic and lexical rules, called *transfer rules*, to map grammatical information from one language to another. The simplest transfer rules specify only the syntactic structure of the sentence (i.e., how it's constructed of nouns, verbs, and other grammatical objects). To identify the structure of the input sentence, transfer systems use software called *parsers*. Although there are hundreds of different parsers and dozens of theories regarding syntax, most parsers would come up with the type of sentence analysis that you see in figure 1.

After creating a parsing tree, the system

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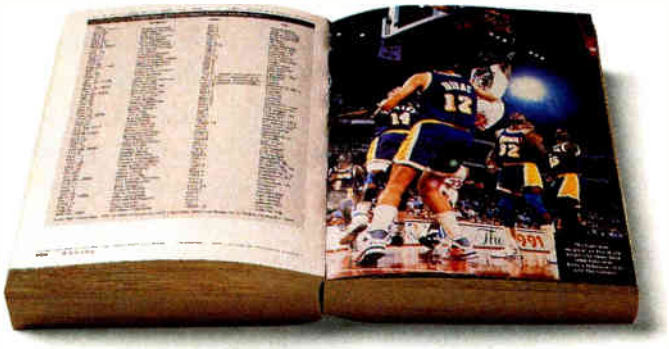

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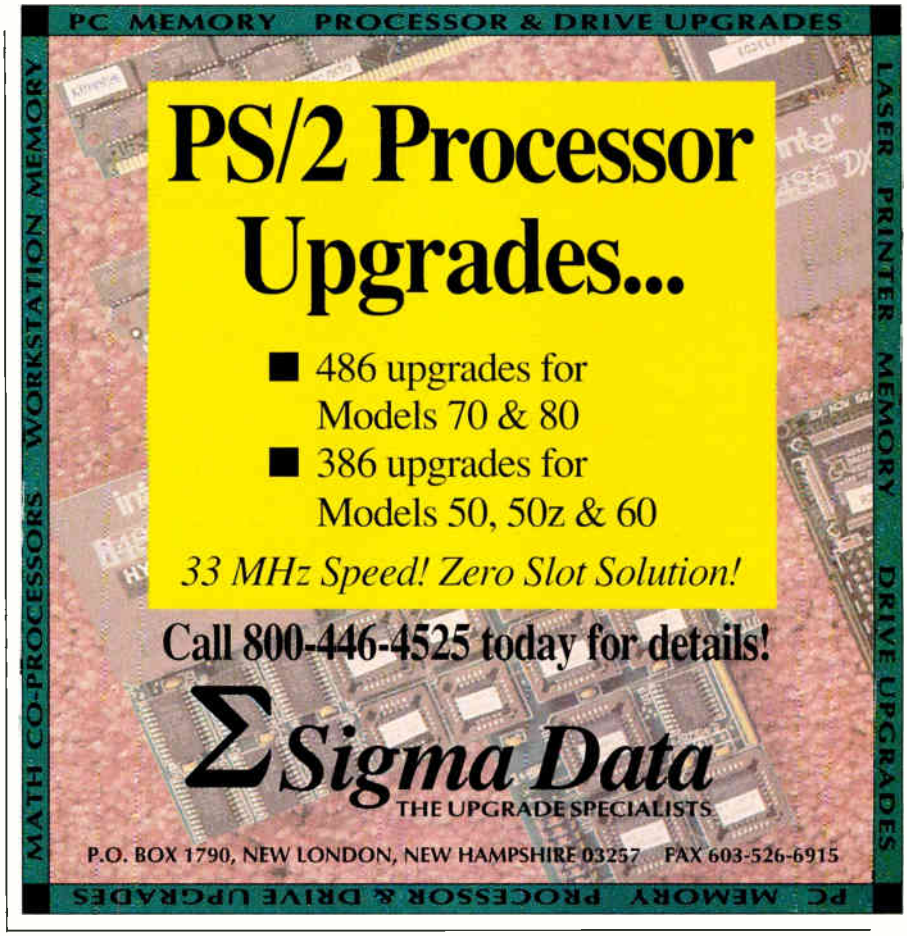

uses its transfer rules to rewrite the tree so that it obeys the syntax of the target language. In figure 1, this mapping is straightforward (it's often more complex), and it produces the output that you see in figure 2. Once the target-language tree has been built, the system's sentence generator builds the sentence, making sure the words are the appropriate tense and number.

It's difficult to delineate where direct MT systems end and where transfer systems begin. Systran, one of the most successful systems produced, began as a direct system and evolved into a syntactic transfer system. Most commercial systems and many prototype systems use transfer MT of varying depths of analysis (e.g., IBM Japan's Shalt [Japanese and English] and Mitsubishi's Meltran [Japanese and English]).

Shallow Semantic Transfer

Although syntactic transfer works well in simple cases, you usually need deeper analysis for better translation. Shallow semantic transfer systems analyze sentences for their meaning.

Researchers in computational linguistics and AI are adept at building software representations called *shallow semantic frames*, which capture the main aspects of the sentence's meaning without going into too much detail. By using representation terms that are tied closely to the words of the source and target languages, system builders construct lexicons of shallow semantic frames.

In the example, after semantic analysis of the English sentence is complete, the system applies its transfer rules to rewrite the resulting frame into one suitable for German. The rules specify appropriate substitutions, operating on frame items instead of grammatical classes. Even though the resulting German-oriented frame looks similar to the English one, in general, shallow semantic frames differ between languages.

System developers also build programs called *analyzers*, which identify the appropriate representation terms for each word or phrase and assemble the terms into a coherent structure. The analyzer often contains a parser, and sometimes it uses the parser as a front end.

Next the system must generate the natural language from the computer's internal data. Semantics require more generator sophistication: The generator has to find appropriate target-language words for the semantic frames it encounters.

In simple systems, each frame has just one lexical item, but in more complex systems, a semantic primitive may be linked to several alternative lexical items. For example, *announce-act* may be expressed with the word *state*, *proclaim*, or *say*. To make a decision in such cases, the generator requires more information on the formality of the text, the relationship between the author and audience, and the style.

Many recent systems perform semantic transfer and are implemented on single or multiple workstations, although the goal in many cases is to eventually shift them to personal computers. These systems include Logos (Logos, Mt. Arlington, NJ), Metal (Siemens Nixdorf, Munich, Germany), and Astransac (Toshiba, Kawasaki, Japan). Astransac operates on Toshiba's personal workstations, and Metal operates on multiuser workstations, using a Lisp environment server in the background.

In recent years, groups at the University of Kyoto (Japan) and the University of Manchester (U.K.) have started developing example-based MT systems. This software blends the two approaches, using the direct approach for stereotypical phrases (e.g., greetings) and a variant of the transfer approach in other cases.

Semantic Representation

Constructing valid representations of meaning is difficult—terms can't be combined

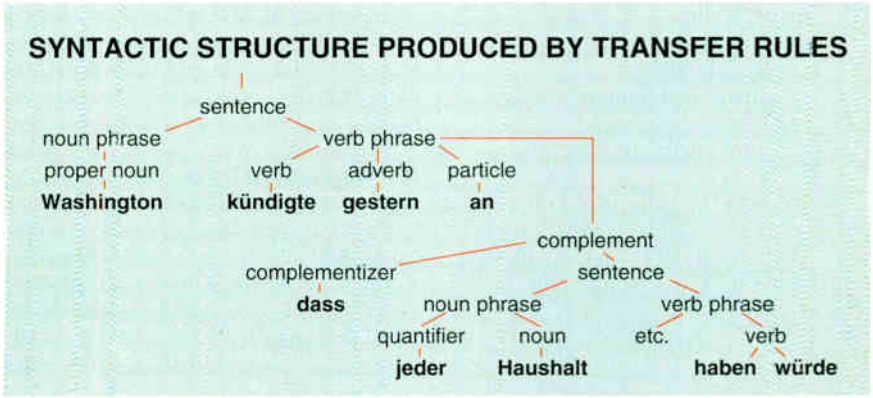

Figure 2: *Part of the syntactic structure produced by the transfer rules from the tree in figure 1. Notice the movement of the embedded verb to the end of the sentence.*

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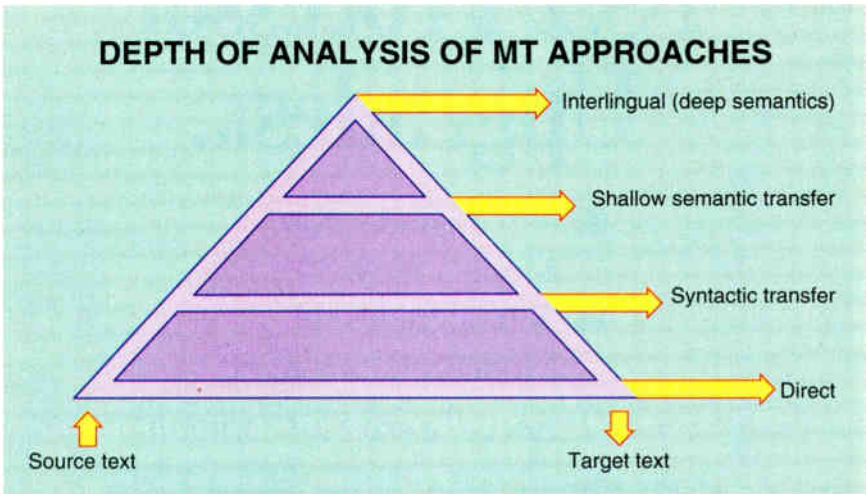

Figure 3: *The approach taken in an MT system is correlated with the amount of analysis performed on the input sentences before they are translated. Direct systems perform little analysis, while interlingual systems construct complex internal representations of the meaning of the input.*

willy-nilly. Each term must be chosen with care, because it limits what other terms can be used. A wrong choice can mean that an aspect of the sentence can't be represented. In this case, the sentence would have to be analyzed again.

Consider the clause "each home will have an MT system." In what sense will each home have an MT system—the way one has an arm, a child, an idea, or a car? Languages such as Hungarian, which make more delicate distinctions than English and have different words for these senses of *have*, need more precise information.

In a simplified shallow semantic notation, the sentence of the earlier sample would be as follows:

```
announce-act
   actor: Washington
   act-time: yesterday
   announcement: possess-state
        actor: home
             quant-determination: every
        object: MT system
             quant-determination: single
        state-time: decade
             meas-determination: end
```

Notice how the verb *have* in the sample sentence is represented as *possess-state*. The semantic lexicon entry for *have* contains a pointer to several possible meanings, including *possess-state*, *think-act* (i.e., the act of having an idea), and *parent-state* (i.e., the act of having a child). Each of these meanings is a frame with empty slots labeled *actor*, *object*, and *time*.

Each slot contains information that specifies the kinds of frames that can fill the slot. For example, the *object* of a *possess-state* must be a nonhuman physical object. Thus, neither an idea, which is defined as a nonphysical object, nor a child, which is a human, can be objects of *possess-state*. Conversely, the verb *have* must be represented as *possess-state* when it is applied to a physical object. Although the matter is not as simple as I have described it here (see the text box "The Five Layers of Ambiguity" on page 174), most analysis programs work along these lines.

As analysis of the source language goes deeper, it becomes more semantic, but generation back to the surface becomes more difficult. Fortunately, at least one function becomes easier for the system to perform: The amount of transfer required by the transfer rules decreases—the end point of analysis approximates the starting point of generation. This diminishing distance is illustrated in figure 3, which shows an arrangement of MT approaches along a gradient of increasing depth of analysis. More and more, the internal representations approach the ultimate goal: deep semantics, or language neutrality.

Interlingual Systems

Interlingual systems are software programs that translate text using a central data-representation notation called an *interlingua*. These systems have been experimental prototypes, usually written in Lisp and run on workstations. The East Asian consortium CICC (Center of the International Cooperation for Computerization) has been building an interlingual system since 1987, working with groups in Japan, China, Thailand, Malaysia, and Indonesia.

In the U.S., recently developed interlingual systems include KBMT at Carnegie Mellon University (Pittsburgh, PA), Ultra at New Mexico State University (Las Cruces, NM), and Pangloss, which is being jointly developed by the aforementioned universities and the University of Southern California's Information Sciences Institute (Marina Del Rey, CA). CICC and Pangloss systems run on multiple chained workstations. Systems like these should be available on personal computers by the end of this decade.

Constructing a set of transfer rules is tedious, but constructing an interlingua powerful enough to represent all the information every language may require, with the appropriate analysis and generation rules, is much more difficult. Consider the sample sentence again. Humans immediately realize that the word *Washington* is shorthand for "an announcer for the U.S. government" (this type of shorthand is called *metonymy*). A deep semantic representation must explicitly reflect this fact, because some languages may use different verbs for *announce*, depending on whether the announcer is a person or an official notice or bulletin.

Interlinguas must handle many phenomena similar to metonymy. In the example, the past tense reflected in the word *announced* means that the announcement took place before the author wrote the text. In general, in an interlingua, what is expressed by verb tense in English becomes a complex theory of temporal relationships involving the event, the text production, and the perspective the author takes on the event. Similarly, the meanings of words such as *this*, *that*, *all*, *every*, *the*, and *a* become a theory of how definite, unique, and near the object is to the author.

The meanings of these microtheories must be worked out and represented, and the values for the meanings must be associated with the words of the languages that express them. Although no analyzer has yet incorporated many microtheories of phenomena, most semantic analyzers contain rudimentary versions of them for common phenomena (e.g., time and focus).

The same increased complexity carries over to the generator. Given the semantic nature of an interlingual representation, a sufficiently powerful generator can usually produce several paraphrases of the input sentence.

Interlingual vs. Transfer

A debate is raging over which is the better approach—interlingual systems or transfer systems. Interlingual systems are criticized because they require more detailed analysis than is necessary for any language

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The Five Layers of Ambiguity

BERNARD E. SCOTT

Computers stand up well to a grand master when it comes to the logic of chess, but they can't match the skills of a 7-year-old when it comes to language.

The reason for the glacial pace of progress in MT (machine translation) over the past four decades can be found in one factor: the intractable ambiguities of natural language. An MT system must peel away at least five layers of ambiguity before it is able to map sentences from one language to another with any degree of accuracy (see figure A). If you understand how MT copes with these difficulties, you will have a clear idea of just how these systems work and why they do not work better.

Step Inside the Beasty

Step inside an MT system and see how it handles the following simple sentence: *The heavy-duty truck turned into a driveway.* As you follow this sentence through the system, notice how nearly every other word poses a challenge—and an opportunity for error.

When the system looks in the dictionary for the word *truck*, it immediately encounters ambiguity: The word is encoded in the dictionary as both a noun and a verb. The system's dictionary can tell you only that *truck* can take the form of two parts of speech. It can't tell you which form it takes in this sentence.

To make that determination, you must move further into the system and view the word in the context of the sentence. At this point, the system still has no idea what the sentence means and sees it only as a syntactic string containing elements that have more than one interpretation.

To operate at the sentence level of the syntactic stage, you must have some kind of grammar—typically stored as a set of rules. One of these rules will determine that, in the given sentence, without violating grammatical rules, *truck* cannot be anything but a noun. So far, so good—although it is not always going to be that easy.

Now that you know that *heavy-duty truck* is a noun phrase, a second layer of ambiguity comes to light. The system still sees your noun phrase purely syntactically, as the string Adj N1 N2. It has no idea, for example, whether the adjective *heavy* modifies *duty* or *truck*. The system has to resolve this ambiguity if it's to get the agreement right. Therefore, you have to go beyond syntax into lexical semantics.

The Next Stage

At this deeper stage, more intelligent rules come into play and use the semantic properties that were retrieved for the words earlier in your sentence during the dictionary lookup stage. These semantic-property codes are designed to resolve ambiguities such as that posed by *heavy-duty truck*. Now you're going to run into some rough going.

The majority of low-end MT systems don't get into semantics—or they do so only in trivial ways. These systems generally are weak, but even high-end systems will have trouble trying to figure out which noun *heavy* modifies. The issues are subtle. At this point, most developers will resort to brute force by storing the phrase as a unit in the dictionary.

Slightly more tractable examples of this kind of ambiguity would be *old people and children* and *smart girls and boys*. If a smart rule uses a test for semantic symmetry (or lack thereof) among the noun pairs, it could figure out that the adjective *old* modifies only *people* and that *smart* modifies both *boys* and *girls*. Clearly, getting a machine to cope with this challenge isn't easy.

Processing at the lexical semantic stage introduces its own kind of confusion—the third layer—having to do with multiple meanings of words. For example, the verb *turn into* has at least two lexical meanings: One is the sense of motion, and the other is the sense of becoming. To decide which meaning applies in your sentence, you have to move to sentence-level semantics, where the verb *turn into* can be examined in its semantic context.

A semantic rule associated with the words *turn into* would know that the meaning of this verb is going to be a function of the verb's direct object. So, in this sentence, the rule has to test only the semantic-property code for *driveway* to determine the verb's meaning: If *driveway* were given a semantic-property code signifying a path, the rule would know to select the verb's motional sense. Such a rule would work with Cinderella, too, if her carriage turned into a driveway rather than a pumpkin.

Going for the Gold

A fourth layer of difficulty has to do with ambiguities introduced at the sentence level of the semantic stage. Unfortunately (or fortunately), the sample sentence doesn't illustrate this kind of complexity. But to get the idea, consider the meaning of the preposition *for* in the following sentences: Check the newspapers for errors. Check the newspapers for dates.

In the first sentence, the preposition *for* signifies *for the presence of*, and in the second sentence, it means *for information about*. As used in this example, in a language like Vietnamese, the preposition *for* would be expressed differently in each case.

Thus, the system has to determine which case applies if it's to translate the meaning correctly. You can see that the meanings of the word *for* are a function of the sentence as a whole; you won't find them in any dictionary. Also, notice how the sentence as a whole affects the meaning of the verb *check*. In the first sentence, *check* means to examine. In the second, *check* means to consult.

A fifth layer of ambiguity concerns more technical issues, such as ellipses and anaphora (e.g., antecedents of pronouns). This level of translation sophistication calls for processing at a

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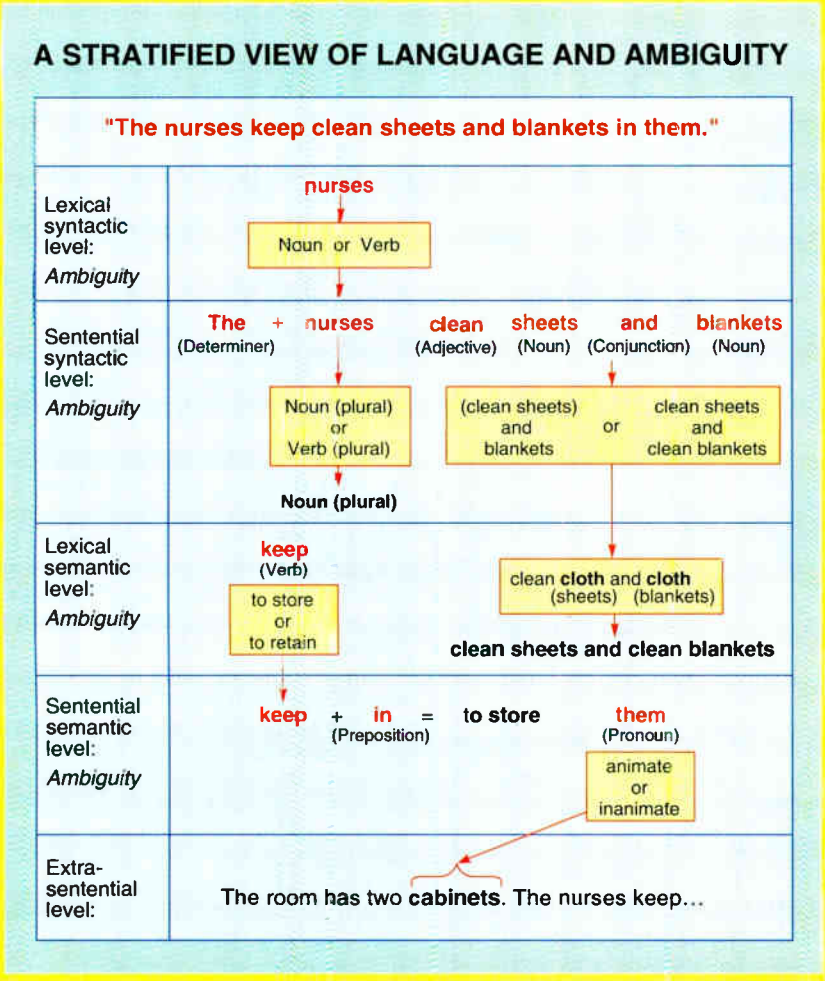

Figure A: *MT systems are composed of one or more levels of parsing sophistication (going from syntactic to semantic). A simulated, advanced, multilevel system such as this one might determine the meaning of each word or phrase in the sentence (i.e., parse the sentence) by posing and/or resolving questions, eliminating ambiguity as the words or phrases move through the various levels in the system.*

discourse level—something few systems can do.

But don't worry. MT systems are steadily becoming more robust. The key is semantics. As the semantics of these systems improve, so will the power of the systems to dispel ambiguity and, in the final analysis, to translate.

Bernard E. Scott is the head of his own consulting agency, Parse International (Ledgewood, NJ). Previously, he founded Logos (Dedham, MA) and was the principal architect of the Logos MT system. You can reach him on BIX c/o "editors."

pair. Why bother resolving the "Washington" metonymy when English, German, and French all say it the same way? Depending on the flexibility of the interlingua itself, however, this complaint is not always valid. In most systems, the analyzer is free to fill in less detail, and as long as the generator doesn't fail, the translation proceeds satisfactorily.

A major advantage that interlingual systems have over transfer systems lies in the number of rules used. A three-language transfer system, for example, requires transfer rules between languages A and B, A and C, and B and C in both directions—six sets of rules altogether. Adding another language involves creating rules to and from the new language to each of the first three languages, bringing the total to 12 sets of rules. In general, for n languages, you need $n \times (n\text{-}1)$ sets of rules. That number can grow prohibitively large, because modern commercial MT systems have lexicons of over 150,000 words and grammars of several hundred rules.

Interlingual systems deal with this challenge by creating one representation midway between all the languages. Analyzers and generators have to work harder to reach this interlingual representation, but less human effort is required to construct the transfer rules.

Adding a new language to an interlingual system involves just two sets of rules: the analyzer's rules for going from sentences in the new language to interlingual representations and the generator's rules for going from interlingual representations to sentences in the new language. Because of the language neutrality of the interlingua, the analyzer does not require information about what the target language will be, nor does the generator have to have information about what the source language was.

Statistical Systems

Whether the MT system is interlingual or transfer, it requires large lexicons and rule sets to ensure that it will be robust when handling new text. In direct MT, you can encode information in dictionaries, phrases, and words; in transfer systems, you can place the data in grammars, lexicons, and transfer rules; in interlingual systems, you can locate the information in representation ontologies and lexicons.

The work required to create these resources by hand is daunting. As a result, in the past few years, there has been a resurgence of attempts to acquire the requisite information automatically.

What makes statistical systems different isn't so much how they perform translation but how their correspondence lexicons are

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constructed—automatically, not by humans. For a computer to create a correspondence lexicon, there must be two duplicate sets of a large amount of text—one set in each language. One such body of parallel text is the parliamentary record of the Canadian government. It contains several years' worth of representatives' debates in both English and French. Approximately 3 million sentences of this text are on-line.

Given such a mass of information, you can build programs to line up, as accurately as possible, each word in each sentence with its foreign counterpart. Recent alignment algorithms achieve over 90 percent accuracy. The result of such an alignment can be thought of as a bilingual correspondence lexicon of words and phrases.

Once the alignment algorithm has constructed the correspondence lexicon for the system, translation is effected by direct substitution, followed by a process of reordering the words to achieve good grammar. The reordering is performed using statistically derived rules regarding the probable order of words in given contexts.

Breeding Hybrids for Strength

The various approaches to MT theory have crystallized into a smooth continuum from direct systems to interlingual systems. The strengths and shortcomings of each approach are well understood. It's unlikely that new developments will uncover a magic formula that will make MT easy.

Recent developments in the Candide system from IBM (Hawthorne, NY) show that it's possible to create hybrid statistically based transfer systems. In such hybrid systems, the correspondence lexicon contains not only words and phrases but syntactic terms that represent time, number, and part of speech.

Statistically based systems require several mainframes to build and store their correspondence lexicons. They also need millions of sentences of parallel text containing the words to be translated. Given their capabilities and resources, however, hybrid systems are one way to minimize the human effort required in lexicon, grammar, and rule construction.

In the future, all major MT systems will be hybrids of one kind or another. Statistical lexicons and rule acquisition will provide the raw material that will be incorporated into MT systems, using increasingly powerful interlingual theories of meaning, pragmatics, and style. ■

Eduard Hovy is a project leader at the Information Sciences Institute of the University of Southern California. You can reach him on BIX c/o "editors" or on the Internet at hovy@isi.edu.

Circle 105 on Inquiry Card (RESELLERS: 106).

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If you're looking for a computer that will grow with your needs, there are basically only two ways you can go.

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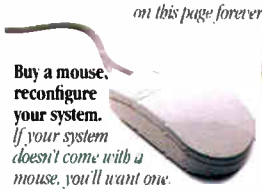
The hard way.

Add networking card, reconfigure your system. *To share files and send e-mail to other PCs, you may have to add a card. This means going through the long, tedious process of reconfiguring your system. On a Mac, you just plug in a cable.*

Upgrade your memory, reconfigure your system. *Add memory to a Mac, and it reconfigures itself accordingly. But add memory to a PC, and you'll almost always have to run a setup program to configure the new memory – or the computer won't know what to do with it.*

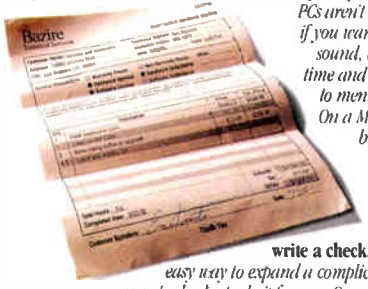
Add almost anything, reconfigure your system. *Expanding your PC's capabilities can be amazingly frustrating. But a Macintosh easily adjusts to whatever extra device you add to it.*

Add Windows, buy a new PC. *Most PCs in use today weren't designed for graphical computing. So if you want to run Windows, you may have to buy a new computer. Why not consider a Macintosh and avoid all the problems on this page forever?*



Buy a mouse, reconfigure your system. *If your system doesn't come with a mouse, you'll want one. But first be prepared to install and configure a special software driver. (No need with a Mac – you just plug it in.)*

Play and record sounds, reconfigure your system. *Multimedia promises to be the future of computing. But most PCs aren't ready for it. So if you want to work with sound, it'll cost you time and trouble – not to mention money. On a Mac, sound is built in.*



Call for help, write a check. *There is one easy way to expand a complicated PC – hire somebody else to do it for you. Over time, of course, that can wind up costing you more than the PC.*

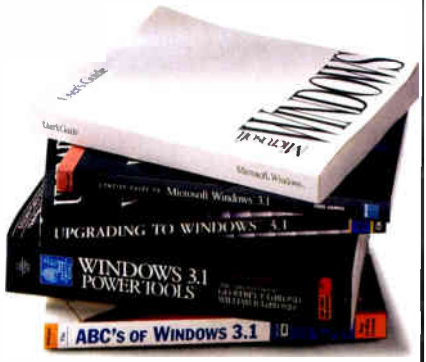
Add peripherals, reconfigure your system for each one. *Want to add a CD-ROM or hard disk drive? Then prepare to spend hours installing cards, flipping switches and editing files – for each one. With a Mac, you can add up to seven peripherals by simply plugging them in and clicking a button or two.*

Add printer, adjust DIP switches. *Hooking up a printer seems easy. Until you set your DIP switches, install your driver, locate your Windows diskettes, make an error and start all over again.*

Expand your PC, take two aspirin. *Inevitably, you'll want to expand your computer's capabilities by adding extra devices. The more instructions you slog through and switches you fiddle with, the more time it will take. And the more pain reliever you'll need.*

Change monitors, reconfigure your system. *Add a new monitor, and you'll have to reconfigure your entire system – or your monitor could look like this one. A Mac recognizes a new monitor and adjusts to it automatically.*

Whoops! *When you add something to an ordinary PC, you may have to "reconfigure" your system – a process of hardware and software adjustments, which can be complex, tedious, and take up hours of your time.*



Manual labor. *Software like Windows purports to make things easier. But the reality is, you'll still spend hours reading manuals just to make it all work – time you could spend doing more useful things with your computer.*

On a typical PC, even adding a simple hard disk can be extraordinarily complicated. You'll probably have to "reconfigure" your system – the time-consuming process of telling your computer what pieces you've added. You may have to edit complex CONFIG.SYS and SYSTEM.INI files, install special device drivers and fiddle with DIP switches. And, of course, building even a basic network is extremely difficult – what with installing

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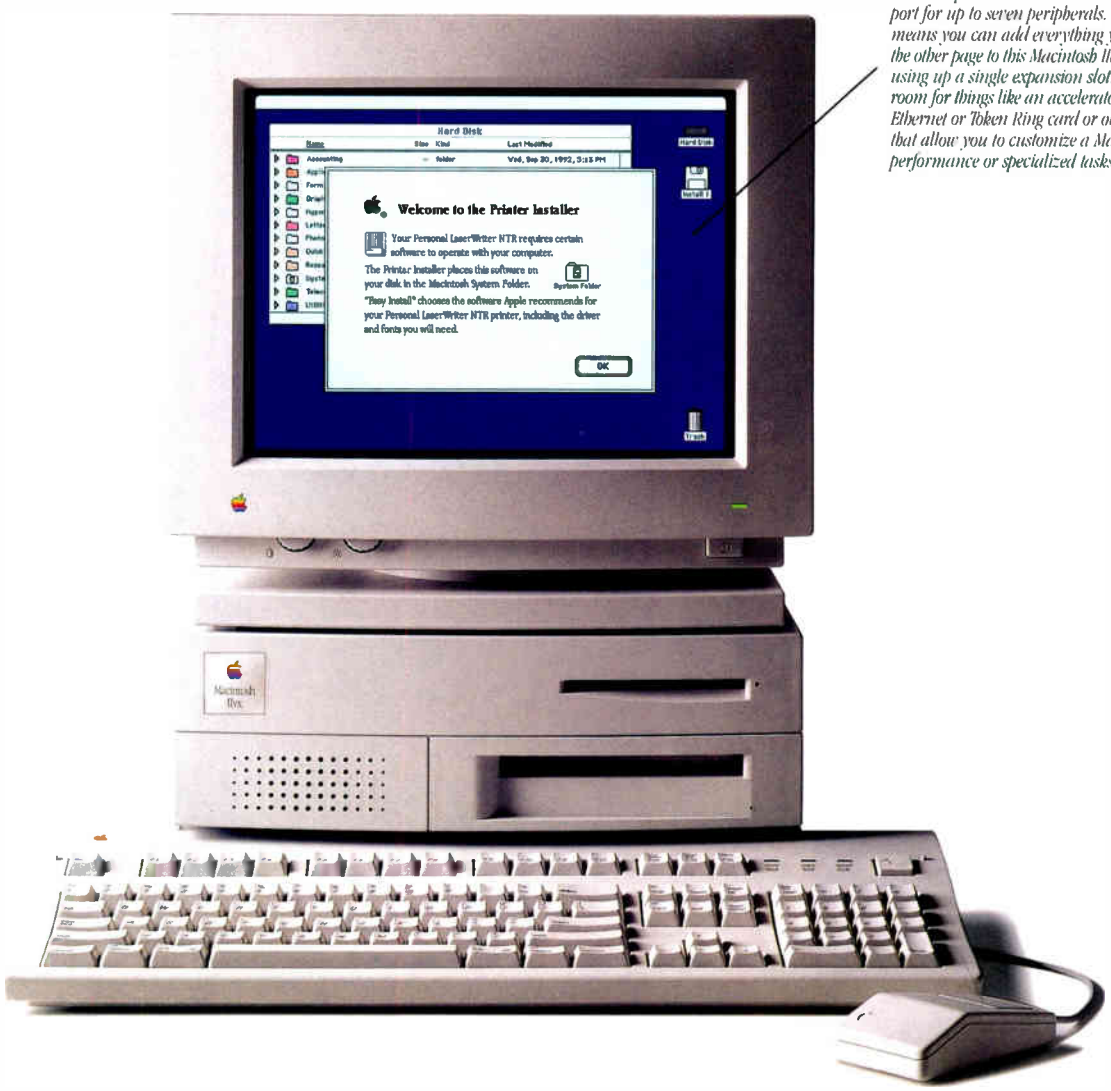
The easy way.

Macintosh *is designed to make it easy to grow. Networking and sound support are already built in. File-sharing and multimedia capabilities are standard. So is support for up to seven peripherals. Which means you can add everything you see on the other page to this Macintosh IIvx without using up a single expansion slot. Leaving room for things like an accelerator card, an Ethernet or Token Ring card or other cards that allow you to customize a Mac for high-performance or specialized tasks.*



cards and networking software. An Apple® Macintosh®, on the other hand, knows when you've added a hard drive. Installing a CD-ROM drive or scanner is a matter of plugging in a cable and clicking a couple of buttons. Even installing a network requires nothing more than plugging one Mac® into another. It's just one more example of how a Macintosh works in a simple, logical way. So you can, too.

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If you know how to use a plug, you know how to expand a Macintosh.

This Macintosh IIvx has built-in monitor support for up to a 14" color monitor. Buy a card, and you can add a second monitor—significantly enlarging your desktop work area so you can move documents, files and folders across both screens.

Plug in an AppleCD™ 300 CD-ROM drive, and you'll have access to huge libraries of reference sources, fonts, clip art and video images on CD. (It even supports Kodak's exciting new Photo CD technology.)

A Mac gives you professional-quality documents even if you're on a student budget. Just plug in an Apple StyleWriter™ printer.

You can easily record sound into every new Macintosh computer. Most even come with a microphone.

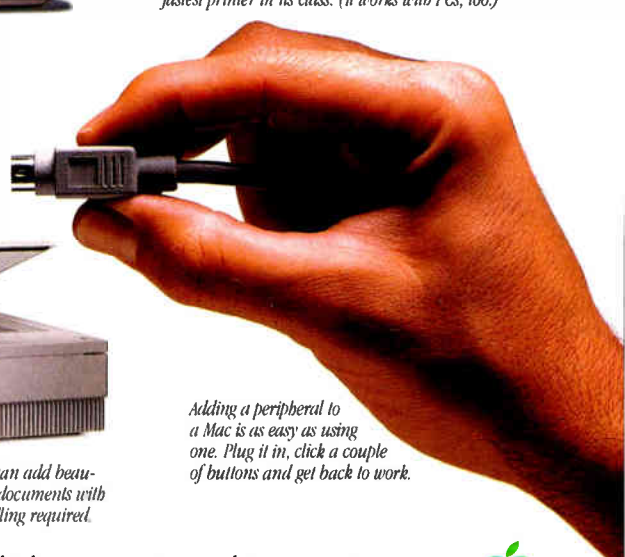
Plug in an Apple Personal LaserWriter™ NTR, and everyone in your workgroup will have access to the fastest printer in its class. (It works with PCs, too.)

Plug in a SyQuest drive, and you'll have virtually unlimited hard drive storage via removable 44MB or 88MB cartridges.

Plug in an Apple LaserWriter IIg, and everyone on your network will instantly be able to take advantage of the Apple PhotoGrade™ technology that rivals 800 dpi printers costing thousands more—for spectacular-looking documents.

Plug in an external hard drive or other storage device, and you increase your storage capacity in seconds.

Plug in an Apple OneScanner,™ and you can add beautiful black-and-white photographs to your documents with one touch of a button. No fussing or fiddling required.



Adding a peripheral to a Mac is as easy as using one. Plug it in, click a couple of buttons and get back to work.

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BABELWARE FOR THE DESKTOP

Personal computer and workstation translation software offers you the most affordable access to MT

L. CHRIS MILLER

Now that personal computers and workstations are powerful enough to run MT (machine translation) software, many MT products are becoming available for the desktop. Some applications have migrated from the mainframe; others are new and are designed for desktop use.

MT software for personal computers translates language sentence by sentence, using AI or linguistic rules to deal with syntax and grammar. Sets of rules or algorithms enable verb conjugation, syntax adjustment, gender and number agreement, and word reordering.

MT software will process your document in either a batch mode or an interactive mode. The interactive mode might ask you to choose among multiple translations of a word or allow you to choose from a list of synonyms, or it may translate one sentence at a time and pause to let you postedit the output on-line (see screen 1).

Retail prices for these packages range from $79 to $1200. The languages that are available include Arabic, Danish, Dutch, Finnish, French, German, Greek, Italian, Japanese, Korean, Russian, Spanish, and Swedish. Translation software for Portuguese, Chinese, and Norwegian is being developed. The software is generally sold in *language pairs* (e.g., Spanish to English or English to Spanish). The Language Assistant Series 5.0 from MicroTac Software (San Diego, CA) and GTS-Basic 1.0 and GTS-Professional 3.0 from Globalink (Fairfax, VA) are sold in bidirectional units (e.g., Spanish to English and English to Spanish).

Toltran (Barrington, IL) uses a patented modular-language-translation concept for its Professional Translation System 2.0.

continued

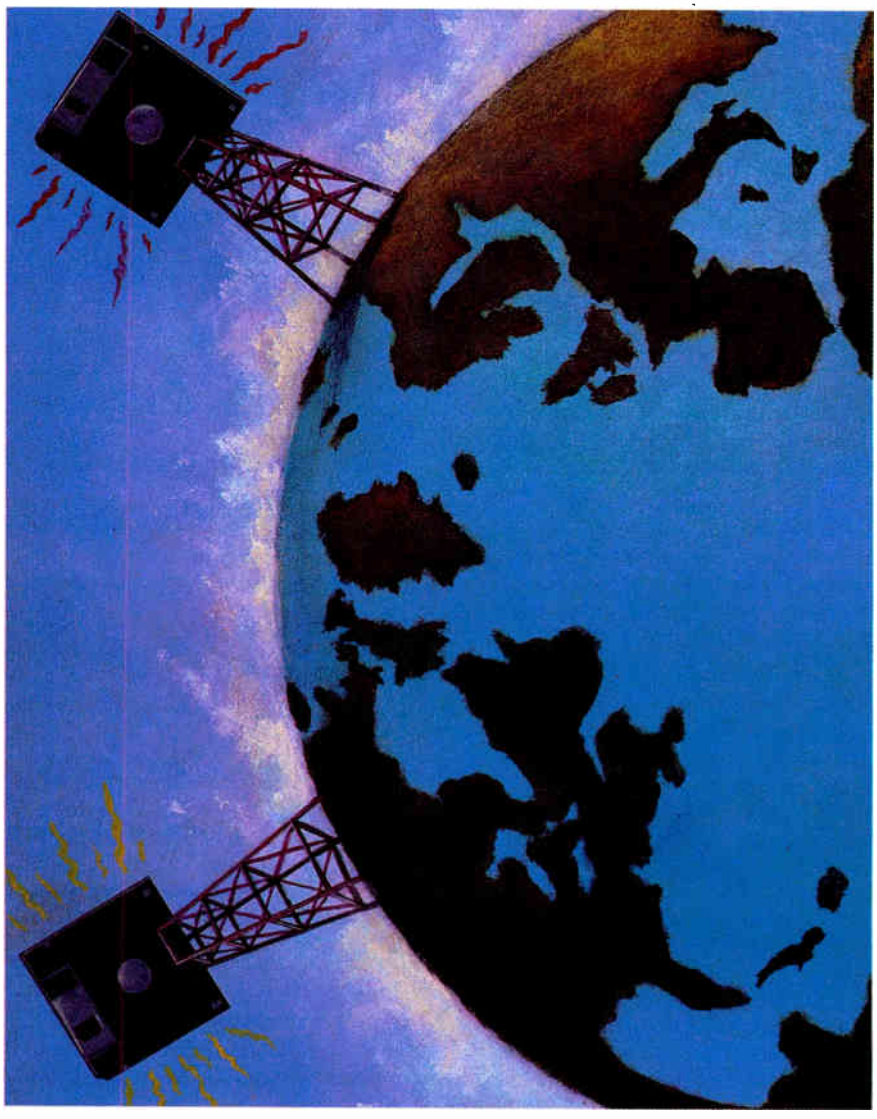

ILLUSTRATION: GREG RAGLAND © 1993

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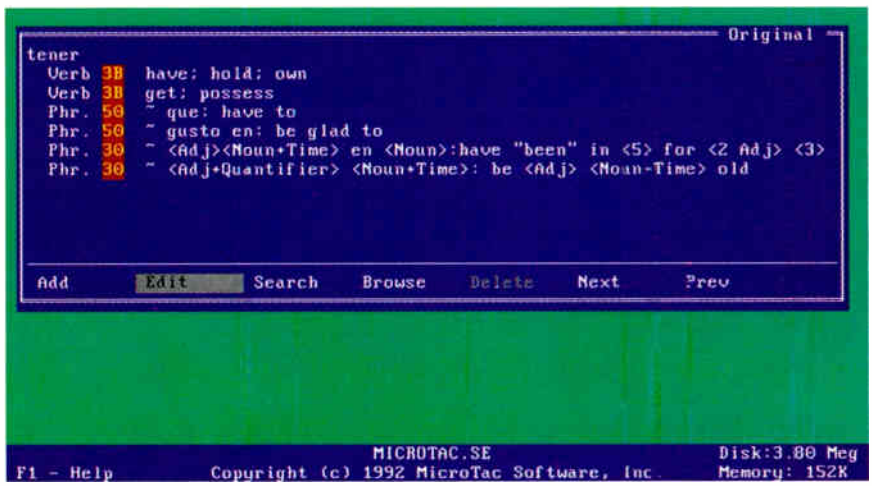
Screen 1: *This sample of an on-line translation using MicroTac Software's Spanish Assistant shows the original Spanish sentence in the upper left box and the English translation in the upper right box.*



Screen 2: *The dictionary coding for the verb* tener *(which is Spanish for* to have*) includes the part of speech (verb); the morphological rule code (3B), which determines conjugated forms of the verb; and the translations of the verb. Rules for advanced pattern matching (e.g., noun + time) are encoded to enable the computer to correctly translate the verb in various phrases.*

In this approach, a language is sold as either a source-language module or a target-language module. Any source-language module can be translated into any target-language module.

MT software for personal computers typically runs under MS-DOS and requires 640 KB of RAM and from 1.5 to 15 MB of space on your hard disk. You must have a VGA card and a VGA monitor to translate languages with graphical characters (e.g., Russian and Japanese). For example, EJ Bilingual (Torrance, CA) requires one expansion slot for the KanjiBoard included with EZ JapaneseWriter 1.09.

Mac owners have limited options. The Translator 2.0 by Catena (Tokyo, Japan) runs on a Mac using a Japanese operating system called KanjiTalk. Unfortunately, the only way to run many MT software packages on a Mac is by using a DOS environment emulator, such as Insignia Solutions' (Mountain View, CA) SoftPC. Under these conditions, the software will run much slower than in a true DOS environment.

The translation speed varies from 10,000 to 30,000 words per hour on a 16-MHz 386 computer. The smaller programs can easily be placed in RAM to increase the speed. The translation process may become faster if the software is temporarily storing previously found words in a buffer or in RAM.

MT Possibilities for Your Desktop

All MT products for personal computers allow you to send ASCII text files to be read and translated. Some systems link directly to your word processing programs via a menu to simplify the conversion of text to and from ASCII files. A few systems can process WordPerfect and other leading word processor files. And several companies offer products that retain the formatting codes of the original document. This is an important timesaving feature, because attributes such as boldfaced type, underlining, and chart and table formats are restored in the output.

The quality of your output is dependent on the dictionaries (sometimes called *lexicons*) that are included in the software. A core, or general, single-word dictionary (i.e., one with 20,000 to 80,000 canonical terms) is standard. Most programs also include a multiple-word dictionary that stores phrases and idiomatic expressions.

A Different Kind of Dictionary

MT dictionaries provide grammatical information regarding the use of words and phrases. The computer uses the information to enact the rules or algorithms necessary to convert the text in the source language into intelligible output in the target language (see screen 2). Subject-specific dictionaries are available for technical areas, such as finance or law.

If you regularly translate documents from more than one technical area, you'll find it useful to have a feature in your system that allows you to stack dictionaries. This enables you to define the search order according to the text you are translating. PC-Translator by Linguistic Products (The Woodlands, TX) allows you to stack up to 10 single-word dictionaries and 10 phrase dictionaries.

Creating your own dictionary or customizing the one included in your software

Key Features of Desktop MT

- available for PC, Mac, and Unix platforms
- applications have migrated from mainframes
- works in batch mode or interactive mode
- provides good dictionaries

Future Enhancements

- more variety of products
- more sophisticated technology
- additional language pairs

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Is MT Right for You?

MURIEL VASCONCELLOS

You need to keep several points in mind when deciding if MT is right for you. First, you must determine if you have an application for which MT is appropriate. It's important to pick your application and then decide on your system rather than vice versa.

Costs soar when the input isn't in machine-readable form, and an OCR (optical character recognition) device, while helpful, isn't a panacea. If your documents aren't in electronic form, you may want to think twice about using MT. In addition, there should be a large volume of material (e.g., 100,000 words per month) to be translated, with the expectation that more will be coming from the same source. In the beginning, there should be only one domain (i.e., subject matter); you can branch out later as you become more familiar with all the ins and outs.

Your decision to use MT will hinge, in large part, on the format, volume, and linguistic characteristics of the source-language text. The text should contain no ambiguities.

Hardware and Human Factors

You need a hardware platform that an MT system will run on. In a multiuser setting, you must be sure that there is good word processing support and that all the users have strong word processing skills. Multitasking workstations designed for translators are helpful.

Be sure to recruit people who have a positive attitude about using MT. This is especially important during the first few months while you are getting your system up and running. This stage involves customizing the dictionaries and gaining proficiency in postediting.

Your choice of a system will depend on the characteristics of your application, so it's important to identify criteria that are specific to your needs. And don't be tempted to buy software just because it's inexpensive. As with a house pet, the price you pay up front is a drop in the bucket compared to the cost of the care and feeding for the rest of your mutual lives. For example, a less expensive system might cost more in terms of support personnel and customer support (some MT companies charge you for it). Also, if your time frame for translations is tight and if your budget for human intervention is limited, it's crucial that you test the system's performance on randomly selected texts.

Despite decades of scientific study, the evaluation of translations is an uncertain exercise. The definition of an error will vary, depending on the purpose of the translation and the values of the end users. Errors in raw output are important mainly to the analyst, who knows the inner workings of MT systems and can classify the error types according to their causes. Such an analysis can tell something about the system's potential and the effort that will be required to fix and to maintain it. You should make sure that you compare outputs from different systems produced under the same conditions.

The value of a system depends on its potential to grow and to improve its performance, as well as how easy it is to use and to maintain. It's important to know the language combinations that have been developed for the system, the size of the dictionaries or knowledge bases, the ease with which you can add to the dictionaries, and the possibilities of extending the system to include the domain that you are interested in.

Muriel Vasconcellos is president of the Association for Machine Translation in the Americas and is a Washington, D.C.–based consultant in translation and machine translation. You can reach her on BIX c/o "editors" or on CompuServe at 71024,123.

is essential with any MT product for personal computers, because it lets you add your own terminology to the program. PC-Translator simplifies the creation of your own dictionaries by importing lists of terms in ASCII format directly into the software. In addition, MT software generates lists of words not found in a given text to help you customize your software. You decide which words and phrases to add to the dictionaries. The ability to add, delete, or modify dictionary entries dramatically improves the quality of a translation and reduces the time spent postediting an output. You'll find that it can take from two to four weeks to customize a system.

All these systems ask you to insert the part of speech of the word you are adding and to provide its translation. With extensive dictionary coding, the system can deal with ambiguities that arise from the use of words that can take the form of multiple parts of speech. For example, the program will recognize the different translations of a homograph (i.e., a word that is spelled like another but has a different meaning or pronunciation) used as a verb and as a noun in the same sentence (e.g., "The can can explode"). Because Globalink's GTS-Professional can classify *can* as both a verb and a noun, it's better able to translate the sentence than a product that requires less dictionary coding.

Workstation-Based MT Products

MT workstation products are designed to handle heavy volume—when you have to translate 2000 or more pages of text per year. Translation speeds range from 20,000 to 1 million words per hour.

A workstation MT system is a large investment. Software prices start at $10,000. A system can cost several hundred thousand dollars, and pricing structures are as diverse as the possible configurations.

Socatra (Quebec, Canada) spent over 12 years preparing its XLT computer-assisted translation system for the commercial market. Access to XLT is uniquely controlled by the company. Socatra rents software for a specific number of words. After you pay an initial subscription, Socatra provides you with the software and an access card, which resembles a credit card. The card contains a microprocessor that counts the words translated and acts as a security device. You can obtain an XLT

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LANGUAGE PAIRS

Shown here is a sampling of MT software packages and the language pairs that are available or are in development. Source languages (left) can be translated into all the target languages (right) in the same row. (● = available; ○ = in development.)

Company	Product	Source languages: A	C	Da	Du	E	Fr	Ge	Gr	I	J	K	P	R	Sp	Sw
Globalink	GTS-Basic/GTS-Professional		○			●	●	●		○			○	●	●	
Intergraph	DP/Translator					●	●	●							●	
Linguistic Products	PC-Translator			●	○	●	●	●		●			○		●	●
							○								○	
								○								
Logos	Logos					●		●								
MicroTac Software	Language Assistant Series					●	●	●		●					●	
Siemens Nixdorf	Metal					●	○	●							○	
					●		●									
Smart Communications	Smart Translators					●	●	●		●					●	
Socatra	XLT					●	●	○		●				○	●	
Systran Translation Systems	Systran					●										
							●	●		●	●	●	●	●	●	
								●								
							●									
														●		
Toltran	Professional Translation System		○			●				○			○	○	●	
Tovna Machines	Tovna MTS					●										
		○					●	○		○				●	○	
							●									

Source and target languages key

A = Arabic, C = Chinese, Da = Danish, Du = Dutch, E = English, Fi = Finnish, Fr = French, Ge = German, Gr = Greek, I = Italian, J = Japanese, K = Korean, N = Norwegian, P = Portuguese, R = Russian, Sp = Spanish, Sw = Swedish

card for word amounts that range from 100,000 to 1 million.

Tovna Machines (Washington, DC) gives you a perpetual license for Tovna MTS 1.0. Other MT workstation companies offer host, site, or floating licenses. You can obtain Systran from Systran Translation Systems (La Jolla, CA) with monthly or yearly leases.

MT workstation products support various operating environments, including Unix, Xenix, and MVS (Multiple Virtual Storage). Smart Translators by Smart Communications (New York) runs under Windows 3.1. The OEM Personal/370/Adapter/A (P/370), which was scheduled to ship in December, will make it possible for Systran to run on stand-alone PS/2s. And Multilingual Document Translation Software 7.0 from Logos (Mt. Arlington, NJ) supports MS-DOS and Mac users via LANs or WANs (wide-area networks).

The assortment of language pairs for MT workstation products is impressive (see the table). Systran offers 27 language pairs and 20 technical glossaries. Most operational language pairs have about 100,000 entries in their dictionary. A Russian-to-English dictionary typically contains 500,000 entries. With Smart Translators, you can choose between Castilian Spanish and Latin American Spanish or between European French and Canadian French. Many systems offer non-English language pairs.

MT workstation products are generally well integrated into the document-production process. Converters preserve the formatting codes from many software packages. Unix-based converters can preserve codes for Interleaf and FrameMaker, and DOS-based converters preserve codes for WordPerfect, Word, and Ventura Publisher.

DP/Translator by Intergraph (Huntsville, AL), for example, supports ASCII, tagged ASCII, SGML (Standardized Generalized Markup Language), Microsoft Word RTF (Rich Text Format), QuarkXPress tagged, FrameMaker MIF (Maker Interchange Format), and Troff (Unix-based text format). Formatting codes for such things as headings, footnotes, and columns remain intact in the translated output. Documents ready to be translated can be queued or batch-processed during off-peak hours.

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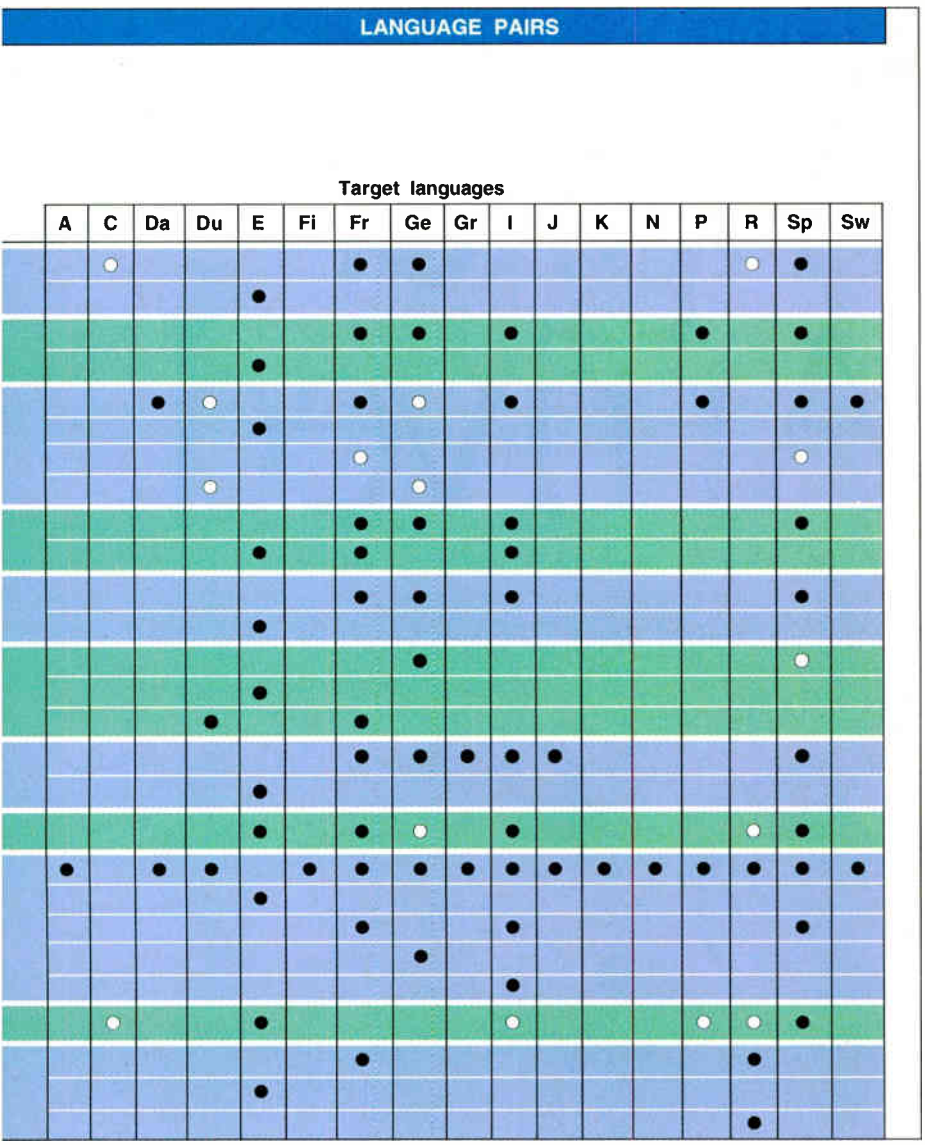

Tovna MTS's developers say that you can teach this software to learn by examples and rules. As the system processes translations, the computer watches what changes you make to the document. If Tovna MTS encounters changes, it remembers them and uses the new information.

The dictionaries supplied with MT workstation products allow deep coding for each term, so they can work with words with multiple definitions. You can add descriptors to help the computer distinguish among the many possibilities. *Descriptors* are attributes used in coding a dictionary entry and include terms such as *animate/inanimate*, *human/machine*, *place*, or *time*.

Coding a lexicon this sophisticated requires an understanding of linguistics and fluency in the source and target languages. MT system companies will help you design an efficient system for your needs, and training is often included in the system's price.

MT has proved that it can reduce the time and money spent on bulk translation of highly repetitive technical text. Commercial MT products for personal computers and workstations offer you the most affordable access to the power of MT. ■

L. Chris Miller is a computer consultant based in the Washington, D.C., metropolitan area. She has been involved in MT development for the past four years. You can reach her on BIX c/o "editors" and on CompuServe at 70303,314.

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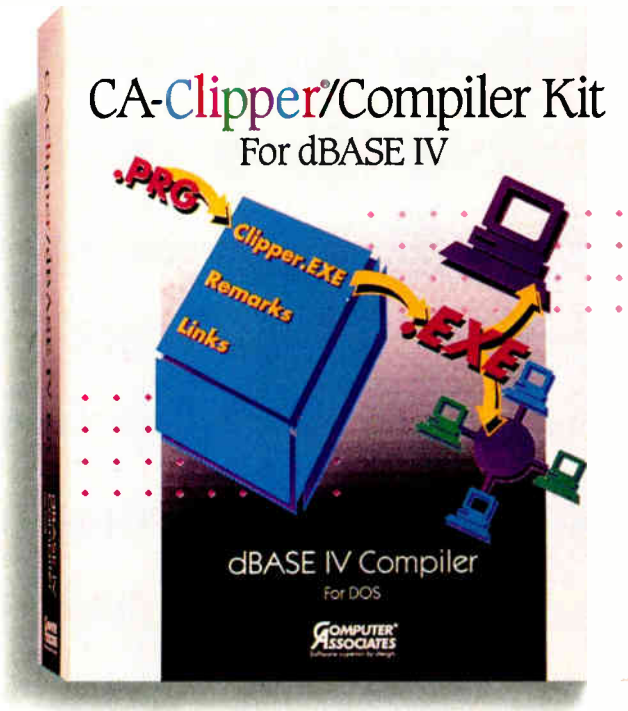

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Machine-Translation Software

A surprisingly wide range of machine-translation products are available for both personal computer and workstation platforms. The products listed below are merely a sampling of what is for sale now and what is under development. (This resource guide was compiled by L. Chris Miller.)

PC SOURCES

EZ JapaneseWriter 1.09
English into Japanese
Price: $1200 with KanjiBoard
Requirements: AT/XT compatible or a PS/2 Model 25, 30, 35, or 45 with a VGA card/monitor, an expansion slot for KanjiBoard, and 3 MB of available hard disk space.

EJ Bilingual, Inc.
2483 Torrance Blvd., Suite 1
Torrance, CA 90501
(310) 320-8139
fax: (310) 320-3228
Circle 1146 on Inquiry Card.

GTS-Professional 3.0
Bidirectional English/Spanish, English/French, and English/German, $998; Russian into English, $1495
Requirements: PC compatible with 640 KB of RAM, DOS 3.1 or higher, and 11 to 13 MB of available hard disk space; a VGA card and monitor for Russian.

GTS-Basic
Bidirectional English/Spanish, English/French, and English/German, $495; Russian into English, $750
Requirements: PC compatible with 640 KB of RAM, DOS 3.1 or higher, and 10 to 12 MB of available hard disk space; a VGA card and monitor for Russian.
Under development: English into Russian, Chinese into English, Italian into English, and Portuguese into English.

Globalink, Inc.
9302 Lee Hwy., 12th Floor
Fairfax, VA 22031
(800) 255-5660
(703) 273-5600
fax: (703) 273-3866
Circle 1147 on Inquiry Card.

PC-Translator 3.3
English into Spanish, French, Danish, Swedish, or Italian; or Spanish, French, Danish, Swedish, Italian, or German into English, $985 each
Requirements: PC compatible with 640 KB of RAM, DOS 3.1 or higher, and 2.5 MB of available hard disk space.
Under development: English into German, Portuguese, and Italian; Portuguese and Italian into English; French into Spanish; and Spanish into French.

Linguistic Products
P.O. Box 8263
The Woodlands, TX 77387
(713) 298-2565
fax: (713) 298-1911
Circle 1148 on Inquiry Card.

Spanish Assistant 5.0, French Assistant 5.0, Italian Assistant 5.0, and German Assistant 5.0
Bidirectional English-Spanish, English-French, English-Italian, and English-German, $99.95 each
Requirements: PC compatible with 640 KB of RAM, DOS 2.1 or higher, and 3 MB of available hard disk space.

MicroTac Software
4655 Cass St., Suite 214
San Diego, CA 92109
(800) 366-4170
(619) 272-5700
fax: (619) 272-9734
Circle 1149 on Inquiry Card.

Toltran Professional Translation System 2.0
English source, English destination, Spanish source, and Spanish destination, $249 per module
Requirements: PC compatible with 286 or higher, 512 KB of RAM, DOS 3.0 or higher, and 1 MB of available hard disk space per module.

Toltran Foreign Correspondent
English into Spanish, Spanish into English, and English into French, $149
Requirements: PC, XT, or PS/2 compatible with 512 KB of RAM, DOS 3.0 or higher, and 2 MB of available hard disk space.
Under development: English into German, and German into English; Russian, Chinese, Italian, and Portuguese modules.

Toltran, Ltd.
119-D Shoreline Rd.
Barrington, IL 60010
(800) 872-6752
(708) 382-4998
fax: (708) 382-2078
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Translate V.1.1
Price: $169
Requirements: PC compatible or Mac under SoftPC with 640 KB of RAM, DOS 3.0 or higher, and 9 MB of available hard disk space.

FinalSoft Corp.
3900 Northwest 79th Ave., Suite 230
Miami, FL 33166
(800) 232-8228
(305) 477-2703
fax: (305) 477-0680
Circle 1151 on Inquiry Card.

The Translator 2.0
English into Japanese
Price: $1195
Requirements: Mac with KanjiTalk 6.0.7 or higher, 4 MB of RAM, and 20 MB of available hard disk space.

The Translator Mini
English into Japanese
Price: $595
Requirements: Mac with KanjiTalk 6.0.7 or higher, 2 MB of RAM, and 5 MB of available hard disk space.

Catena Corp.
c/o Qualitas Trading Co.
2029 Durant Ave.
Berkeley, CA 94704
(510) 848-8080
fax: (510) 848-8009
Circle 1152 on Inquiry Card.

Winger 92
English into Danish, and Danish into English
Requirements: PC compatible with 640 KB of RAM and 40 MB of available hard disk space.
Under development: English into Spanish, and Spanish into English.

Winger A/S
Skodsborgvej 48 F1
DK-2830 Virum, Denmark
+45 4583 1166
fax: +45 4583 0244
Circle 1153 on Inquiry Card.

WORKSTATION SOURCES

DP/Translator
English into French, German, Spanish, Italian, and Portuguese; German into English; French into English; and Spanish into English
Platforms: Unix-based Intergraph RISC workstations.
Price: $10,000 and up.

Intergraph Corp.
1 Madison Industrial Park
Huntsville, AL 35894
(800) 826-3515
(205) 730-2700
Circle 1154 on Inquiry Card.

Logos Multilingual Document Translation Software 7.0
English source into French, Spanish, German, and Italian; German source into English, French, and Italian
Platforms: Sun Sparcstations and IBM RISC System/6000.
Price: Host licenses start at $25,000.

Logos Corp.
1 Dedham Place
Dedham, MA 02026
(617) 326-7600
fax: (617) 326-9341
Circle 1155 on Inquiry Card.

Metal 3.0
German into English and Spanish, English into German, French into Dutch, and Dutch into French
Platforms: Sun Sparcstations.
Price: Software starts at $28,000.
Under development: English into Spanish, Spanish into English, and French into English.

continued

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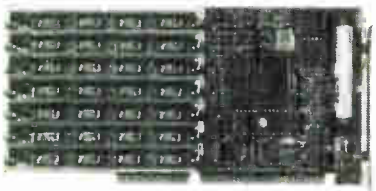

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2235 Sheppard Ave. E,
Suite 1800
Willowdale, Ontario,
Canada M2J 5B5
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fax: (416) 496-8524
Circle 1156 on Inquiry Card.

Smart Translator 3.0
English to Castilian or Latin-American Spanish, European or Canadian French, German, Italian, and back; English into Greek; and English into Japanese
Platforms: Sun Sparcstations, Hewlett-Packard Apollo, IBM RISC System/6000, Bull DPX-2, or a 386 with 8 to 12 MB of RAM, a 20-MB hard drive, and Windows.
Price: Site licenses or floating licenses start at $25,000.

Smart Communications, Inc.
885 Third Ave., 29th Floor
New York, NY 10022
(212) 486-1894
fax: (212) 826-9775
Circle 1157 on Inquiry Card.

Systran
English into French, German, Spanish, Italian, Portuguese, Arabic, Dutch, Russian, Korean, Greek, Danish, Norwegian, Finnish, Swedish, and Japanese; French, German, Spanish, Italian, Portuguese, Russian, Japanese, and Korean into English; German into French, Italian, and Spanish; French into German; and Russian into Italian
Platforms: IBM 9371 or PS/2 (with PC370 card) with 4 MB of RAM and a 200-MB hard drive.
Price: Monthly leasing, $3300 for first pair; annual leasing is available. On-line access available at 0.040 to 0.055 cent per word.

Systran Translation Systems, Inc.
1055 Wall St., Suite 213
P.O. Box 907
La Jolla, CA 92037
(619) 459-6700
fax: (619) 459-8487
Circle 1158 on Inquiry Card.

Tovna MTS 1.0
English into French, French into English, English into Russian, and Russian into English; French into Russian, and Russian into French—requires a three-month notice
Platforms: Sun Sparcstations and Digital Ultrix.
Price: Sold as a perpetual license. Prices upon request. Evaluation licenses are available.
Under development: Spanish, German, Italian, and Arabic.

Tovna Machines, Ltd.
c/o Translation Technologies International
3007 Tilden St. NW, Suite 3L
Washington, DC 20008
(202) 244-8500
fax: (202) 244-8165
Circle 1159 on Inquiry Card.

XLT
English, Spanish, French, and Italian in all directions
Platforms: PC compatible (a 386 is recommended) or a Unix or Xenix machine with 4 MB of RAM and 200 MB of available hard disk space.
Price: Initial subscription, $5000; additional language pairs, $2500. Microchip access rates from 2 to 3 cents per word. Annual renewal, $1000.
Under development: German and Russian.

Socatra
5500 Royalmount Ave.,
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Mount Royal, Quebec,
Canada H4P 1H7
(514) 735-7079
fax: (514) 735-9697
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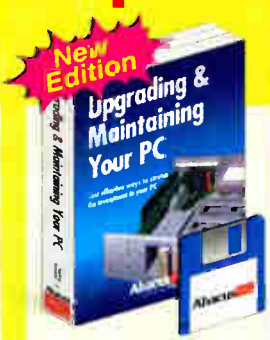

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PUTTING YOUR DATA ON THE MAP

The best desktop mapping software to meet your needs

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Not too many years ago, the ability to browse databases by pointing on a computerized map was out of reach for all but dedicated systems. Now with the proliferation of desktop computers with high-resolution graphics, mapping software is not only common but also the preferred way to look at geographic data.

This month, the BYTE Lab evaluates five important mapping products. Three of them—Arc/Info 3.4D from Environmental Systems Research Institute, Atlas GIS 2.0 from Strategic Mapping, and MapInfo 2.0 for Windows from MapInfo Corp.—are market leaders in the category. We also looked at two other packages: Tactician 2.0 from Tactics International, for its cross-platform and networking orientation, and GeoQuery 3.0 from GeoQuery Corp., for its clean Macintosh interface and System 7.0 features.

Mapping Applications

Desktop mapping penetrates many different markets. The design and management of sales territories is one common application. A marketing department could simplify a direct-mail campaign by automatically selecting all potential customers within a 50-mile radius of an upcoming seminar. You can plan business trips more efficiently by displaying clients that reside along a given route. Demographic analysis can target potential customers, help plan advertising campaigns, and streamline distribution channels.

Mapping-software products are also used extensively for city planning and for routing of cables and pipelines. Education and research markets call on mapping software to teach geography and to assist in environmental-impact studies. Banks can use them to determine the best location for a new branch office or an automatic teller machine. Other possible applications are numerous and diverse (e.g., real estate, insurance, traffic management, and prospecting).

If you look at the information in your databases, you'll probably find that more than half of the data is, in some way, tied to location information (e.g., street addresses, ZIP codes, building numbers, or territory numbers). In fact, if you consider

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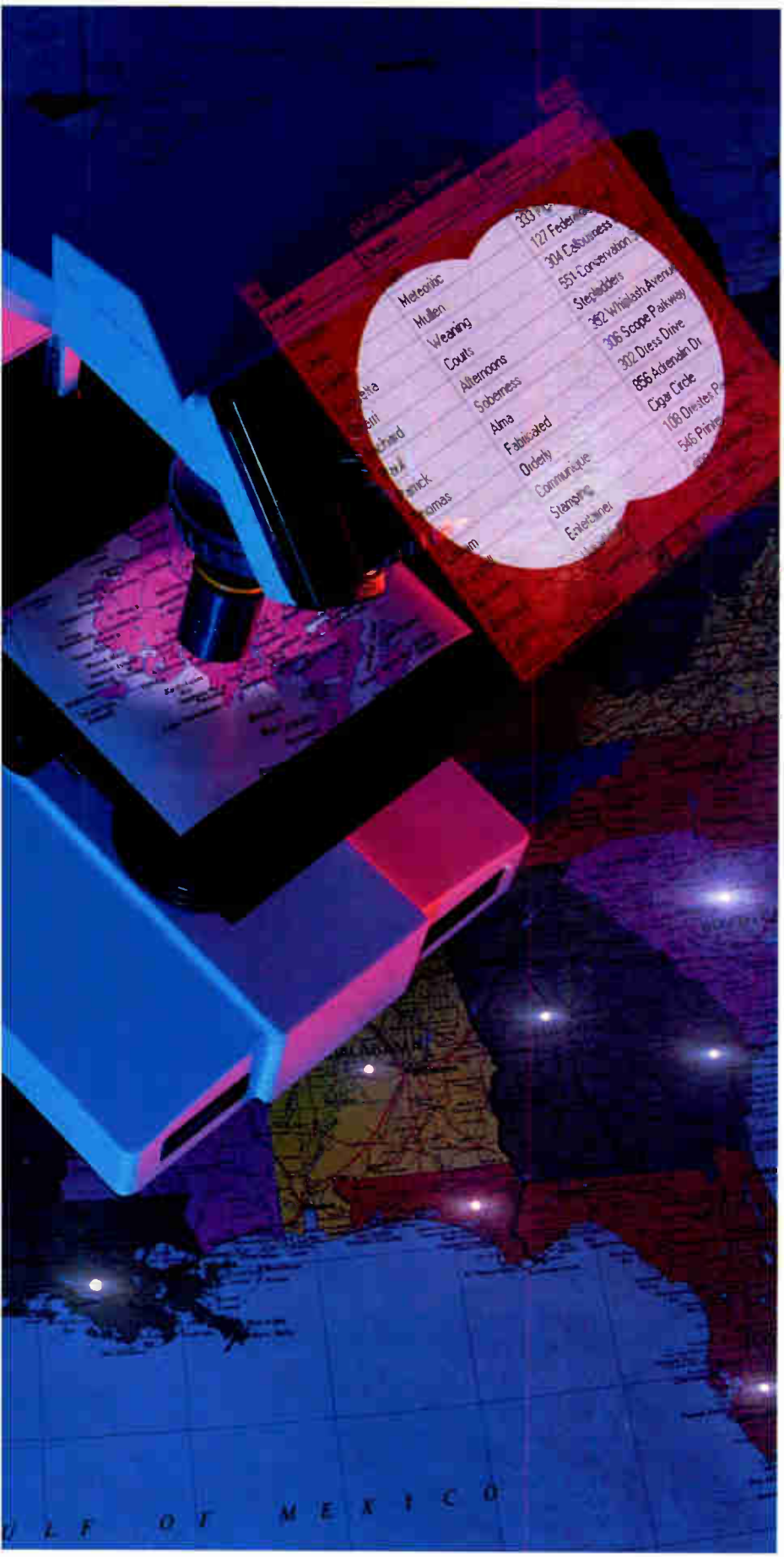

BYTE ACTION SUMMARY

- **WHAT MAPPING SOFTWARE IS**
  Mapping software lets you connect database information to maps for the visual display of information.
- **LIKES**
  Enhances demographic analysis, site location, territory planning, and many other geographic applications.
- **DISLIKES**
  There's often a steep learning curve, and the data is expensive.
- **RECOMMENDATIONS**
  MapInfo 2.0 for Windows strikes the best balance between price and features. For creating your own maps, Atlas GIS 2.0 is the best choice.

how you organize your data, you will find that the location information is often the logical key for sorting and grouping the data. When this is the case, mapping software allows you to picture the physical relationships between the groups and elements of your data. Numbers (e.g., in addresses, ZIP codes, and longitude and latitude) don't naturally form the pictures that you need. With mapping software, you can let the numbers be the keys to your maps and let the maps position and display the data.

Some mapping products have a narrow focus. For example, TTG's StarManager is designed for territory allotment and reporting. Other narrow-focus products include Tru-Chart 2.11 from Maptech, which focuses on nautical navigation, and electronic road atlases from Automap, DeLorme Mapping, and Softkey Software Products. Instead of these narrow-focus mapping products, we've selected general-purpose ones. With most of the general-purpose products, you can build a system for vertical applications. More important, you can use one or more of these products to solve your own problems and build your own interface to your data.

Before you select your mapping software, you should evaluate your needs. Each of these programs has a different focus and a variety of strengths and weaknesses. It makes no sense to use a mapping package designed for scientific research when you just want to build attractive presentations from a combination of ZIP code maps and your sales data. So, look at what your priorities are—accessing multiple databases running on remote machines; generating new geographic maps

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Mapping-Software Terms

buffer zone A zone with boundaries that are generated as a result of their proximity to another object. For example, a buffer of 50 feet from a road would be the area that includes 50 feet on either side of the road.

digitizing The process of entering a sequence of scaled locations for generating objects in a map. Both the source map (or photo) must include reference coordinates for orientation and scale.

geocode The key by which you can quickly retrieve a geographic object. A simple example is a ZIP code, but you may also have your own keys that are generated from the longitude, latitude, and map layer, or any method that you want. All geocodes within a map must be unique.

GIS (geographic information system) A specific class of mapping products, usually on a scale needed for scientific- and academic-level research. Only a few mapping-software systems can be considered full-blown GISes.

projection Because the surface of the Earth is an ellipsoid (i.e., it's somewhat spherical), any flat-surface representation of lines and positions must include some sort of distortion. A projection is a depiction of a map that accounts for the earth's curvature in a graphical way. The different kinds of projections maintain the accuracy of some information at the expense of other information.

query language A database query and reporting language for specifying the data that you want to look at. The two most common examples are SQL and Xbase.

resolution The level of detail available as you zoom into specific areas of a map. The finer the resolution, the greater the level of detail as you zoom in.

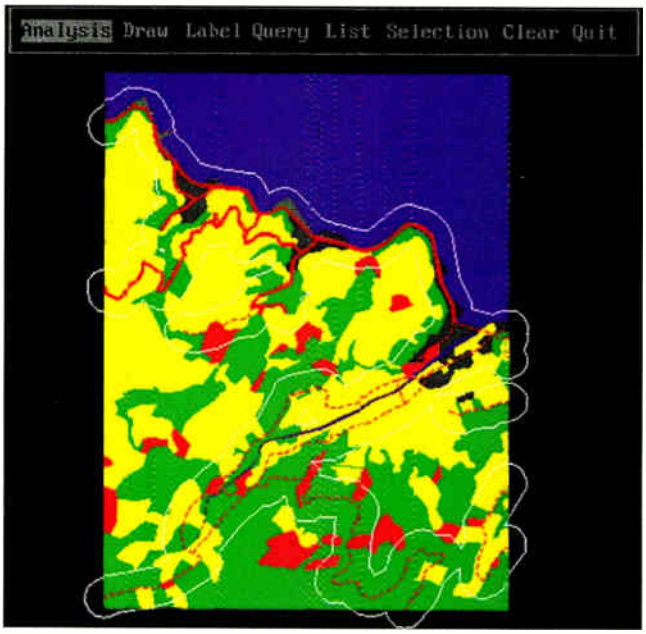
scripting language A language with which you can automate repetitive operations or build your own user interface for a special mapping-software application. An example is MapInfo's MapBasic.

thematic map A map that displays different quantitative ranges of data by varying colors, textures, symbols, or embedded charts.

by digitizing the areas, lines, and points that make up the map and then merging the map with a database or spreadsheet; SQL (Structured Query Language) database queries; market research; retail management; or statistical analysis. Given the diversity of mapping software, you must know, up front, what you expect the software to do for you and then find the program with the power and flexibility to accommodate your application. The most popular product may not always be the best for your needs.

When evaluating the price of mapping software, you should consider not only the basic package but also the optional data files. For example, from one vendor, four CDs of U.S. street data and geographic details sell for more than $40,000. Most of this information is in the publicly available U.S. geographic and street data from the Census Bureau, although the format is different and the data has been enhanced by third-party resellers. Each vendor requires proprietary file formats for geographic data.

The field of desktop mapping software includes some complex products, especially when you consider full-fledged GISes (geographic information systems). For definitions of commonly used mapping terms, see the text box "Mapping-Software Terms" above.



Screen 1: *Although Arc/Info 3.4D is largely command-language-based, you can drive it through Arcshell, a menu system written in Arc/Info's scripting language, SML. Under Arcshell, the graphics display updates after each command. Shown here is a buffered region that encloses a 10-mile radius around a network of roads.*

Arc/Info 3.4D

ESRI's Arc/Info 3.4D is a large, all-encompassing package that touches on all aspects of desktop mapping. Its price ($5995 for all the modules; $1495 for the starter kit) reflects this complexity and depth. The central theme of Arc/Info is a geographical database that defines map elements and their relationship to other elements and binds data to each element.

The primary user interface of Arc/Info is command-line driven. In the DOS implementation, system components are a series of modules; the individual commands are stored as separate DOS executables.

continued

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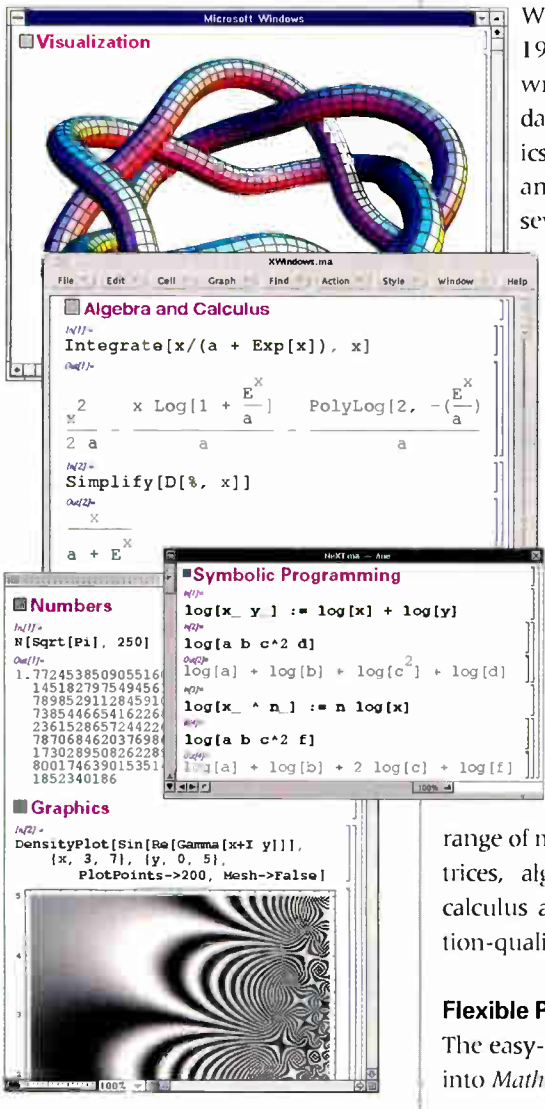

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Arc/Info Features

- command-line interface
- rich command set
- application programming language (SML)
- screen, digitizer, and printer/plotter support
- fully relational database analysis
- MS-DOS platform
- price: $5995 for all modules; $1495 for starter kit

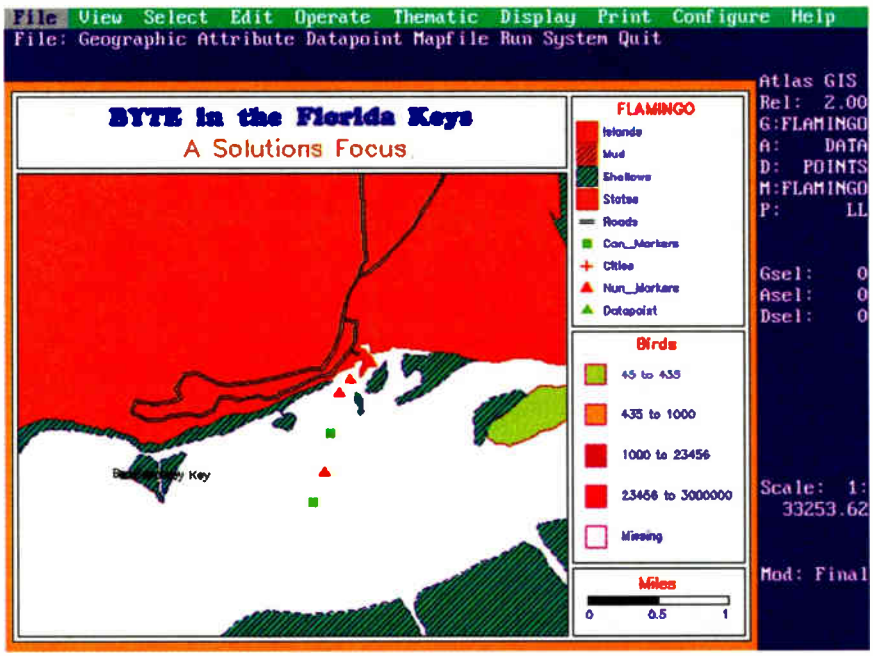
Arcedit is the main data-entry and editing module. You must go through Arcedit to change existing map features or to add new ones. The Arcplot module handles the graphics display and any printer or plotter you have installed. The Overlay module controls the interaction among multiple pieces of data. For example, you would use the Overlay module to calculate the overlap of one map feature onto another. If you have one map of all the major interstates and highways and another of all the retail magazine outlets, the Overlay module could show you the places within 5 miles of an interstate or a highway where you could buy the latest copy of BYTE. Finally, the Network module handles geocoding, routing, and address management. Arc/Info incorporates a custom-command processor to turn these modules into one cohesive unit.

Arcshell serves as an interface menu to save you from memorizing and typing all the commands (see screen 1). You still have to know what the commands mean, but Arcshell has them grouped by logical function and can prompt you for arguments. The standard Arcshell interface is the *form handler*, an on-screen graphics box with one line for each command argument. You simply fill in the blanks and press the OK button. If you need more help, the form handler gives you a scrolling list of possibilities to choose from. This combination of forms entry and Arcshell is easier than using the raw command line, but it's not the same as using a true graphical interface; even with Arcshell running, Arc/Info still feels like a command-line package with the shell doing the typing for you.

The last component of the Arc/Info package, and perhaps the most important, is its SML (Simple Macro Language). SML is a cross between a programming language and an extension of DOS batch files. It offers many of the features you'd expect to find in a programming language: variables, macros, I/O functions, and flow control (e.g., IF...THEN, WHILE, and GOTO). SML lets you automate the procedures you would otherwise input from Arc/Info's command line or the shell. Arcshell itself is written in SML, as are other Arc/Info functions. If you use Arc/Info to write a vertical-market application, you'll use SML to handle the flow between modules and provide the interface. SML's compiler makes your finished programs run quicker and take up less space, and it prevents end users from making changes to your program or reading your code.

A variety of attributes make Arc/Info stand out among the packages in this review. First, Arc/Info is a big package: It took over 12 MB of disk space to install, and the installation itself was delicate. Our graphics tablet (a Summagraphics SummaSketch II Plus) wasn't directly supported, and it took a call to ESRI's technical support to get the right patch to the driver table. Once we got past that, parts of the package still wouldn't work until we reinstalled them a second or third time. At least we discovered ESRI's technical support to be knowledgeable and patient.

Another attribute is Arc/Info's learning curve. We worked with the package for a few weeks and felt rather frustrated. The tutorial itself takes the better part of a week to get through, and after a reasonable amount of time, we still didn't have much to show for it. After talking with ESRI, we found out that the company expects a new user to spend six months or longer getting comfortable with the package. We weren't able to become proficient with Arc/Info during the course of this review.



Screen 2: *Atlas GIS 2.0 uses drop-down menus that require only a series of single keystrokes or point-and-click operations from the mouse or digitizer. You can remap any of the commands (or your own combinations of commands) to any of the function keys, Alt keys, mouse buttons, or tablet buttons.*

Atlas GIS 2.0

If your mapping-software requirements go beyond a mapping front end to database queries and instead focus on generating maps for your output, then Atlas GIS 2.0 from Strategic Mapping should fit your needs. Atlas GIS focuses more on producing maps than on interfacing to external databases. All the geographic information is stored in a proprietary file format. The data information is stored in the same file format (the .DBF file) that dBase and FoxBase use. To use data from other databases, you must import it. There are translation utilities for dBase, Lotus 1-2-3, and various ASCII-based delimited and column-format files. As is typical with many of the Atlas GIS configuration screens, you specify the mapping of source fields to internal fields by filling out specification tables. An Atlas GIS map project

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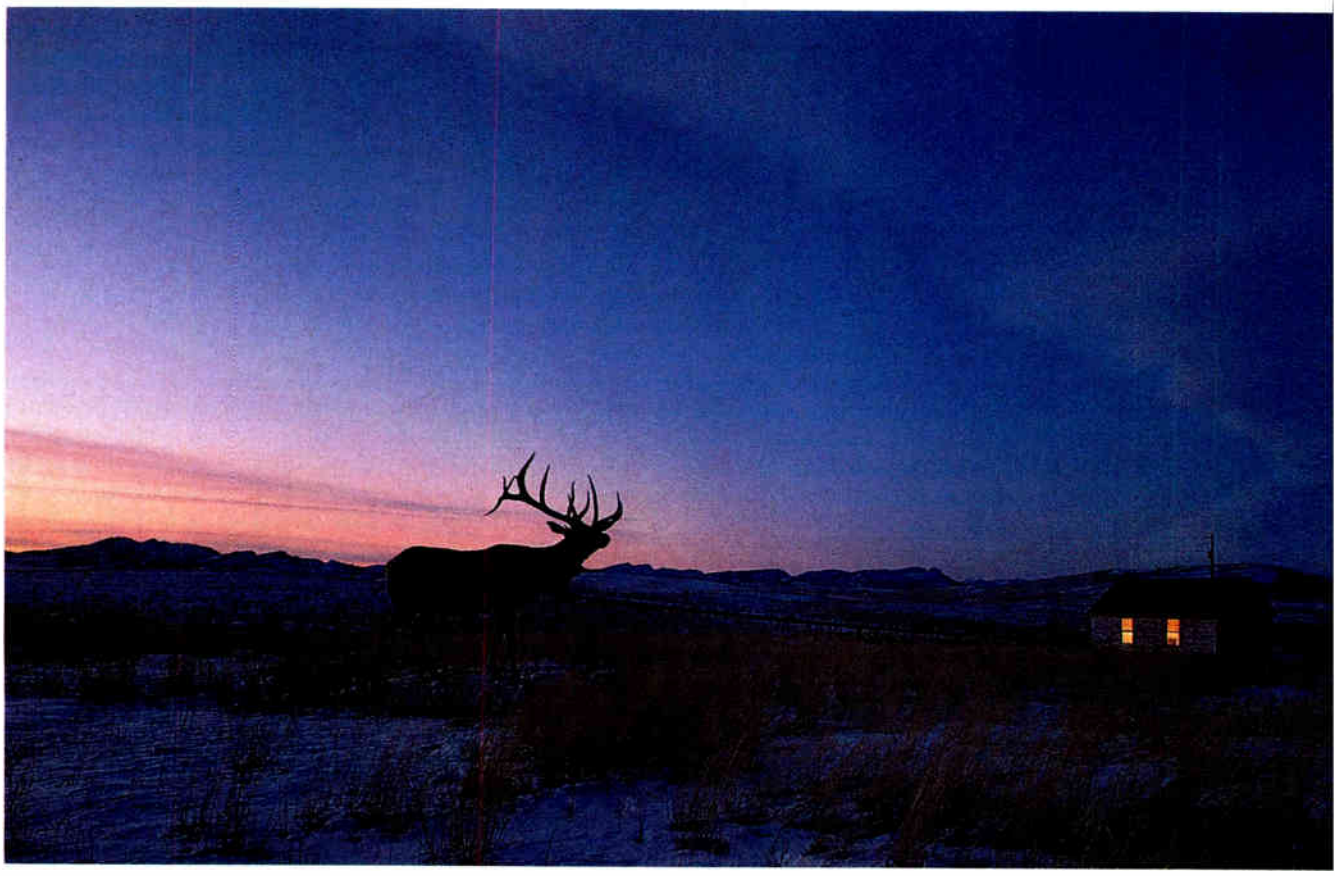

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consists of a dozen different files, some specifying configuration information and others containing the data.

Atlas GIS has borrowed more than configuration screens from the spreadsheet paradigm; you access commands through a hierarchical menu system that requires only a series of keystrokes or point-and-click operations from the mouse or digitizer (see screen 2). You can remap any of the commands (or your own combinations of commands) to any of the function keys, Alt keys, mouse buttons, or tablet buttons. You can also define your own tablet template and submenus. Other than the macros that you can create for keys and buttons, Atlas GIS has no underlying programming language.

The concept of map layers is integral to the Atlas GIS design. The key to geographic information is based on longitude and latitude, but you can create free-floating maps, using your own values for scale and your own grid system. The simplest are the *x*, *y* coordinates of your digitizer. Atlas GIS can easily convert a map between any of the standard map-projection and coordinate systems, so you can combine information from many different sources.

We found Atlas GIS the easiest package to use for digitizing new maps or adding detail to existing ones. You can access all the commands from a menu bar, which is fully functional, from the digitizer, a mouse, and the keyboard at the same time.

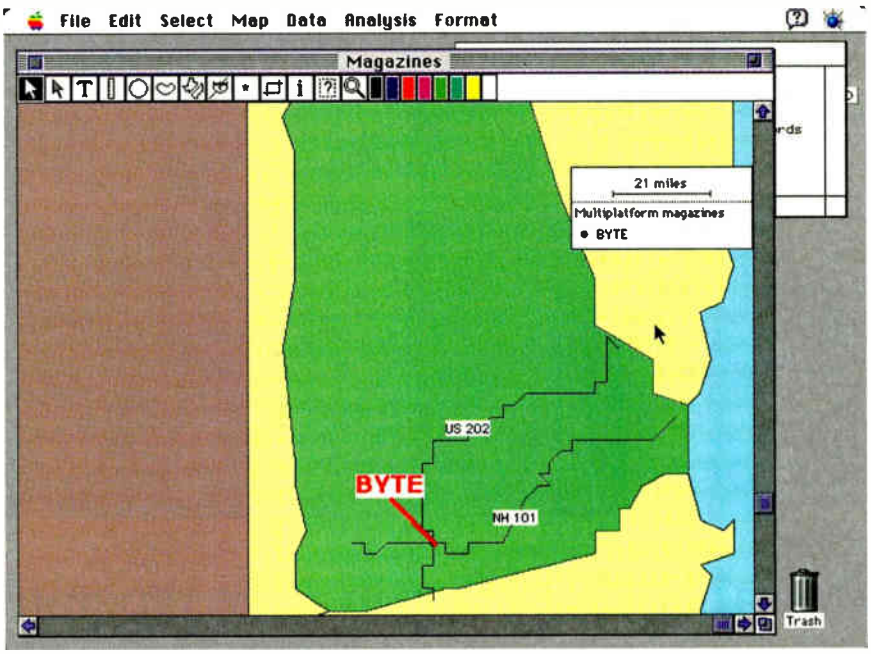
You draw maps in Atlas GIS using three kinds of map objects: regions, lines, and points. You can define a region by its boundaries or by its proximity to another object (as a buffer zone). Regions are rendered using solid colors and overlay textures. You can control the rendering of a line's color, width, and style (including a railroad style with left- or right-ticked lines, which are appropriate for rendering elevation lines). There are over 100 different symbols that you can use to display points.

You are limited to two themes for displaying any single thematic map, but you can construct the themes from complex expressions that pull their data from any number of quantitative data fields. You can use expressions not only to calculate the appropriate display for thematic maps but also to define the fields within a layer. Expressions can be as simple as the name of a field or complex enough to include a subset of the dBase operators and functions. By the time you read this, there will be a Windows version of Atlas GIS.

Atlas GIS is a true GIS product in that it lets you build your own applications, maps, and databases. It gives you substantial control over the format of your maps. Unlike most of the vertical-application mapping software, the emphasis of Atlas GIS is on the map as output, not as an interface for querying databases.

Atlas GIS Features

- single keystrokes drive menus
- extensive tools for developing thematic maps
- keystroke macros
- digitizer, plotter, and printer support
- dBase-oriented
- MS-DOS platform
- price: $2595



Screen 3: *GeoQuery 3.0 uses a standard Mac interface to access the package's search and display features. Although the toolbox has some unfamiliar icons, they are easy enough to use after a bit of practice. Curiously, GeoQuery doesn't have a real zoom feature—to zoom on a piece of a map, you have to delete the other regions first and then set the scale.*

GeoQuery 3.0

GeoQuery 3.0 is a Macintosh application that is primarily designed to examine preexisting databases and maps for details. For example, you might issue each of your salespeople a Mac PowerBook, a copy of GeoQuery, and a database of your current customers. With a minimum of training, your sales force can find out the location of each customer and their proximity to major landmarks and plan out an appropriate route. While GeoQuery lets you create new maps, you're mostly limited to assembling them from pieces of larger ones. The package we reviewed has exclusively U.S. coverage.

The metaphor in GeoQuery is the pushpin. The home office loads in the customer database (which is imported from formatted ASCII files, Apple's DAL (Data Access Language), or some other mainframe link) and geocode each data point as a pushpin. The basic GeoQuery package has the five-digit ZIP codes for all 50 states. Other coverage is available from the vendor. Using the pushpin metaphor makes it easy to balance sales territories, find customer sites, analyze market saturation, or generate reports on individual customers in a given area.

GeoQuery's other data-analysis modes are centered around shaded maps. Unlike the pushpin approach, the shaded map treats each data point as one of many and performs data collection based on a large group of customers. Using editorial-survey information, a magazine could produce a map showing the areas of the country with the most active OS/2 use, or a national moving company could find the cities that produce the most business.

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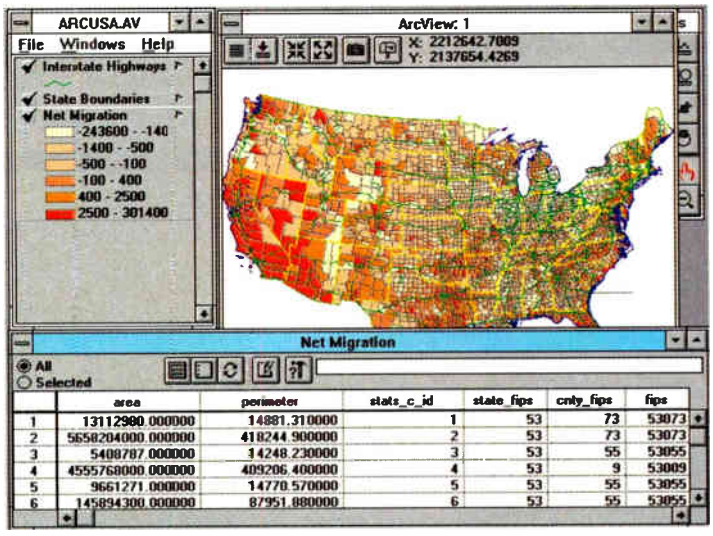

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"ArcView for Windows provides a major breakthrough in the usability of GIS, making it easy and fun for users to visualize, analyze, and explore geographic information."
–Jack Dangermond, ESRI President

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GeoQuery is also System 7.0–savvy. Besides supporting Apple's DAL for data entry, it also supports Publish/Subscribe for sharing completed map images with other applications. For example, the newsletter you send out to your regional sales staff might have a map of the last month's activity, using Publish/Subscribe to link the map to your desktop publishing package. If you have a spreadsheet or database application that can publish data, GeoQuery can subscribe to it and, as the data changes, automatically update the document. Using both capabilities, you can establish a link from a remote mainframe database right through to the final newsletter layout; as the mainframe data changes, a few mouse-clicks will update the printed document with minimal intervention.

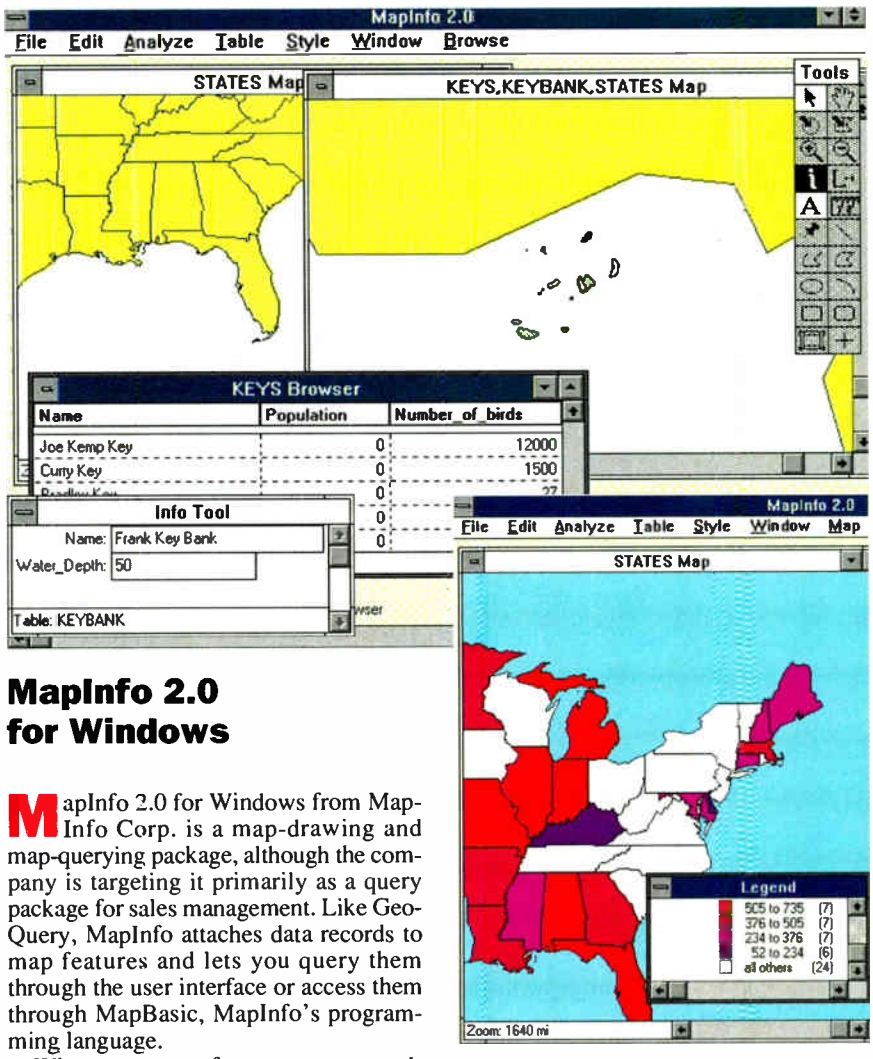
If you need to incorporate a mapping capability into your custom application, GeoQuery supports Apple events for loading and manipulating map data from within other applications. The current release is supported by Acius's 4th Dimension database package; the Apple event documentation is available from GeoQuery if you want to drive it from your company's custom software.

Simply being a Macintosh application suggests ease of use, and GeoQuery is consistent with other Mac applications. The toolbox has selection tools, a text tool, and drawing tools, as well as some map-specific tools, such as query tools and special selection tools. An information tool lets you click on anything on the map and find out the name of a region, road, or landmark. A snooper tool (a magnifying glass) lets you bring up the data record for any pushpin object on the map. The package was very easy to learn and use.

GeoQuery has a couple of unusual features. You can zoom in and out of a map by setting the map scale, but you cannot zoom in close enough to exclude any visible states (see screen 3). To zoom in on a particular area of the country, you have to delete the rest of the country from the map. That seems odd and a bit contrary to the standard Mac interface. We suspect that GeoQuery does this to speed up redrawing of the increased detail as you zoom in, but it's still disconcerting. It's also unfortunate that there's no macro language or other way of automating a mapping sequence. As easy as GeoQuery is to use, some functions and tools will be unfamiliar to a novice Mac user.

GeoQuery Features

- standard Mac interface
- strong market-analysis and reporting focus
- no programming language
- System 7.0 support, including Publish/Subscribe
- fully relational database analysis
- Macintosh platform
- price: $395



MapInfo 2.0 for Windows

MapInfo 2.0 for Windows from MapInfo Corp. is a map-drawing and map-querying package, although the company is targeting it primarily as a query package for sales management. Like GeoQuery, MapInfo attaches data records to map features and lets you query them through the user interface or access them through MapBasic, MapInfo's programming language.

When most manufacturers port a product to several platforms, they try to keep the interface consistent across the different platforms. That approach is both good and bad: It makes it easier for users in a mixed-computing environment to switch between machines, but it makes it difficult for a user of a given platform to learn the package. MapInfo takes on the look and feel of a standard Windows application.

You build a MapInfo image as a series of layers. One layer might be state or country outlines, the next layer could be lakes and rivers, and the next might be roads followed by cities. You can choose to display or hide any layer at will, and you can edit data on any layer at any time. To

Screen 4: *MapInfo 2.0 for Windows lets you merge multiple databases and maps together into one display, including multiple views of the same map. The Info tool (selected here) displays information on any map feature, and the Browser window displays the map's underlying data. MapInfo has a full data-analysis capability that uses both an interactive data-entry form and a programmable language interface (MapBasic). The inset shows a map of the U.S., shaded to show the number of customers located in each state. The legend is automatically created to reflect the current shading.*

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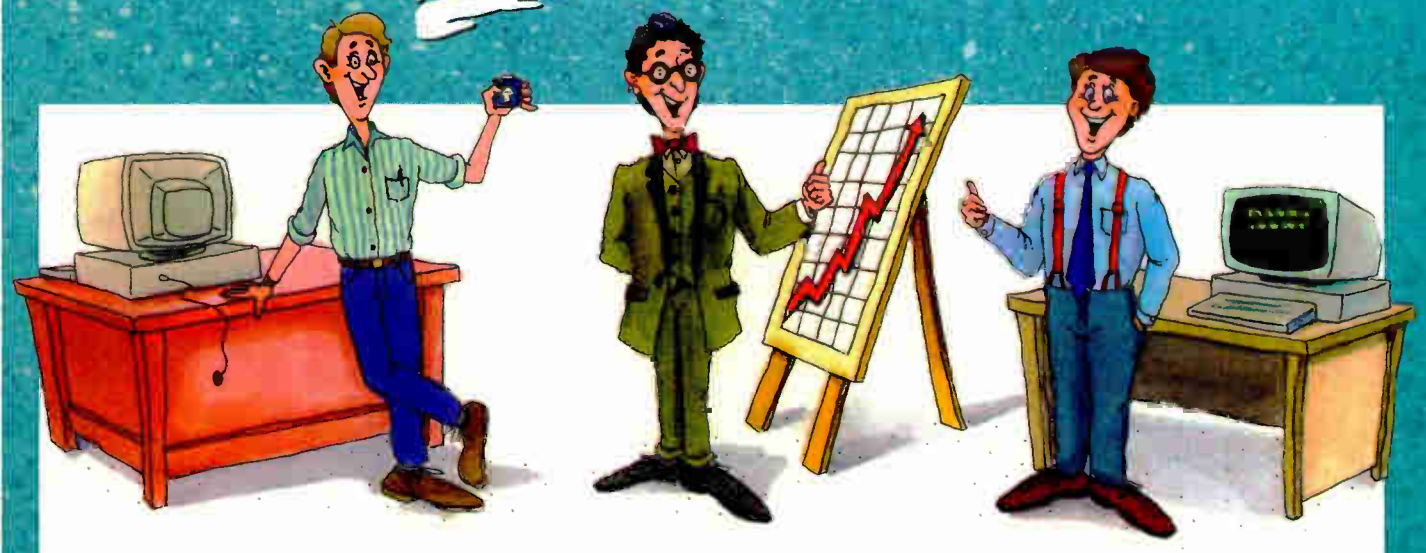

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MapInfo Features

- standard Windows interface
- full-featured map drawing and a query application programming language (MapBasic)
- screen, printer/plotter, and Windows-device support
- point-and-click and SQL database query
- fully relational database analysis
- MS-DOS, Windows, and Macintosh platforms
- price: $995 ($795 for MapBasic)

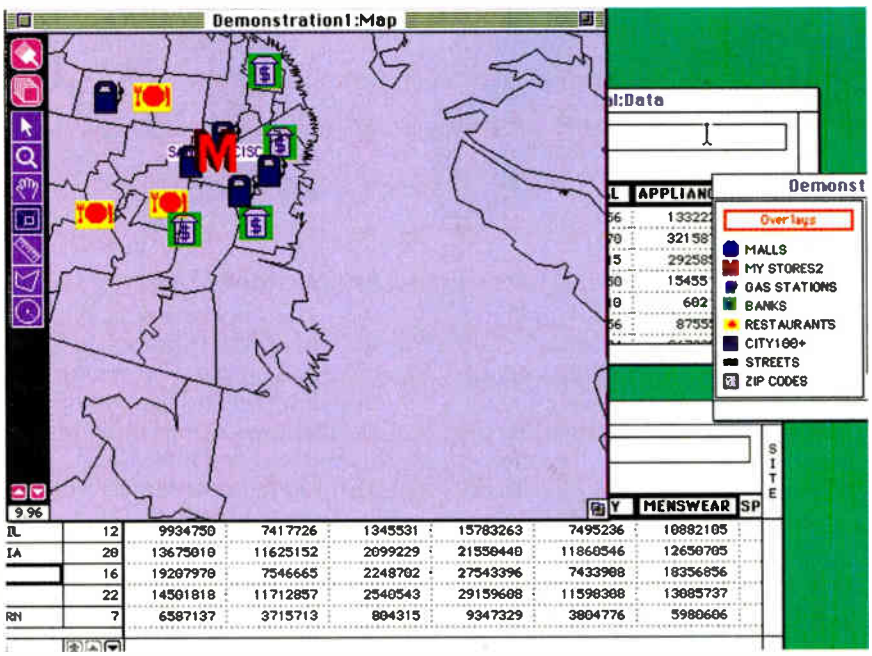
access data beneath the layers, MapInfo offers a rich set of selection tools and access methods (see screen 4). For example, you can select a point on the map and then select any city within 500 miles of that point that has a population of over 100,000, or you can show all petroleum storage sites that sit within a half mile of a watershed area.

If you don't like any of the existing maps, MapInfo lets you digitize your own maps or import maps in other formats. Specific data for cities and other map features can come in from formatted ASCII-, dBase-, Lotus 1-2-3–, and Microsoft Excel–formatted files. The first step is defining the correlation between the incoming data and your map's field layout. As the data is drawn into the map database, geocodes are assigned to each element of data, and the data becomes associated with a location on the map.

During the geocoding process, MapInfo compares the incoming data to known features that already have map coordinates assigned to them. In most cases, postal codes will provide a good match; street addresses can provide an even closer match if the information is available. If MapInfo can't find an exact match during the process, it stops and displays the data and lets you manually assign geocodes. That process can be tedious for large databases, so you also have the option of ignoring any uncodable data and assigning geocodes to it later with a different database.

Analyzing map data is MapInfo's forte. Each map layer has its own database, and all the analytical functions are relational; therefore, you can analyze data on any one layer as a function of the data on another layer. For example, if your company is a wholesale manufacturer of recycled containers, you might want to see which cities in a given area need more resellers. You would probably put the cities on one layer and your existing reseller base on another. By relating the two layers, you could highlight those cities where the resellers' inventory is insufficient to cover the population in those cities.

MapInfo handles dozens of projection types and has a primitive page-layout capability for combining multiple maps onto a single printed page, a sophisticated SQL implementation (for complex queries), and MapBasic, a full programming language for creating turnkey applications. Compared to the other packages we reviewed, MapInfo for Windows is full-featured, fast, and easy to use. While we can't know if MapInfo will solve your mapping problem, it's hard to imagine one it can't handle.



Screen 5: *Tactician 2.0 runs on the Macintosh and under Windows, but it doesn't look or behave like your typical Macintosh or Windows program, because it migrated from the DEC VAX/VMS world.*

Tactician 2.0

If the data you want to display resides on several different hosts within different database systems, then you should look at Tactics International's Tactician 2.0. Tactician runs on the Macintosh and under Windows. (The Macintosh version has more functionality; therefore, we evaluated Tactician on a Mac Quadra 950.) But it doesn't quite look or behave like your typical Macintosh or Windows program, because it migrated from the DEC VAX/VMS world (see screen 5).

Even though the focus of Tactician is on market analysis, you can use it for other projects. It doesn't qualify as a full-blown GIS (you must get your geographic information from some other system—AutoCAD or a GIS program), but it has more data-analysis and display options than some GIS programs. If you plan to use Tactician for general-purpose mapping, there are several missing elements; for example, there is no provision for creating buffer zones (although Tactician lets you create a similar feature using a territory), and the map-format generation is not as flexible and full-featured as that of most of the other products we reviewed.

The emphasis of Tactician is on the data. The map is a consequence of the data. This isn't to say that the mapping capabilities of Tactician are lacking; in fact, there are more ways to map data with Tactician than with any other package that we looked at. Not only can you generate thematic maps using color and dot density, but you can also call out data using several different types of charts that are displayed right on the map. By putting the emphasis on the data underlaying the map, Tactician ends up displaying more data windows than windows with maps.

Most of the data windows look like spreadsheets, but they are actually table-formatted representations of the data Tactician is looking at. You still need to import

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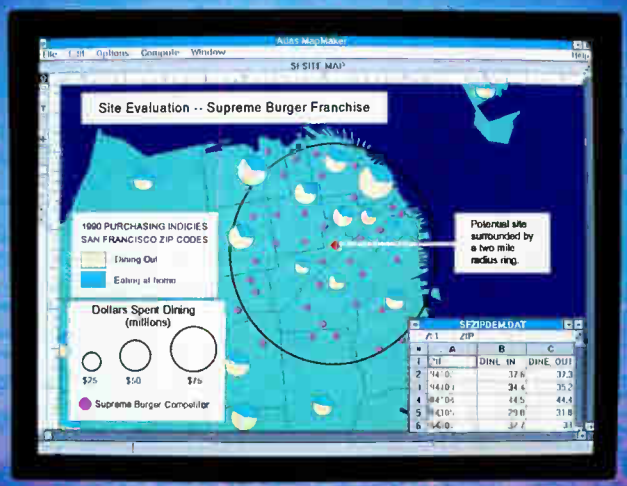
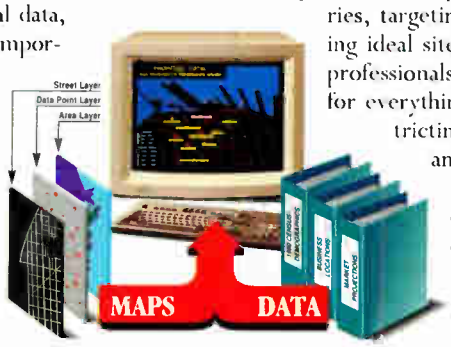
ATLAS SOFTWARE

A NEW DIMENSION IN DATA MANAGEMENT



Most business and government professionals view and analyze data with spreadsheets, databases and occasionally in business graphics packages. While these types of software work well when displaying statistical data, they are blind to important geographical information — such as market potential by sales territory, distribution coverage by product, or customer locations by ZIP code or street address.



Atlas Software™ is changing that. By linking data from spreadsheets, databases and even other applications — on your PC or Macintosh® — you can now add the important geographical dimension to your information system.

And when we say important, we mean mission critical. For example, *Atlas Software* can help business professionals answer "what if" and "show me where" questions for optimizing sales territories, targeting customers, and selecting ideal site locations. Government professionals can use *Atlas Software* for everything from political redistricting to land-use planning and public safety analysis. Without *Atlas Software* decision makers often overlook important geographic information and allocate resources ineffectively.

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In the UK, call 44-81-994-2780
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In Australia, call 61-3-866-1766
In Belgium/LUX, call 32-2-771-25-75
In the Netherlands, call 34-340-266-436
In France, call 33-1-45-27-20-61
In Denmark, call 45-42-25-17-77
In Spain, call 34-1-564-1356
In Brazil, call 5521-262-9459

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Tactician Features

- menu-driven
- strong market-analysis and reporting focus
- fast access to data
- flexible filtering for external data querying and importing
- spreadsheet-oriented
- Macintosh and Windows platforms
- price: $2495

the data from other systems. You can click on samples of your data to specify what goes where. Unfortunately, you must do this for all external data. There is no built-in way to get this information out. But once you have determined how to do it, you can automate the information using Tactician's scripting language.

Unfortunately, Tactician suffers from many of the user-interface problems typical of an application brought to the Macintosh from a miniframe or mainframe environment. For example, the typical Macintosh user is not accustomed to listing all the files that are associated with a project and having to reopen them, one by one, until the full set of necessary files is available on the desktop.

There are other problems: The icons on the map window don't have the same look and feel as other Macintosh programs, there are too many layers to each of the operations, and, worst of all, the code is not foolproof—a novice user will crash the operating system by trying to do operations that are not appropriate.

The Macintosh is known for the intuitive and consistent interface of the applications on it. Tactician is far from being intuitive. Even though Tactician excels in data manipulation and retrieval, it is a complex program that is beyond the capabilities of a nontechnical person. Nonetheless, the package can be of great value to those who will take the time to climb the learning curve. Its most impressive feature is speed. It is far faster at data retrieval and recompilation than any of the other products.

Mapping Your Options

Each of the five mapping-software products reviewed here has unique strengths and weaknesses. You will need to match your needs to the attributes of the software. For example, if you are dealing with vast amounts of data from a database and the speed of data access is the most important criterion, then Tactician shines above all the rest. But don't pick Tactician if you are looking for a complete GIS for your research project; it is designed for marketing analysis and reporting only.

Arc/Info is complete and extensible, but you shouldn't pick it if you want to get your data up and running as soon as possible. It is the most difficult package to install, configure, and learn.

The easiest package to learn is also the most feature-limited one: GeoQuery. It is best implemented on the Macintosh, since it uses many of the capabilities that are specific to the Macintosh. However, it lacks a programming language and is not designed for repetitive tasks.

The most balanced mapping-software packages are Atlas GIS and MapInfo. Both are designed for creating maps, as well as querying them. Even though they are complex, the average technical user can get a good grasp of their design and functionality in a week or less. The discriminating factor is one of focus. If you need to produce your own maps, Atlas GIS is your best choice. But for managing, analyzing, and visually displaying your data, MapInfo is the best product. Take your pick. ■

Ben Smith and Howard Eglowstein are testing editors for the BYTE Lab. Ben is the author of UNIX Step-by-Step *(Howard W. Sams, 1990); you can contact him on BIX as "bensmith" and on the Internet at ben@bytepb.byte.com. Howard holds an S.B. from MIT. You can contact him on BIX as "heglowstein."*

COMPANY INFORMATION

Environmental Systems Research Institute, Inc.
(Arc/Info 3.4D)
380 New York St.
Redlands, CA 92373
(714) 793-2853
fax: (714) 793-5953
Circle 976 on Inquiry Card.

GeoQuery Corp.
(GeoQuery 3.0)
475 Alexis R. Shuman Blvd., Suite 385E
Naperville, IL 60563
(800) 541-0181
(708) 357-0535
fax: (708) 717-4254
Circle 977 on Inquiry Card.

MapInfo Corp.
(MapInfo 2.0 for Windows)
200 Broadway
Troy, NY 12180
(518) 274-6000
fax: (518) 274-6066
Circle 978 on Inquiry Card.

Strategic Mapping, Inc.
(Atlas GIS 2.0)
3135 Kifer Rd.
Santa Clara, CA 95051
(408) 970-9600
fax: (408) 970-9999
Circle 979 on Inquiry Card.

Tactics International, Ltd.
(Tactician 2.0)
16 Haverhill St.
Andover, MA 01810
(800) 927-7666
(508) 475-4475
fax: (508) 475-2136
Circle 980 on Inquiry Card.

OTHER COMPANIES MENTIONED

Acius
(4th Dimension)
10351 Bubb Rd.
Cupertino, CA 95014
(408) 252-4444
fax: (408) 252-0831
Circle 981 on Inquiry Card.

Automap, Inc.
(Automap—The Intelligent Road Atlas)
9830 South 51st St.
Building A-131
Phoenix, AZ 85044
(800) 545-6626
(602) 893-2400
fax: (602) 893-2042
Circle 982 on Inquiry Card.

DeLorme Mapping
(Street Atlas USA)
P.O. Box 298
Lower Main St.
Freeport, ME 04032
(800) 227-1656
(207) 865-1234
fax: (207) 865-9628
Circle 983 on Inquiry Card.

Maptech
(Tru-Chart 2.11)
225 Sperry Ave., Suite 1000
Ventura, CA 93003
(805) 654-8006
fax: (805) 654-8147
Circle 984 on Inquiry Card.

Softkey Software Products Florida, Inc.
(Keymap 2.02)
4800 North Federal Hwy.
Third Floor, Suite 300D
Boca Raton, FL 33431
(407) 367-0005
fax: (407) 367-1611
Circle 985 on Inquiry Card.

Summagraphics Corp.
(SummaSketch II Plus)
60 Silvermine Rd.
Seymour, CT 06483
(800) 729-7866
(203) 881-5400
fax: (203) 881-5367
Circle 986 on Inquiry Card.

TTG, Inc.
(StarManager)
10 State St.
Woburn, MA 01801
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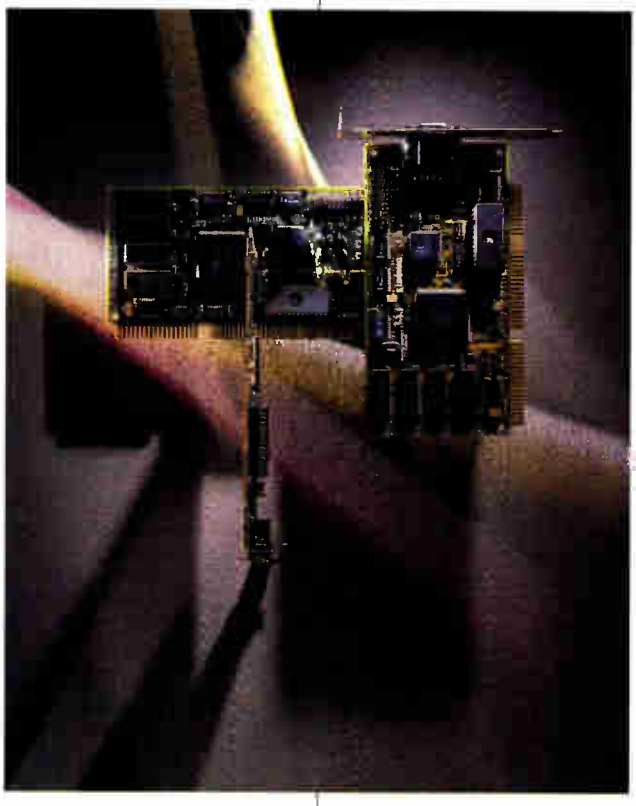
Now You Can Afford To Buy Some Time.

At $149, any budget can afford ViewRx, the Windows Business Applications Accelerator.



Kingston knows that staring at an hourglass isn't the best use of your time. We know that people who run Windows spreadsheets and word processors don't like to wait for text scrolls, reformats, cuts and pastes. We know that your time is valuable.

But we also know that budgets are tight, and when faced with the choice of just muddling along with slow business applications or spending hundreds of dollars on a Windows accelerator, you may reluctantly choose to just muddle along.

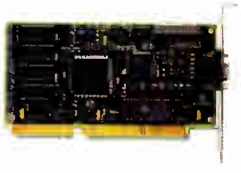
The affordable Windows Accelerator.

That's why we created ViewRx, the cure for slow running Windows business applications. Windows spreadsheet tests show that ViewRx makes your applications run three times faster.

ViewRx is based on the Weitek 5186 chip that has Windows BitBLT and line draw functions built in. That means that these often used Windows functions are handled by ViewRx, not by the CPU. And that means better performance for you. ViewRx supports up to 1024 x 768 screen resolution to fit even the largest spreadsheets on the screen. For the least possible screen flicker, ViewRx offers a 72Hz refresh rate and supports non-interlaced mode. ViewRx comes complete with trouble free drivers for Windows 3.1 and popular CAD packages.

Kingston Reliability.

Every ViewRx is thoroughly tested and warranted for five years. You can always count on Kingston's free technical support if you have even the slightest problem. For more information on the remedy for slow Windows or a reseller near you, call Kingston at (800) 835-6575.



Identical Excel spreadsheet tested on 386SX-20 PC with ET-4000 VGA and ViewRx cards. All Trademarks and Registered Trademarks are of their respective holders. Kingston and Kingston Technology are Registered Trademarks of Kingston Technology Corporation.

Kingston TECHNOLOGY CORPORATION

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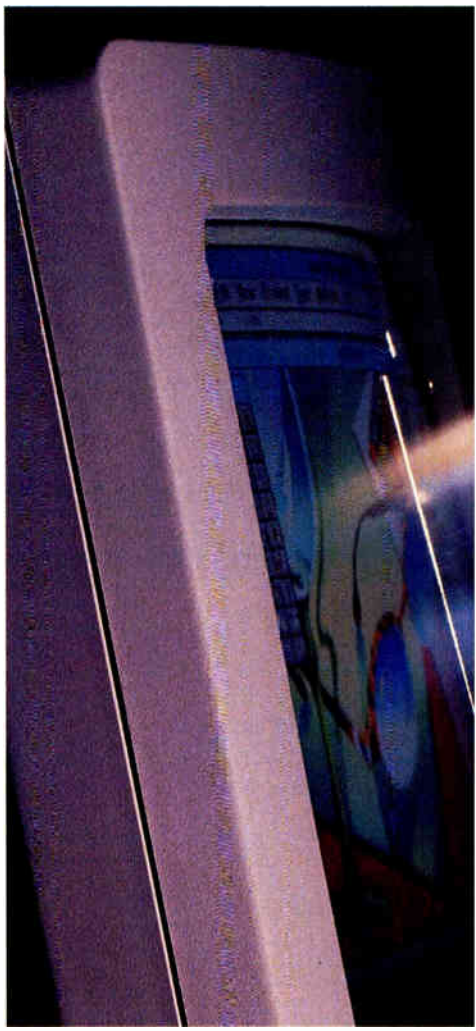
HARDWARE

Making Windows Rock and Roll

RICK GREHAN



If you're running Windows, your PC's central processor is working overtime. It has to take all those window frames and dialog boxes and put them on the screen. Quickly. Meanwhile, the recalc or redraw command you sent it has to sit in the pipeline while the CPU does its Windows-related chores. Everything slows down, and you spend valuable time waiting for your screen to refresh.

The solution: Pass those Windows chores off to a Windows accelerator board. All a Windows accelerator does is graphics; it takes the graphics load off the host CPU, which is then free to work on the computing task at hand.

Windows is rife with repeated graphical elements and operations. Just look at your typical Windows display and see how many rectangles there are: window frames, title bars, dialog boxes, tool palettes, scroll bars, check boxes, and on and on. Chances are that a single Windows low-level routine drew all those rectangles. If you want to speed up a piece of software, then optimize those operations that the software performs most frequently.

Hardware designers have taken those operations and moved them into silicon. The results are chips like the S3 86C911 and 86C801, the Weitek W5186, the Western Digital WD90C31, and the Texas Instruments 34020. A graphics board containing one of these chips looks like a standard VGA card when you boot your system up. But with the right display driver (i.e., software that knows there's a graphics accelerator hiding on that card), graphics operations that used to require the host CPU's total involvement now become a handful of instructions that amount to no more than storing a few parameters in some on-chip registers.

In this review, I look at 16 PC boards that speed up Windows. Some are fixed-function accelerators; they take over common Windows operations from the CPU. Others are built around a programmable processor, TI's 34020; they rev up applications, such as CAD programs, written to take advantage of them. Windows accelerators now range in price from less than $200 to more than $2000. While the high-price boards have definite advantages, such as rapid drawing of ellipses, you don't have to spend a fortune to significantly boost the speed of Windows.

What They Do

No matter what chip they're based on, Windows accelerators typically boost a few fundamental operations:

- *Line drawing.* Next to text, lines are probably the graphics elements that most frequently appear on a screen. All those rectangles on your Windows screen require horizontal and vertical lines. Because rectangles appear so frequently, and because of the simplicity of an algorithm to draw one, some accelerators include special routines just to draw rectangles.
- *BitBlts.* In its simplest form, this is the act of copying a rectangle of the display—pixel by pixel—from one location on the screen to another (or from some location in nonvideo memory to the screen). When you grab a window's title bar and drag that window to another spot on-screen, the system moves that window's display contents with a BitBlt operation.
- *Rectangle fills.* Whenever you open a window in Windows, the system has to draw a rectangle and fill it with some specified background color. Some accelerators can do the filling for the host CPU; all the driver need do is specify the rectangle's location, size, and fill color—the accelerator does the rest.

Many Modes and Drivers

The most striking feature of all these cards (beyond their graphics prowess) is the number of display modes they support. They are all at least compatible with VGA, which makes them backward-compatible with the IBM PC MDA, CGA, and EGA modes; most can also mimic a Hercules HGC adapter. The boards all support a big array of graphics modes; see the features table on page 204 for more information.

Except for the ViewRx from Kingston Technology, every board reviewed here supports at least 256 simultaneous colors in resolutions of 640 by 480, 800 by 600, and 1024 by 768 pixels. The ViewRx can deliver 256 colors only in 640- by 480-pixel mode—it supports 16 colors in the other modes. This is because the ViewRx comes with only 512 KB of on-board RAM. The Weitek W5186 graphics accelerator used by the ViewRx is capable of 65,536 colors in 640 by 480 and 800 by 600 modes, and 256 colors in 1024 by 768 mode, but it requires 1 MB of video-board RAM to produce the additional colors.

Although I focus on the cards as accelerators of Windows 3.1, all the boards I cover are supplied with drivers for specific applications. The most popular drivers

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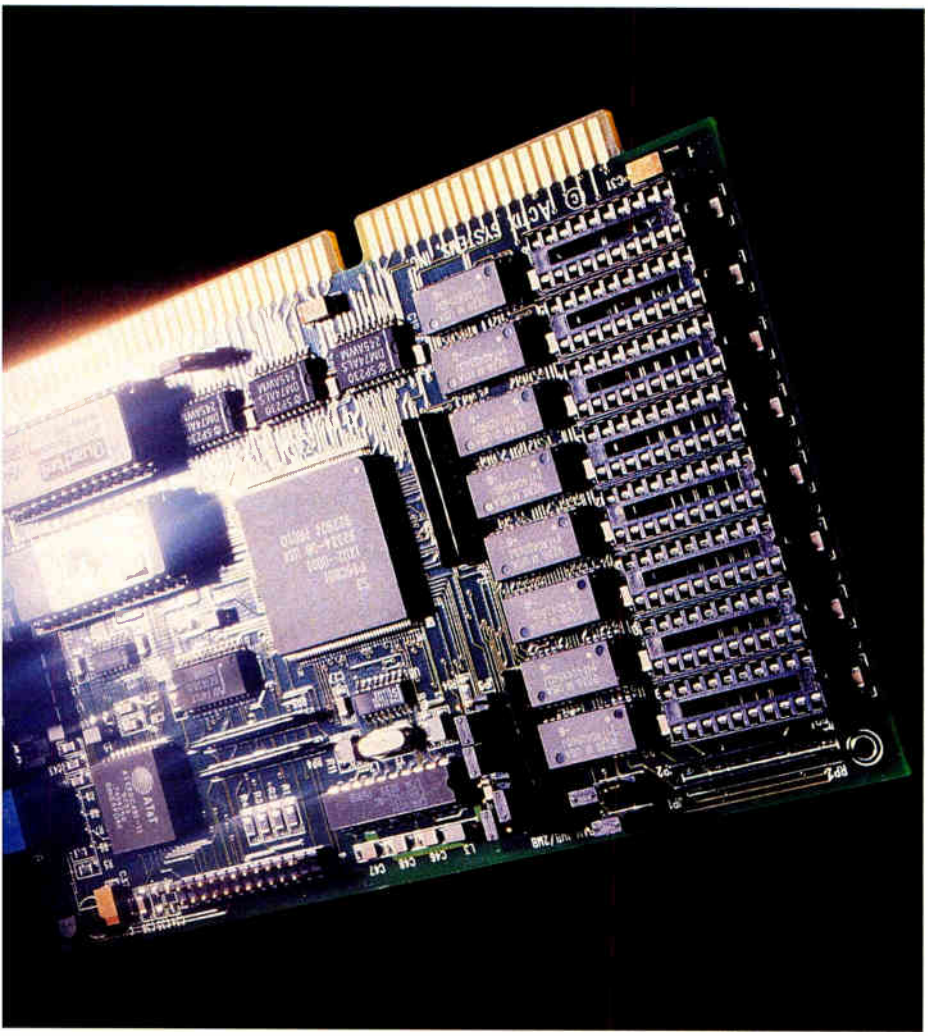

BYTE ACTION SUMMARY

- **WHAT WINDOWS ACCELERATORS ARE**
  Graphics cards that speed up graphical operations.
- **LIKES**
  Eliminate time wasted waiting for windows to redraw; lots of drivers; easy to set up.
- **DISLIKES**
  The 34020-based boards are not worth the price for general-purpose Windows operations.
- **RECOMMENDATIONS**
  For all-around Windows performance, the Actix Systems GraphicsEngine 32 is the best of the bunch. If you're looking for a big boost in speed without spending more than $300, the top choice is National Design's Volante Warp 10. If speeding up your drawing and design work is more important than speeding up regular Windows operations, a board based on TI's 34020 processor, like Truevision's 1024-32 or Omnicomp's The Texan, is worth the higher cost.

are for DOS versions of AutoCAD, Lotus 1-2-3, Microsoft Word, and WordPerfect. See the table for which drivers are included. Board suppliers are adding new drivers all the time, so it's likely that the driver list provided by a particular board will be different by the time you read this.

Two of the 34020-based boards—The Texan, from Omnicomp Graphics, and WinSprint, from Artist Graphics—also support TIGA (Texas Instruments Graphics Architecture). From the user standpoint, TIGA is a collection of graphics routines. TIGA-compatible applications can communicate with graphics boards based on TI's 340x0 chips. A TIGA board has to support a minimal set of graphics operations. (For a more thorough discussion of TIGA, see "The Brains Behind the Graphics," November 1989 BYTE.)

Some Unique Traits

Although the boards are similar in function, some of them have interesting sidelines. The Truevision 1024-32, for example, features pan and zoom. Press the Alt-+ key combination and the screen is magnified two times; press it again and the screen is magnified four times. You don't have to be in any particular application to use this magnifier, which would be especially useful inside drawing software or helpful to people with poor vision who have to read small text.

Orchid Technology's Fahrenheit VA has two extra connectors on the back: one for a microphone, the other for an external speaker. The board supports a Voice Notes utility. Plug a microphone and speaker (or use the PC's internal speaker) into the Fahrenheit and you're ready to attach a voice note (an audible sticky note) to any application that supports OLE.

ATI Technologies' Graphics Ultra Pro, based on the company's own Mach 32 graphics controller, distinguishes itself with a multimedia hook: The video-RAM-based board can play back Microsoft Video for Windows (formerly AVI) "movies" in windows of up to 1024 by 768 pixels and at speeds of 30 frames per second. Besides being a Windows accelerator, the $799 Graphics Ultra Pro is a cost-effective means of playing full-motion video.

The WinSprint includes a handy Windows application, called Command Center, that lets you access menu-bar commands from a small pop-up window that you activate by clicking the right mouse button. So, for example, if you're inside your word processor and want to save a file, instead of having to move the mouse up to the top of the screen and pulling down a menu, you just click the right mouse button. The pop-up appears under your pointer. (You can tailor the pop-up for your favorite applications.)

Testing with New Benchmarks

I tested the accelerator cards using a modified version of BYTE's low-level Windows benchmarks. Specifically, the unmodified benchmarks time themselves

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PERFORMANCE AND FEATURES OF WINDOWS ACCELERATORS

We used the new BYTE Windows benchmarks to measure how fast each board is in three categories. If your work involves applications such as CAD and illustration, results in the basic-graphics category are most important; these tests time the drawing of ellipses, lines, rectangles, and polygons. If you're more interested in speeding up general Windows operations, the speeds of BitBlts and text display are most relevant. The numbers represent how many times the board performed a particular operation in 1 second. The results were normalized against a standard VGA card (Orchid's Pro Designer II). Performance leaders are in red.

	Basic-graphics index	BitBlt index	Text index	Chip type	Maximum RAM	Maximum refresh
Actix Systems GraphicsEngine	4.60	11.32	2.33	86C924	1 MB	72 Hz
Actix Systems GraphicsEngine 32	4.93	20.51	3.18	86C801	2 MB	72 Hz
Artist Graphics WinSprint	5.30	2.60	1.08	34020	20 MB[1]	75 Hz
ATI Technologies Graphics Ultra Pro	4.50	19.36	2.88	Proprietary	2 MB	76 Hz
Cardinal Technologies VGA900	4.53	10.96	2.29	86C911	1 MB	72 Hz
Celerite Graphics Galaxy 2000	1.82	5.51	1.14	Primus P2000A	2 MB	72 Hz
DFI VG-8000W	1.88	7.93	1.14	WD90C31	1 MB	72 Hz
Diamond Computer Systems SpeedStar 24X	3.21	9.84	1.37	WD90C31	1 MB	72 Hz
Kingston Technology ViewRx	1.27	5.61	1.52	W5186	512 KB	72 Hz
National Design Volante Warp 10	4.90	12.60	2.53	86C801	1 MB	70 Hz
Omnicomp Graphics The Texan	5.85	10.00	1.64	34020	10 MB[2]	72 Hz
Orchid Technology Fahrenheit VA	4.75	15.78	2.81	86C801	1 MB	72 Hz
Sigma Designs Legend GX	4.11	10.95	2.26	86C924	1 MB	76 Hz
Truevision 1024-32	3.54	2.58	1.91	34020	20 MB[1]	120 Hz
Video Seven WIN.VGA	1.69	3.23	0.98	HT216/F	1 MB	76 Hz
Western Digital Paradise	1.86	6.66	1.18	WD90C31	1 MB	72 Hz

NOTES
[1] 3 MB of video RAM plus 17 MB of DRAM.
[2] 2 MB of VRAM plus 8 MB of DRAM.

OTHER DRIVERS
A = AutoCAD/ADI
B = Cadvance
C = GEM
D = Generic CADD
E = Lotus 1-2-3
F = Microsoft Word
G = TIGA
H = Ventura Publisher
I = WordPerfect

Chips That Accelerate

S3 86C911

S3's 86C911 GUI accelerator, used in the Cardinal VGA900, enhances graphics performance by executing a number of primitive graphics operations in hardware. S3 has aimed the 86C911 straight at windowing environments such as Microsoft Windows, OS/2 Presentation Manager, and even the X Window System. You can see this if you examine the graphics primitives that the 86C911 supports in hardware. These include line drawing, BitBlts, rectangle fills, hardware clipping, and hardware cursor.

A software driver running on the host "talks" to the 86C911 by loading specified registers on the chip with command parameters and then storing a command in the chip's command register. These commands and command parameters are actually placed into an eight-command-deep FIFO (first-in/first-out) queue, which serves as a buffer between the host and the 86C911. Consequently, the 86C911 can be processing one command while the host is busy sending it another.

S3 86C924

The 86C924 (used by the Actix Systems GraphicsEngine and Sigma Designs Legend GX) is basically an 86C911 with minor enhancements and corrections. Apparently, there is a bug in the hardware clipping that the 86C911 performs in modes that support 1280 pixels across the screen. This means that drivers have to handle clipping in software for 1280- by 960-pixel modes when run on the 86C911. The 86C924 hardware fixes this problem.

S3 86C801

S3's 86C801 can handle up to 16 million colors in its 640- by 480-pixel mode. Where the 86C911 allows only up to 16 colors in 1280 by 1024 mode, the 86C801 can deliver 256.

For added performance, the 86C801 contains a read-ahead cache, so when the host CPU requests data directly from video memory, the 86C801 can actually prefetch additional bytes in anticipation of upcoming requests.

The 86C801's outstanding performance can be easily seen in Actix's GraphicsEngine 32 and National Design's Warp 10. Not only did the GraphicsEngine 32 turn in first-place individual scores for rectangle drawing and BitBlt operations, it also placed first in the aggregate text-output index. The Warp 10—though not placing

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Other drivers	Color modes*						Price
	640 × 480	800 × 600	1024 × 768	1024 × 1024	1280 × 960	1280 × 1024	
A,B,C,D,E,F,H,I	◒	◪	◪		□	□	$299
A,B,C,D,E,F,H,I	■	■	■		□	□	$199 with 1 MB
G	■	■	■				$1995
A,C,E,F,H,I	■	■	■			◪	$799
A,E,F,I	■	◪	◪		□		$349 with 1 MB
A,C,E,F,H,I	◒	◒	◪	◪		◪	$139
A,B,D,E,F,I	◒	◒	◪		□	□	$179
A,B,D,E,F,I	■	◒	◪	□	□	□	$249
A,E,F,H,I	◪	□	□				$149
A,B,C,D,E,F,H,I	■	■	◪			□	$299
A,G	◪	◪	◪				$1450
A,B,C,D,E,F,H,I	■	◪	◪		□	□	$299 with 1 MB
A,C,E,F,H,I	■	◪	◪		□	□	$329
A,E,H,I	■	■	■				$2295
A,B,C,D,E,F,H,I	◪	◪	◪				$129
A,B,D,E,F,I	◒	◒	◪		□	□	$249

COLOR MODES
□ 16 colors
◪ 256 colors
◒ 32,000 colors
■ 65,536 colors
■ 16 million colors
* Blank spaces mean color modes not supported.

internally—timing consists of a "software stopwatch" turned on and off before and after the Windows GDI (Graphical Device Interface) routine under test. Ordinarily, this would be fine, since the stopwatch would time how long it took the host CPU to carry out the graphics operations. With an accelerator in place, however, such a scheme would time only how long it took the host to pass the request to the graphics coprocessor. (As an example, the 86C911 has an eight-entry command queue; it can be carrying out one graphics command while the host CPU is simultaneously loading the next command.)

I therefore modified the benchmarks to display a white rectangle at the bottom of the screen while a particular test was under way. The rectangle would turn black when the test was completed. Thumper, the BYTE Lab's automated testing device (see Reviewer's Notebook on page 246), was watching the screen. One of Thumper's light sensors was placed near the screen over that rectangle, and Thumper simply timed how long the light sensor saw white. In this way, I could time how long it actually took graphics commands to be processed.

Each accelerator card was plugged into a Tangent Model 433i, a 33-MHz 486 PC (with 7 MB of RAM and a 100-MB hard drive), connected to a Nanao FlexScan

first—turned in scores that consistently put it in the top four.

Weitek W5186

The Weitek W5186 Windows accelerator, found on the Kingston ViewRx, focuses solely on boosting line drawing and BitBlt operations. (Weitek says 50 percent to 85 percent of the overhead in a typical unaccelerated Windows system is consumed in line-drawing and BitBlt operations.)

The host communicates with the W5186 in a style reminiscent of SCSI transfers. Specifically, the host processor initiates an operation on the W5186 by sending a 16-byte command packet to the graphics processor. Since the W5186 supports a 4-KB command queue, up to 256 commands can be queued up at one time (i.e., as long as there's room in the queue for a command, the host doesn't have to wait for the graphics coprocessor to finish one command before sending the next).

Primus P2000A

The Primus P2000A chip, used on the Celerite Galaxy 2000 board, was designed by Primus Technology. The P2000A is a graphics engine plus memory-control circuitry, host interface, video FIFO, and font-control circuitry on one chip. This hardware boosts such Windows activities as rectangle filling, screen-to-screen BitBlt operations, line drawing, and displaying of bit-mapped fonts.

Western Digital WD90C31

Western Digital's WD90C31 rides in the Paradise board. This graphics accelerator includes a hardware cursor and hardware BitBlt operations. Like other accelerators, it is VGA-, EGA-, CGA-, MDA-, and Hercules-compatible. The WD90C31's BitBlt hardware can speed the filling of rectangles. And, like the Primus P2000, the chip does *color expansion*, a means of accelerating the display of bit-mapped fonts.

TI 34020

Texas Instruments' 34020 is the offspring of the 34010, the original silicon heart of the TIGA (Texas Instruments Graphics Architecture) interface; it's faster than the 34010 and has a 512-byte instruction cache (compared to its predecessor's 256-byte cache).

Inside the 34020 you'll find a host bus interface and registers, circuitry to support local memory, and 31 32-bit registers. Most of the 34020's general-purpose instructions execute in a single cycle, although the 34020 also supports multicycle graphics instructions. (For example, the FILL instruction fills a 2-D pixel array with a color specified by one of the 34020's color registers.)

Some of the fastest benchmark times came from a 34020-based board. Take ellipse drawing, for example: The Texan whipped out ellipses more than 17 times faster than an unaccelerated board. Most accelerators were lucky to get them out 1.5 times faster.

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T660i multisync monitor. I ran only the graphics and text portion of BYTE's low-level Windows benchmarks, dividing the results into three groups: basic graphics (which includes drawing lines, rectangles, polygons, and ellipses), BitBlts, and text display. I loaded each card's driver and set the resolution to 1024 by 768 pixels and 256 colors where possible. The test results were normalized against an Orchid ProDesigner II VGA card, used in the same Tangent computer. To see how each card did in terms of speed, see the table.

I couldn't run some of the cards in the chosen color mode. As mentioned, the Kingston ViewRx allowed only 16 colors at 1024- by 768-pixel resolution. On the other hand, the 34020-based Truevision 1024-32 and WinSprint handled 16 million colors regardless of the pixel dimensions. You should keep these facts in mind as you examine the results—particularly for the Truevision and the WinSprint; these cards are moving 32 bits around for each pixel, whereas the others are moving just 8 bits per pixel.

Pick of the Pack

Omnicomp's The Texan and Artist Graphics' WinSprint scored in first and second place, respectively, under the basic-graphics category. They owe their high marks to the rapid ellipse-drawing capability of their 34020s.

However, unless your application specifically demands lots of circles, ellipses, or elliptical arcs, it's likely that you'll see no real benefit from high-speed ellipses. It's more likely that a typical Windows application will draw heavily on the accelerator's rectangle drawing and BitBlt operations. Consequently, I'd pick the GraphicsEngine 32 from Actix Systems as the best of the bunch for all-around Windows performance. If you were to drop The Texan's and WinSprint's ellipse-drawing scores out of the equations, the GraphicsEngine 32 would have scored first in all categories—basic graphics, BitBlts, and text display. The GraphicsEngine 32 does 16 million colors in 640- by 480-pixel mode and 65,536 colors in 800- by 600-pixel mode, and it comes with plenty of drivers.

I've got to hang an honorable mention on the Volante Warp 10 from National Design. The Warp 10 scored in the top four for all our tests, making it one of the speed leaders. It, too, comes with plenty of additional drivers, and the $299 price tag looks very attractive when you recognize that the Warp 10's 640- by 480-pixel mode can pump out 16 million colors. In terms of price/performance, the Warp 10 is an excellent buy. Likewise, Orchid's Fahrenheit VA did very well in the BitBlt and text tests and, at $299, is a great buy.

If you do decide you want to upgrade to a Windows accelerator, you've got to base your decision on what you need it for instead of simply checking raw benchmark results. Do you want to speed up screen redrawing under Windows, or are you more concerned with running AutoCAD faster? Be sure to check the list of supported drivers to see if your favorite applications are there. Does your work demand lots of colors or involve drawing lots of fine lines? Also, consider your monitor; some of the low-end cards don't support wide screens. And, of course, the price is always a consideration. But with prices starting at $139, that part's becoming less of an issue. ■

Rick Grehan is technical director of the BYTE Lab. He holds a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. You can reach him on BIX as "rick_g."

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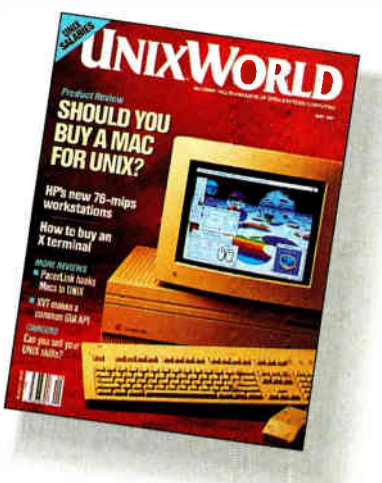

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SYSTEM

AST's PowerExec Goes Modular

ROB MITCHELL

A processor-upgrade option has become a checklist item for many PC buyers. Now the modular, upgradable PC architecture has found its way into the notebook computer market.

AST's PowerExec, built around Intel's power-saving 386SL processor, simplifies system upgrades by allowing quick replacement of the processor board, display, and hard drive. The PowerExec also enhances expandability by including two PCMCIA 2.0 slots. The slots accommodate a wide variety of industry-standard expansion cards, including AST's optional SCSI adapter, data/fax modems, and network adapter cards.

AST's new PowerExec notebook features PCMCIA support, a clip-on trackball, an upgradable screen, and (inset) a removable hard drive and an upgradable CPU.

Sticker Price

The PowerExec comes well equipped (see the photo). For $2395, the base system includes a 25-MHz 386SL CPU with a 64-KB cache; 4 MB of RAM; a monochrome sidelit triple-supertwist LCD; a 60-MB hard drive; a high-density 3½-inch floppy drive; serial, parallel, video, and expansion connector ports; and DOS 5.0. AST padded my unit with a 2400-bps PCMCIA modem card ($279), a security cable lock ($79), and its SmartPoint Cableless Trackball ($69). The system weighed in at 5.9 pounds (7.3 with power supply and cord) and measured 11.5 by 8.5 by 1.8 inches.

The trackball assembly clips to the case just below the space bar and plugs into a small interface that AST calls a "hotshoe." It works adequately (you'll still want to use your mouse at your desk) but is rather clumsy to install or remove. That's unfortunate, since it completely blocks the bay for the removable hard drive.

AST offers a long laundry list of options. You can upgrade to an 80-, a 120-, or a 160-MB hard drive, or you can add a desktop drive-bay adapter ($99) and share the drive with your desktop machine. If you're using the PowerExec as your desktop computer, AST's docking station includes two 16-bit expansion slots and two 5¼-inch drive bays for $499. The PowerExec supports up to 20 MB of RAM using proprietary, user-installable memory modules. An access panel above the keyboard pops off easily to expose the memory slots and math coprocessor socket.

continued

BYTE ACTION SUMMARY

- **WHAT THE AST POWEREXEC IS**
  A modular, 386SL notebook computer with upgradable components (including hard drive, display, and processor) and two PCMCIA 2.0 slots.
- **LIKES**
  Good performance; very good battery life; convenient removable hard drive; two PCMCIA slots and modular architecture make upgrades easy; processor architecture supports upgrade to 3-volt 486SL CPU; and screen and power management control buttons and lights are easily accessible.
- **DISLIKES**
  Unresponsive keyboard and poor key layout; PCMCIA card didn't eject easily in test unit; optional trackball is awkward to remove.
- **RECOMMENDATIONS**
  Ideal for users who want maximum expandability as well as good performance.
- **PRICE**
  $2822 (as tested)
- **FOR MORE INFORMATION**
  AST Research, Inc.
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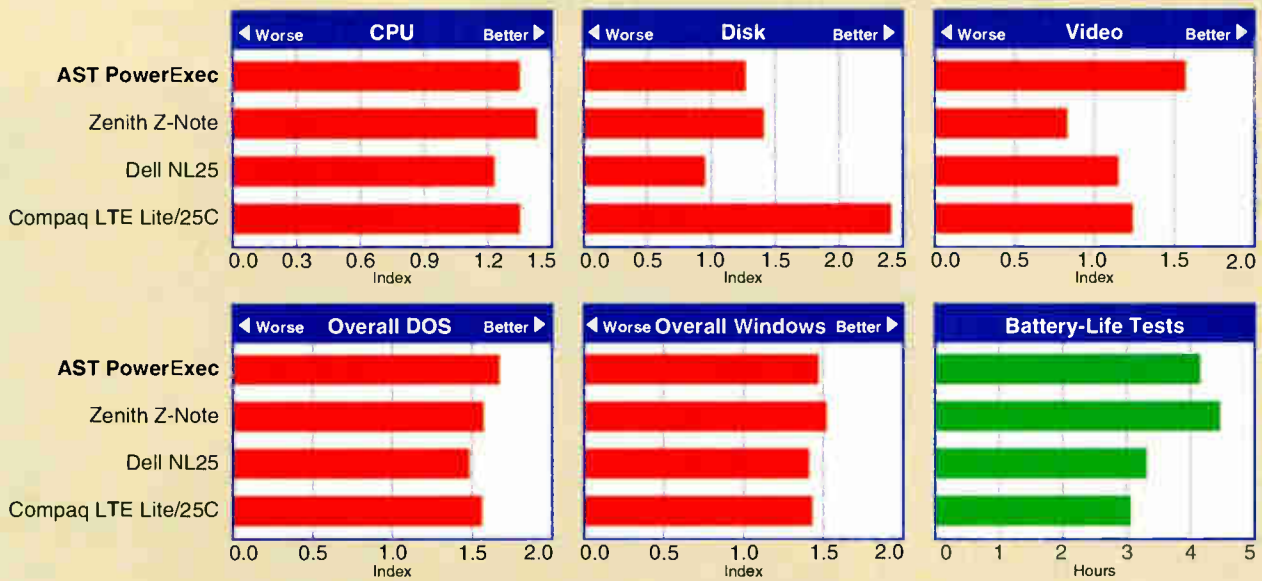
BYTE NOTEBOOK BENCHMARKS



BENCHMARK SUMMARY

	AST PowerExec	Zenith Z-Note	Dell NL25	Compaq LTE Lite/25C
Low-level benchmarks				
CPU index	1.35	1.43	1.23	1.35
Disk index	1.27	1.41	0.95	2.41
Video index	1.57	0.83	1.15	1.24
DOS applications				
Word processing index	1.64	1.46	1.43	1.40
Spreadsheet index	1.80	1.83	1.74	1.83
Database index	1.57	1.42	1.27	1.44
Overall DOS applications index	1.67	1.57	1.48	1.56
Windows applications				
Word processing index	1.63	1.80	1.57	1.62
Spreadsheet index	1.59	1.58	1.47	1.57
Database index	1.20	1.19	1.18	1.10
Overall Windows applications index	1.47	1.52	1.41	1.43
Battery-life tests				
(Hours:minutes)	4:09	4:28	3:19	3:04

Except for the battery-life tests, all results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Toshiba T2200SX running DOS 5.0 and Windows 3.0 = 1.

The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where performance bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: New Looks, New Numbers," August 1990 BYTE. The BYTE low-level benchmarks, version 2.2, are available in the byte.bmarks conference on BIX, or you can contact BYTE directly.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.0. We test three application categories for each environment, running test scripts using the following programs: Word Processing: WordPerfect 5.1 and Lotus Ami Pro 2.0; Spreadsheet: Lotus 1-2-3 release 2.3 and Microsoft Excel 3.0a; and Database: Software Publishing Superbase 4 version 1.3 and Borland dBase IV. The data files and test scripts are available from BYTE.

BYTE benchmark results show that the computing performance of the PowerExec ranks even with fast 386SL machines. The PowerExec's battery-life test results were outstanding.

The processor and display upgrades require dealer installation. AST hadn't released pricing for a 3-volt 486SL processor upgrade at press time. The two color displays are expensive; for the price difference, I recommend the active-matrix display ($2000) over the lesser-quality passive-matrix model ($1499).

Ergonomics

The PowerExec is a solid, well-built machine that's about as sturdy as other models we've tested. The 83-key keyboard has a poor feel and an awkward layout that features half-size PageUp, PageDown, Home, and End keys along the top row and a small right Shift key that's easy to miss. Two tiny support legs under the machine extend to create a better typing angle. A keyboard-based mouse emulator is awkward, but it's usable in a pinch.

The PowerExec's 9-inch VGA display, with 64 shades of gray, offers plenty of contrast. The external port will simultaneously drive an external color monitor at

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800 by 600 pixels with 256 simultaneous colors.

Easily accessible control buttons located above the display turn on power, adjust contrast and brightness, turn the display on and off, and put the computer in suspend mode, which shuts down everything except system and video memory. Other features include a removable hard drive, which slides out easily. The side-mounted floppy drive and PCMCIA slots worked fine, although the modem card I tested didn't eject properly.

One note of caution on PCMCIA cards: The ink was still drying on the software specifications as we went to press. While the cards complied with PCMCIA 2.0 hardware specifications, the driver software (designed by the BIOS manufacturer) did not. As a result, a card that works in the PowerExec requires a different driver to work in another machine. When version 2.0 drivers are available (they should be when you read this), differences between software implementations may still hamper compatibility between two machines that use different BIOSes.

Written documentation consists of a single pocket user's guide. There's no technical reference manual; the more complete documentation is on-line, but that doesn't help much when you're troubleshooting.

Power and Performance

The PowerExec uses one nickel-metal-hydride battery and offers just two power management options: "maximum performance" and "maximum battery life." It has no individual time-out settings for the display, processor, and hard drive. The PowerExec performs these functions automatically, based on your usage patterns. The SmartSleep option mirrors the current memory state to the hard drive and completely shuts the system down.

The PowerExec did well in BYTE's battery-life tests, running for just over 4 hours (see the figure). When the battery is depleted, the PowerExec drops into suspend mode and preserves the machine's current state while you drop in a second battery or hook up external power. The machine also accepts 12 AA alkaline batteries, which AST estimates will last 1½ hours. Recharging takes 90 minutes.

On BYTE's performance benchmarks, the PowerExec scored about as well as the fastest 386SL machines BYTE has tested (see "Eight Notebooks Keep a Tight Grip on Power," September 1992 BYTE). Despite relatively slow hard disk results in the low-level tests, fast video helped the PowerExec post strong results in the DOS and Windows application suites.

Beyond Upgradability

The PowerExec's processor and display upgrade options are appealing as a hedge against obsolescence, but as experience with desktop PCs has shown, few users of modular PCs ever upgrade. Planning ahead and buying what you need up front is usually a better solution.

Beyond upgradability, the PowerExec offers unprecedented flexibility, strong performance, and long battery life. The removable hard drive and dual PCMCIA slots are especially attractive if you want to use a notebook computer as your primary machine. The one disappointment is the keyboard's feel and poor layout—a problem common to many other notebook computers. ■

Rob Mitchell is a senior technical editor at BYTE. You can reach him on BIX as "rob_mitchell" or on MCI as "rmitchell."

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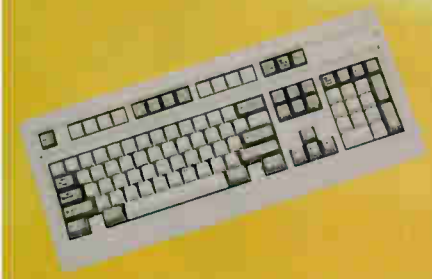

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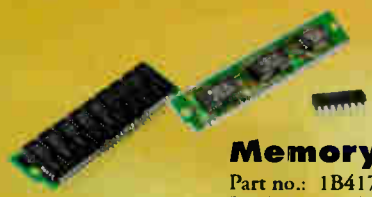

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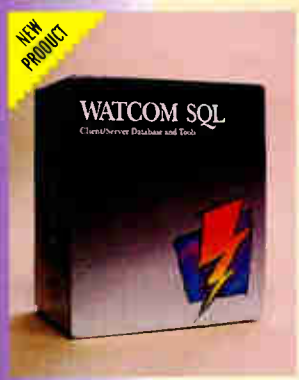

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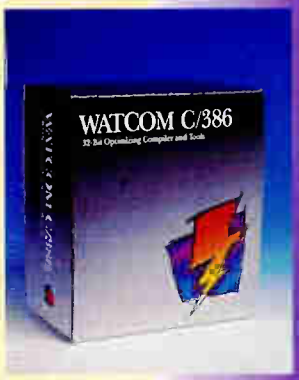

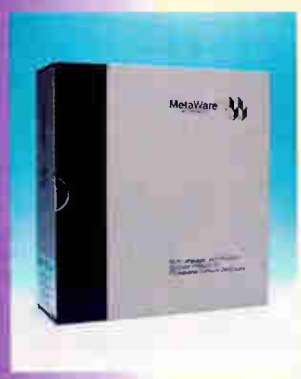

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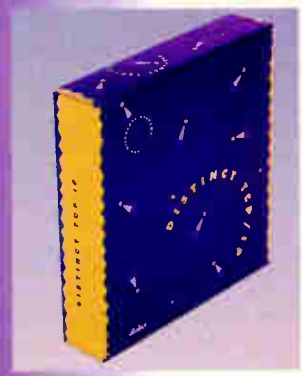

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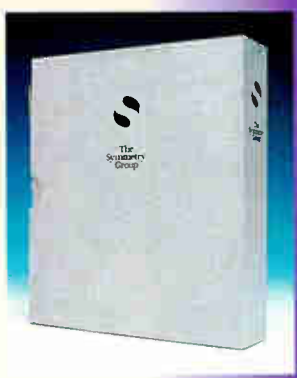

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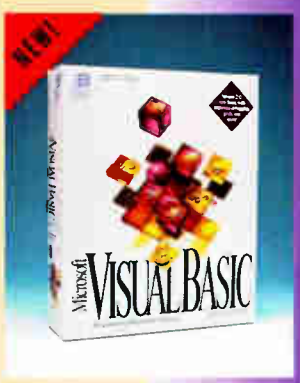

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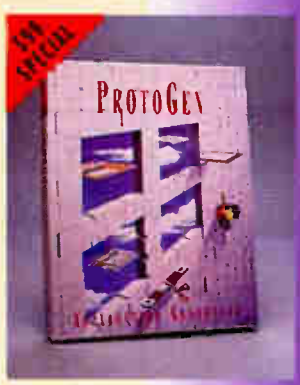

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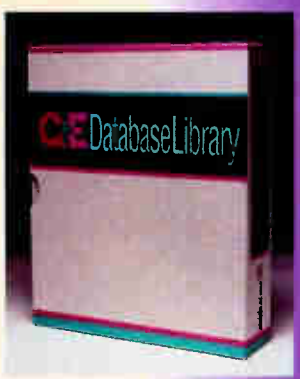

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HARDWARE

Desktop CD-ROM Publishing

JON UDELL

As the multimedia juggernaut rolls along, PC buyers have—at last—begun to view CD-ROM drives as standard equipment. Meanwhile, affordable CD-Recordable drives beckon to a legion of newly empowered desktop CD-ROM publishers. The $7995 Philips CDD521 was a star attraction at the revitalized CD-ROM Expo in Boston last September, and I rate it (along with similar products from Sony and JVC) as one of the two or three most important developments I've seen during my career at BYTE.

Six years ago I worked for one of the first companies to commercialize CD-ROM for the delivery of large quantities of data to the desktop. Dropping a half-gigabyte silver platter into a PC peripheral and rummaging through seemingly inexhaustible databases was a thrill I'll never forget. Producing those platters, though, was a formidable challenge. ISO 9660 (the now-standard CD-ROM file system) and MSCDEX.EXE (Microsoft's CD-ROM redirector for DOS) hadn't arrived yet, so our engineers had to invent a proprietary file system. To test our PC retrieval software against large data sets on a VAX-based premastering system required another clever hack: a CD-ROM emulator.

By 1988, the advent of MSCDEX, ISO 9660, and commercial emulators had taken a lot of the black magic out of CD-ROM publishing but hadn't eliminated the expense, delay, and uncertainty of the disc-mastering process. As a result, the growth of the CD-ROM industry has been a long, slow burn—until now.

The Philips CDD521 double-speed CD recorder writes 600 MB in a half hour.

Hardware and Software

At 16 by 13 inches, the CDD521's footprint is only slightly larger than my old Hitachi 1503S CD-ROM drive. Its 5-inch height, however, is twice that of the Hitachi drive. Into the extra space Philips jams the additional parts needed to not only detect but also create pits on the surface of a CD: a high-powered laser, a polarizing beam splitter, lenses, and control circuitry. Externally, the package is Spartan. On the back panel, you have access to a pair of SCSI-2 connectors, a SCSI DIP switch, a voltage selector, and the power switch. The front (see the photo) sports an open/close button and LEDs for power, read, write, and error status.

Philips bundles the drive with an Adaptec 1542 SCSI-2 adapter and ASPI (advanced SCSI programming interface) driver, a SCSI cable, MSCDEX.EXE, and a set of DOS utilities called CD-Write. Why ship the Adaptec controller with the drive? CD recording depends critically on an uninterrupted stream of data, particularly when—as with the CDD521—the drive runs at twice the normal CD play speed, requiring a sustained transfer rate of better than 300 KBps. (The drive's meager 256-KB write buffer doesn't help matters, and some resellers of the drive offer software that adds extra buffering.) To ensure best results, Philips chose to control CD-Write's environment by optimizing for the Adaptec. The company also specifies that your data source must be a hard disk with a sub-20-millisecond access time.

That hard disk, by the way, is the workspace where you assemble the material you'll write to the CD. CD-Write converts on the fly from the hard disk's DOS file system to the CD's ISO 9660 file system. It can also redirect the ISO 9660 image that it creates to a hard disk and can write such a preformatted image to the CD. You're unlikely to need the image-to-hard disk feature, since the recorded CD itself is ideal for archiving the image, testing it, and conveying it to a disc-mastering house. The image-to-CD feature could be handy if your authoring system can produce only ISO 9660 outputs.

Although CD-Write records only "mode 1" discs, the drive is also capable of "mode 2" formats such as CD-ROM XA (Extended Architecture) and CD-I (Compact Disc Interactive). To create such discs, you need an authoring system that can interleave streams of audio, video, and data, along with a formatter that can lay out sectors according to the XA and CD-I standards. Dataware Technologies is one reseller of the CDD521 that can use the drive this way.

Anatomy of a Writable Disc

The spiral track of conventional read-only CDs consists of a series of pits etched into a polycarbonate substrate that's covered by a reflective layer. Intensity of reflected laser light varies due to diffraction caused by the pits. In the case of writable CDs, the substrate has a *U*-shaped groove (600 nanometers wide and 100 nm deep) covered by a sensitive layer of organic dye and a reflective layer (usually gold). Using the groove to control rotational speed and radial tracking, the laser fuses the dye to the substrate to create impressions that ordinary CD-ROM readers can detect.

The price of a writable disc was initially $40, but it's coming down fast. Kodak recently announced a single-disc price of $25 and predicted $10 discs in three years. Why Kodak? The company's Photo CD

World Radio History

technology creates economies of scale for makers of writable discs and CD recorders alike. (The CD recorder that writes Photo CD discs is, in fact, the Philips CDD521.) That's great news for the nascent CD-recordable industry.

The writable disc's layout reserves two regions for control information. Innermost is the *power calibration area*. Here the drive performs a series of test recordings to find the optimal laser power for each particular disc. (Once this has been determined, the drive remembers the setting and retrieves it from memory when it sees the same disc again.) Next comes the *program memory area*. Since the drive can record up to 99 incremental sessions and does not store a permanent directory in the *lead-in area* until you finalize the disc, this area serves as a temporary directory.

Each session written by CD-Write is an ISO 9660 image. You can select and read any of these sessions with the CDD521. Only the first one, however, is visible when you load the disc into a standard CD-ROM reader. While Kodak's Photo CD player will read multiple sessions, CD-ROM drives available today—including those bundled with MPC upgrade kits—will not.

BYTE ACTION SUMMARY

- **WHAT THE PHILIPS CDD521 DESKTOP RECORDABLE CD IS**
  A CD recorder and ISO 9660 formatter that writes discs readable in standard CD-ROM players.
- **LIKES**
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- **DISLIKES**
  Its immature, quirky software.
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  Invaluable for testing CD-ROM discs prior to mass replication, or for low-volume production of discs. Also useful for archiving and transporting large quantities of data.
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Producing the CD-ROM disc was an amazing experience.

Do-It-Yourself CD-ROM Publishing

I've always wanted to put the indexed full text of BYTE onto a CD-ROM, and the CDD521 gave me the opportunity. Preparing the data, pumping it through the two authoring systems that I chose for the experiment, and running a series of small-scale tests on the CD took several days. Writing 265 MB to the final CD was anticlimactic—it took just 20 minutes.

I started with a collection of 4000-odd files representing the textual content of the last six years of BYTE—about 60 MB of data. First I ran a series of filters to clean up and reformat the text. Next I married the text to the contents of a database of BYTE articles, embedding headers at the top of each file to enable fielded as well as free-text search.

Then I unpacked two text-retrieval systems I'd been wanting to try out: Retrieval Technologies' re:Search for DOS (see "Searching for Common Threads," June 1992 BYTE) and Personal Library Software's Windows Personal Librarian (see the Reviewer's Notebook in the September 1992 BYTE). I used both to index portions of the data set and then eventually all of it. Duplicating the 60-MB data set to accommodate field codes specific to each retrieval system, along with adding the indexes, brought my image size up to 265 MB—still less than half the space available on the CD.

The drive's multisession capability allowed me to test small samples of data directly on the CD. Little problems (e.g., absolute rather than relative path names) become big problems when multiplied by 4000 files, so the ability to test incrementally is incredibly useful. CD-Write has one very annoying quirk. It can write one or more source trees to the CD, but it lops off the top level of each tree. This confused both retrieval systems. Indexes referring to files of the form `\ARCHIVE\1991\filename` broke when those files showed up on the CD as `\1991\filename`. To work around this oversight, I had to use a fake root that I alternately hid and revealed using the DOS SUBST command. Philips acknowledges the glitch and agrees it should be fixed.

Some valid DOS file and directory names aren't legal in ISO 9660. Filenames with hyphens and directory names with extensions are the notable examples. CD-Write alerts you when it spots an incompatible name and aborts. After a few false starts, I wished the program would scan the entire input name space and produce a comprehensive list of problem names. Some resellers of this drive offer software that will write non-9660-compliant names to the CD or that can map such names to legal 9660 equivalents on the fly.

At issue here is the ability to use a CD recorder not only as a publishing tool but as an archiver. Obviously, if you're publishing a disc, you'll want to comply with 9660. It's a different matter, though, if you simply want to dump the contents of your hard drive to long-term storage on a CD. In that case, you'll want to keep hyphenated names (which MSCDEX can, in fact, read) or else correct them automatically.

Opinions differ as to how useful CD recorders are for archiving. Sustaining 300 KBps for the duration of the write session is a stringent requirement, and if there's a break in the flow of data, you've wasted an expensive disc. It's impractical, therefore, to feed the recorder from a network drive. Even a heavily fragmented local DOS volume could pose a problem. While the ability to archive to CD is limited, however, it can still be useful in some circumstances. Philips agrees that a future version of CD-Write should deal with names in a way that better supports archiving.

Quirks aside, producing the CD-ROM disc was an amazing experience. For mass production of discs, you'll still need the services of a disc-mastering house, but the money you'll save by producing and distributing your own beta discs could pay for the drive in short order. Limited production you can simply do yourself, writing CDs on demand. The OSF/1 distribution discs, for example, are published this way using Young Minds' CD-mastering software for Unix and the Philips drive. If you think Quark, Frame, and PageMaker are the be-all and end-all of desktop publishing, you ain't seen nothing yet. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

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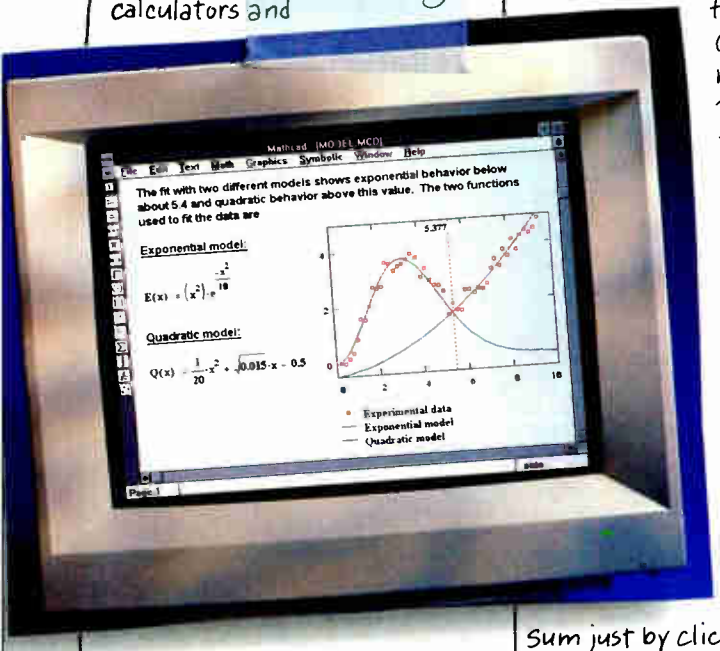

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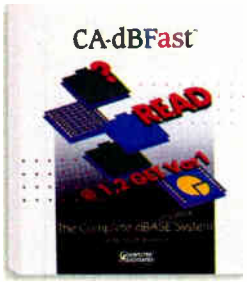

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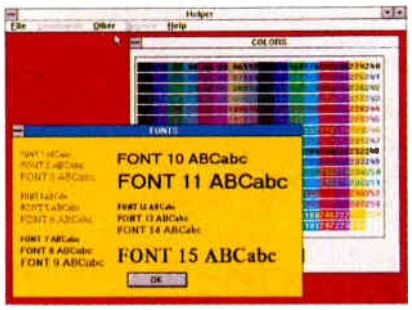

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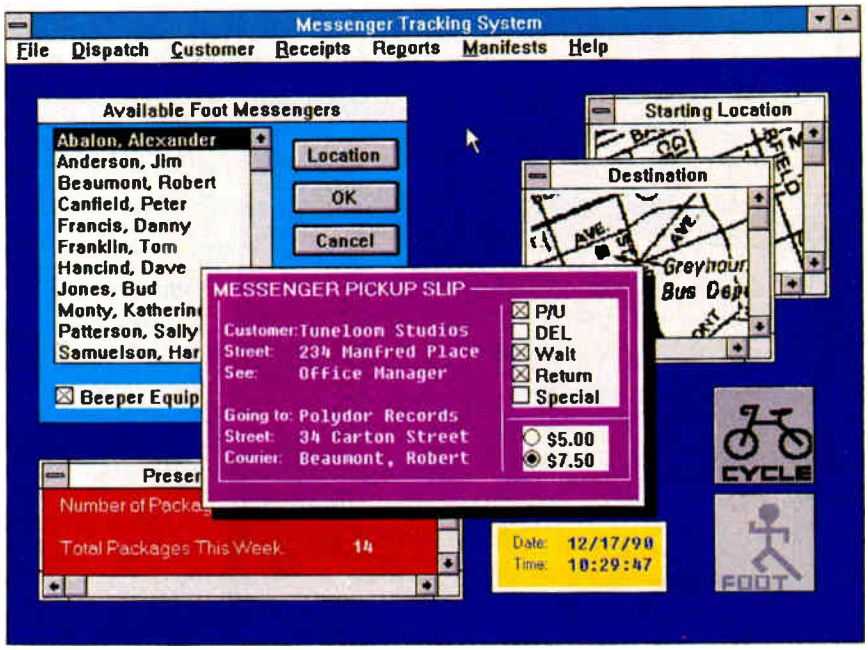

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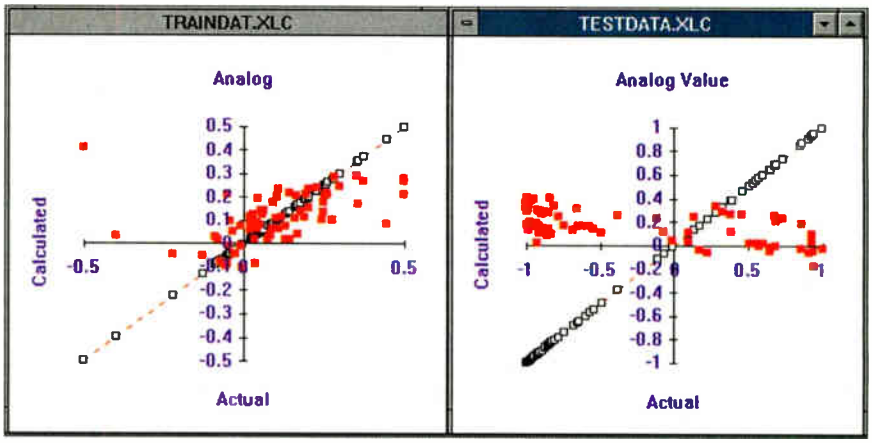
APPLICATION

Neural Net Adds Smarts to Spreadsheets, Slowly

MAUREEN CAUDILL



The charts demonstrate the Excel Braincel expert's performance in testing. The desired output values are displayed as open black boxes, and the expert's actual outputs as solid red boxes. In the left chart, the expert's responses matched the desired answers for the training data fairly well. (Perfect responses would have the red boxes lining up directly on the diagonal line.) The right chart shows that the expert did not yet generalize well with unknown inputs.

Wouldn't it be nice to have an expert inside your favorite spreadsheet program? One who could learn to make decisions just the way you want them to be made? One who could, like a neural network, mimic the learning processes of the human brain?

This enticing scenario is the premise behind Braincel, a $249 neural-network expert shell from Promised Land Technologies. The program is an add-in tool for Lotus 1-2-3 for Windows and Microsoft Excel. The company claims more than a thousand users in science and industry. According to Promised Land, the target audience includes business analysts who understand things like multiple regression and scientific analysts using the product as a modeling tool.

The developers at Promised Land have given a lot of thought to making neural-network simulators easy to use, and their notion of placing one within spreadsheet packages is wonderful. Unfortunately, Braincel's performance doesn't yet measure up to its promise.

Spreadsheets, with their sophisticated number-crunching capability, provide the easiest method of preprocessing data for neural networks. But it's awkward moving the data between the spreadsheet and the neural-network simulator. In most neural-network shells, you must use the spreadsheet to process and format the data, write it out to a file, switch to the simulator program, convert the file to the format the simulator prefers, and then create and train the neural network. Once the network is trained, you convert the network's output back to a spreadsheet file, reenter the spreadsheet, and analyze the results. The process is tedious and prone to error.

Promised Land has placed the neural-network simulator within the spreadsheet program itself and has provided programming macros to access the functions of the simulator. This makes the user interface uncommonly clean and simple to use. Braincel appears as an option at the bottom of the spreadsheet's Data menu.

Braincel uses a variation of back propagation—called *back percolation*—as its network model. In simple terms, a back-propagation neural network learns to perform a task through an iterative, supervised learning procedure. The network typically consists of three or four layers of individual processing elements, or *neurodes*. Each neurode in a layer receives input signals from each neurode in the previous layer and transmits its single non-linear output to all the neurodes in the following layer. The connections between the neurodes are individually weighted (both positively and negatively).

You train the network by presenting the input layer with a data pattern. The activity in the input-layer neurodes transmits to the middle layer and then to the output layer, where the network's answer is recorded. This answer is compared to the true answer for that input pattern. The resulting error first propagates backward to the middle layer and then generates changes to the weight values between the layers. This process repeats for each pattern in the training set. Training a back-propagation network can take from a few dozen passes through the entire training set to hundreds of thousands of passes for very complex problems.

Building an Expert Easy as 1-2-3

Within Lotus 1-2-3, you first format the data you want the expert to learn. For example, in Braincel's easy-to-follow tutorial, the program learns to assess the likelihood of a loan applicant's repaying a loan. In this example, input values include such things as the applicant's monthly income and expenses and number of dependents in the family. You enter the training samples into a spreadsheet, one sample per row.

Each of these data items has its own

BYTE ACTION SUMMARY

- **WHAT BRAINCEL IS**
  A neural network that works with Lotus 1-2-3 for Windows and Microsoft Excel.
- **LIKES**
  Spreadsheet connection; good user interface.
- **DISLIKES**
  Too slow for large-scale problems; poor documentation.
- **PRICE**
  $249
- **FOR MORE INFORMATION**
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  900 Chapel St., Suite 300
  New Haven, CT 06510
  (203) 562-7335
  fax: (203) 624-0655
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TRAINING TAKES TIME

The test network is a three-layer back-propagation (or back-percolation) network with 11 inputs, 25 middle-layer elements, and six outputs. The network's output consists of a single estimated prediction (the analog value) and five category nodes, which should have binary outputs (actually -0.5 or +0.5). A pattern is considered categorized if a single category node has a positive output while all of the other four category outputs have a negative output. The analog error is the average difference (magnitude) between the estimated prediction value and the true value for each pattern. The categorization error indicates, for those patterns in which the network generates a category, how closely the network's category matches the true category of the pattern.

	Braincel Lotus 1-2-3	Braincel Excel	Neural-network simulator*
Training data results			
Network model	Back percolation	Back percolation	Back propagation
Training time	18 hrs., 6 mins.	15 hrs., 24 mins.	2 hrs., 35 mins.
Number of training passes through data	5300	5300	5300
"Error" as listed in simulator's status information	10.3% average error per record	14.5% average error per record	20% true rms error**
Average analog error (smaller is better)	5.4%	4.8%	7.9%
Average categorization error (smaller is better)	0.18	0.23	0.08
Number categorized (larger is better)	62 of 75	56 of 75	62 of 75
Percent categorized (larger is better)	82.7	74.7	82.7
Number categorized correctly (larger is better)	55 of 75	49 of 75	60 of 75
Percent categorized correctly (larger is better)	73	65	80
Testing data results			
Average analog error (smaller is better)	20.3%	24.2%	18.5%
Average categorization error (smaller is better)	1.50	1.60	1.40
Number categorized (larger is better)	41 of 75	47 of 75	48 of 75
Percent categorized (larger is better)	54.7	62.7	64.0
Number categorized correctly (larger is better)	9 of 75	10 of 75	11 of 75
Percent categorized correctly (larger is better)	12	13.3	14.7

* SAIC's Ansim.

** Braincel returns "average" error rates, whereas Ansim uses rms error rates. The rms is a more accurate reflection of how well a neural network has learned a problem; therefore, a slightly higher rms error rate does not mean the Ansim network is less well trained.

reasonable range of values: Monthly income may vary from $0 to $10,000, for example. You decide on reasonable minimum and maximum values and specify these values in the two spreadsheet rows just below the data examples. Braincel uses these minimum and maximum values to scale all data items from 0 to 1. In other columns, you place the desired output for your expert. In the tutorial, for example, the output is a loan quality rating of 1 (excellent) to 5 (poor).

To train the expert, you indicate which open worksheet contains the training data and specify the named ranges containing the input and output examples. The network trains either until the error is reduced to a certain level, or for a specified period of time, whichever comes first. Once the expert has been trained, you query the network using the Ask Expert selection from the menu.

Documentation Needs Revision

Braincel provides some nice chart functions, including two that track the discrepancies between the actual outputs and the desired outputs in either bar-graph or scattergram form (see the screen). Unfortunately, the manual gives no details on how to produce these charts. After I called the helpful Braincel support people, I was able to get the charts to work fine.

If you know what you're doing with neural networks, you can ignore the manual and produce useful results with the simulator. If you're a beginner, chances are the manual will lead you astray.

Is Back Percolation Better?

Braincel has one serious problem: its performance on real-world problems. Braincel sounded like a godsend for one who is using a spreadsheet in conjunction with a neural network, because it would eliminate the awkward conversion process mentioned earlier. I tried Braincel on a scaled-down version of an existing problem to see how it compares with the neural-network simulator I've been using, Ansim from SAIC. I worked with both the Lotus 1-2-3 for Windows and the Excel (4.0) versions on a 33-MHz 386 PC with a 387 coprocessor under Windows 3.1.

The data set I used includes 11 input variables and six output variables. The output consists of a single analog value and five binary categories. A correct output provides an analog estimate, plus a single category determination that should coincide with the analog value. The two thus provide a confidence factor for each other. My actual data has thousands of samples, but for this test I restricted training to 75 randomly chosen patterns. I used a separate set of 75 patterns for testing.

Because of the complexity of the problem, I had little expectation that any of the networks would do well when trained on such a small amount of data. I just wanted to compare Braincel's performance with that of a network trained for the same number of passes on my commercial simulator, Ansim.

Braincel's automatic selection of both network size and learning parameter uses flawed heuristics. The middle-layer size it would have selected—nine—is far too small for a problem of this complexity, and the learning parameter was far too high. When I initially allowed Braincel to

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User Friendliness	8.2	7.7	8.3	8.1	7.5	7.0
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Frequency of Releases	8.3	7.5	6.7	6.9	7.7	7.2
Response to User Request	8.4	7.5	7.8	7.6	7.0	6.5
OVERALL SATISFACTION	8.3	8.7	8.5	8.3	8.0	7.6

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Report writing capabilities	7.84	6.54	6.59	6.50
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use its automatic heuristics, the network never dropped below 45 percent error after extensive testing, producing near-random outputs.

For my comparison, I specified a back-percolation network the same size as in my regular simulator, which uses a fully connected back-propagation architecture. I also set the learning parameters with similar values in each case.

I trained the three networks—Lotus and Excel versions of Braincel, plus my regular simulator—with this data for 5300 training passes and then tested each version on both the original training data and on the unseen test data. The results are shown in the table.

Braincel's back-percolation network performed marginally well in both tests. While the error reported by Braincel was half the rms (root mean square) error reported by Ansim, all three of the networks achieved similar levels of competence.

I found no indication that the Braincel back-percolation networks learned the problem any faster than an ordinary back-propagation network—if anything, their performance was a bit worse. According to Promised Land vice president Murray Ruggiero, back-percolation networks train "much faster than back-propagation and give better answers." He claimed an improvement of as much as tenfold in learning speed using back percolation; my results dispute this claim.

When I described the problem and my training results to Mr. Ruggiero, he said the problem should be recast to a single output (the analog value), thus eliminating the confidence-level categories, and suggested that when any network takes more than 1000 passes to train, the preprocessing has been done incorrectly. Such advice is totally misleading for many real-world problems. Difficult problems do take longer to learn.

His suggestion does imply, however, that back percolation may have difficulty with problems that have more than a single output response or with binary/analog mappings. Since Promised Land does not provide details of this algorithm, there is no way to judge its effectiveness except through side-by-side tests such as the one I used.

To make matters worse, what took 2 hours and 35 minutes in my regular Windows-based simulator took over 18 hours in Braincel's Lotus package to achieve. (The Excel simulator was somewhat faster, training in only 15 hours and 24 minutes.) I suspect that part of the performance problem is due to the overhead from the graphical Excel and Lotus environments.

The Bottom Line

While I love the notion of a spreadsheet-based simulator and had hoped that this product would rescue me from extensive drudgework, I have to give Braincel a thumbs-down for my purposes. Despite its nice charting functions and easy-to-use interface, its performance is too slow.

With a rewritten manual and better selection heuristics, Braincel might suffice for relatively small and simple applications, but performance considerations make it inappropriate for large-scale or difficult problems. ■

Maureen Caudill is author of In Our Own Image: Building an Artificial Person *(Oxford University Press, 1992) and has written extensively on neural networks and AI. She is a consultant based in San Diego, California. She can be reached on BIX c/o "editors."*

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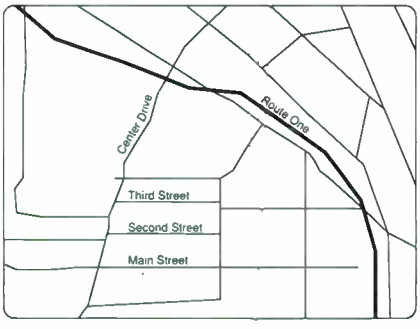

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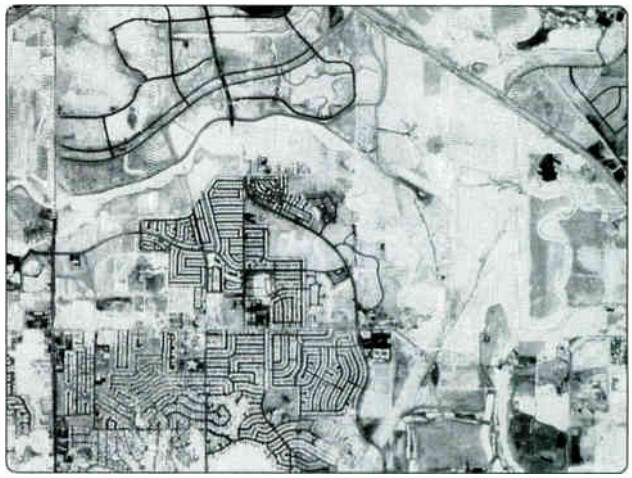

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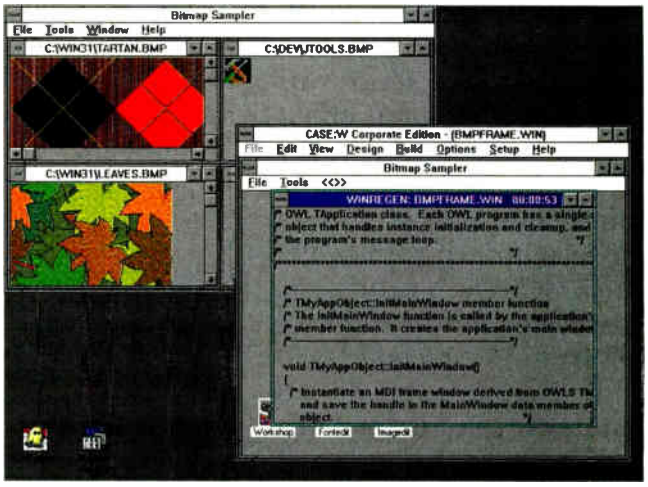

Screen 1: *Case:W 4.02 builds help systems automatically, includes strong support for MDI, and generates code for ObjectWindows.*

Windows programming is a complicated process. Class libraries like Borland's Object Windows Library (OWL) and Microsoft Foundation Classes (MFC) and environments like Visual Basic have gone a long way toward addressing the complexity. But there are still limitations: Visual Basic is too restrictive for some projects, and the class libraries just aren't suitable for quick prototyping.

Caseworks' Case:W and Blue Sky Software's WindowsMaker Professional are Windows development tools that remove these limitations. Each helps you build a user interface with remarkable ease, while letting you work with languages and libraries that can handle the most complex Windows programming job.

The latest versions of these applications generators add snap-in code-generation support for class libraries and other programming environments, as well as some ease-of-use enhancements. And while they present stylistic differences that may make you favor one or the other, one of them should be in every Windows developer's bag of tricks.

Plug and Play

Case:W 4.02 and WindowsMaker Pro 4.0 generate source code from visually specified user-interface designs. Each package consists of a visual design environment, a code-generation module, and a rules database for translating the visual design into program source (usually C and the Windows API). These new releases let you plug in new rules databases for different source targets, like the Windows NT API, OWL, MFC, and XVT's portable library package.

To use both packages, you fire up a Windows application in which you visually design user-interface elements such as menus and dialog boxes. Next, you let the code generator build source code from your design. The code carries all the functionality of the user interface that you've built. To this interface you add whatever additional code is necessary to complete your application.

Both systems supply a complete development environment, incorporating internal and external resource-design and editing tools. They also build a make file, which allows you to compile and link your new interface from within the designer. You can complete an entire project from start to finish without ever completely leaving WindowsMaker or Case:W.

To evaluate these packages, I designed and built the interface for two small applications. The first, Bitmap Sampler, is an MDI (Multiple Document Interface) application that shows Windows .bmp files in MDI child windows and lets you zoom and adjust contrast on each image. The second is a simple table editor that uses buttons and other controls inside the main application window.

Case:W 4.02

Case:W 4.02 includes a rules database for generating C code for the Windows API (Caseworks calls these databases *knowledge bases*). For the moment, you can also purchase additional knowledge bases for OWL and MFC; Caseworks plans to roll these knowledge bases into the base product (and maintain the price) in version 4.1.

Creating and changing menus is somewhat tedious in Case:W because you must constantly switch between the menu bar in your prototype and an "update" menu selection in Case:W's menu bar. Once you've defined a menu, you can link it to another menu, user-defined code, another window, or a dialog box.

One of Case:W's best features is its extended code support for dialogs, which lets you link program variables or functions directly to dialog-box controls. Extended code support can also include data-entry validation. Case:W's other unique features are automatic help-system generation and CUA (Common User Access) monitoring. Checking the Help system menu item makes Case:W automatically build help resource files (which you can edit with a Rich Text editor) and add a working Help pull-down menu to your application. CUA monitoring makes Case:W flag CUA violations in your design and offer suggestions (or automatically make changes) for adhering to CUA guidelines.

Building MDI applications is simple with Case:W (see screen 1). First, you tell Case:W that you want your main window to be an MDI frame; then, you generate another complete window prototype and link that in as an MDI child. Case:W builds the code necessary to initialize child Windows and adds the MDI-required Window menu to your menu bar.

Case:W built Bitmap Sampler into a .CPP source file, an .HPP header, and miscellaneous resource files. Case:W lets you make any additions to generated source you'd like (you just can't change Case:W code within a line), and it will preserve your code through subsequent generations. I found the added code preservation good enough that I didn't even bother to back up sources after a few design iterations.

The code quality was very good, but generation is a little slow; it took Case:W almost a minute to complete Bitmap Sampler (WindowsMaker only required about 4 seconds). I also had a minor problem when choosing the Help building option in the middle of a design, which left an ID definition out of the header file.

WindowsMaker Professional 4.0

WindowsMaker is very similar to Case:W in capabilities and architecture, but it has

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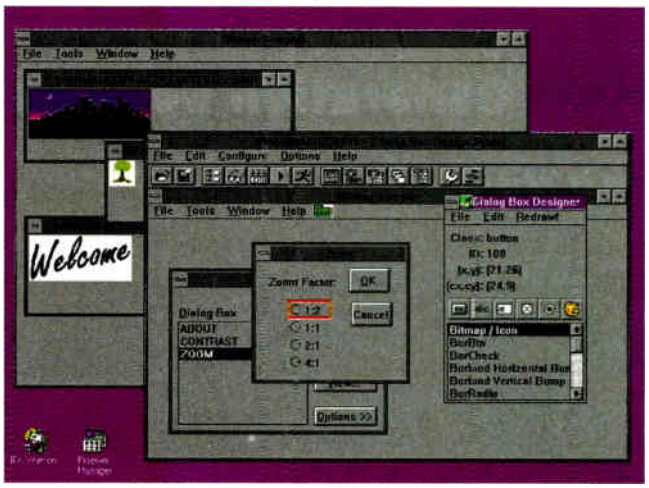

Screen 2: *WindowsMaker Professional 4.0 features a tool-bar-based interface and a built-in dialog editor as well as support for snap-in code-generation modules.*

some significant stylistic differences. Like Case:W, WindowsMaker supports plug-in code-generation databases (called Switch-It modules) for MFC, OS/2 Presentation Manager, OWL, the Windows NT API, and other environments.

Besides support for Switch-It modules, WindowsMaker's most notable new feature is its tool-bar interface. The tool bar lets you get to all the design, generation, and configuration utilities.

Menu-making is easier in WindowsMaker than in Case:W. You just point and click on menu elements to choose menu names, accelerators, and linkages. WindowsMaker also supports multiple menu sets, so you can build menus that need to change dynamically.

WindowsMaker also has a more comprehensive set of design tools than does Case:W. It has a sophisticated built-in dialog editor (see screen 2), which is easy to use and better than the editor provided by the SDK (Software Development Kit). Blue Sky's dialog editor can also pull in custom controls (e.g., Borland's 3-D style controls) from external DLLs.

In general, WindowsMaker has the better visual designer interface. However, it lacks much on-line help and some of the

BYTE ACTION SUMMARY

- **WHAT WINDOWS CODE GENERATORS ARE**
  Prototyping and development tools that generate user-interface code from a visual designer.
- **LIKES**
  They cut development time dramatically, even for applications frameworks; plug-in code-generation modules contribute to portability.
- **DISLIKES**
  Lack of synchronization with integrated compiler environments.
- **RECOMMENDATIONS**
  Choose between them based on personal preference, but every Windows developer should have one or the other.
- **PRICE**
  Case:W Corporate Edition 4.02, $995
  WindowsMaker Professional 4.0, $995
  WindowsMaker Switch-It modules, $495
- **FOR MORE INFORMATION**
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  Atlanta, GA 30338
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  fax: (404) 399-9516
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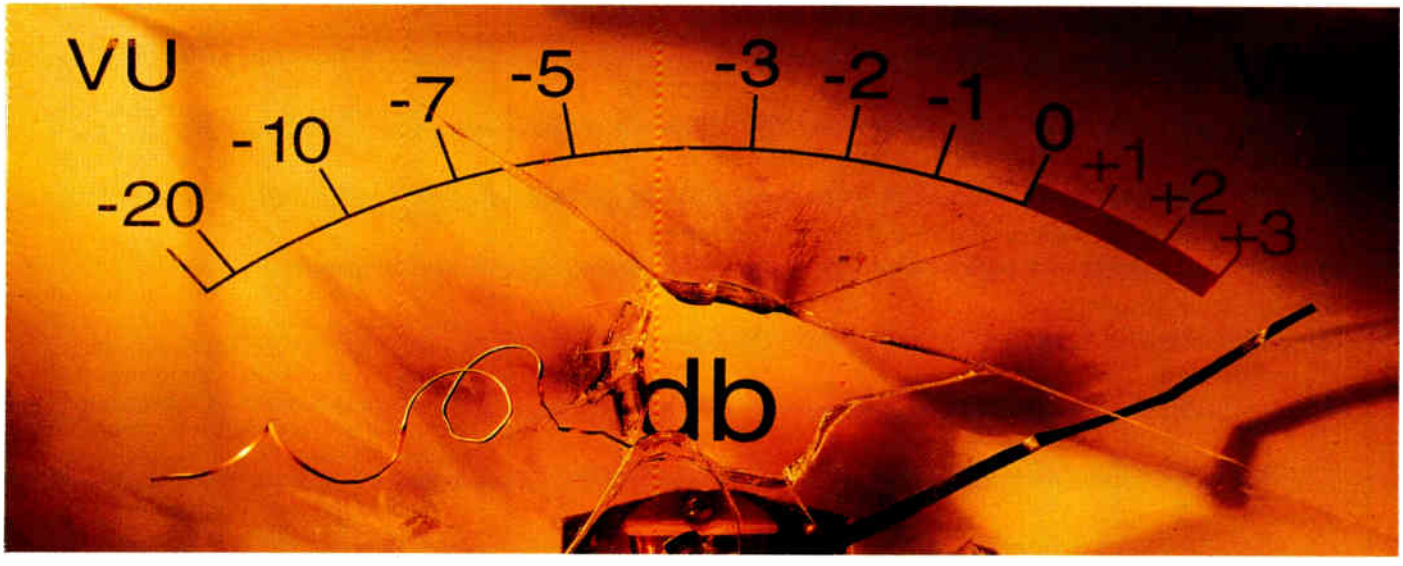

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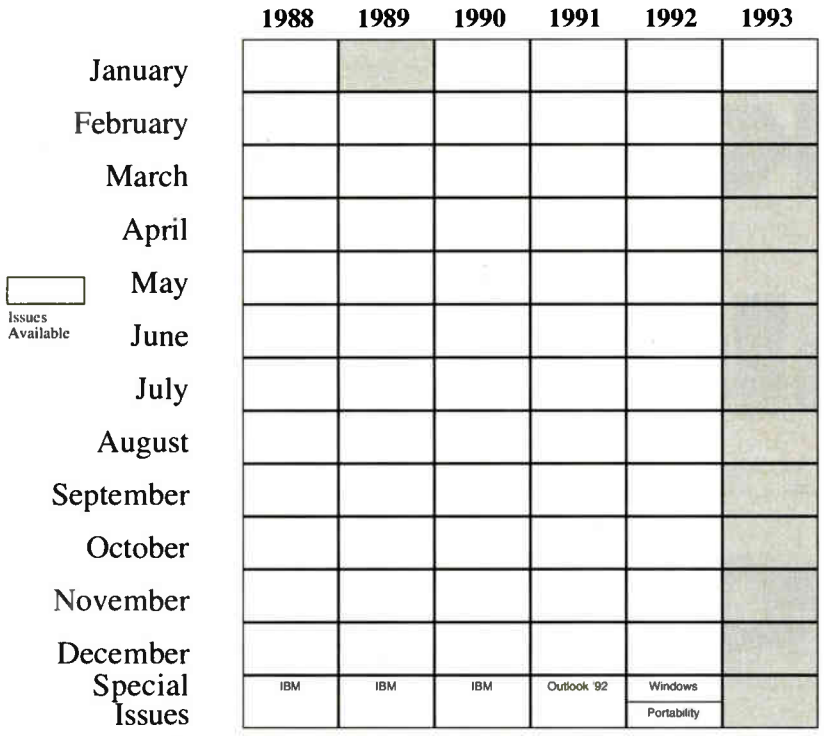

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nicer automated features of Case:W, such as the automatic help system.

WindowsMaker and Case:W diverge most sharply in the design of generated code modules and user modules. While Case:W builds a simple collection of files and relies on its code-regeneration algorithm to protect user additions, WindowsMaker builds a hierarchical system of protected and user-modifiable sources. There are three principal kinds of files: main source module, protected .WMC files, and user modules. Most user modifications go into the user modules, and you're not allowed to touch the .WMC files. WindowsMaker doesn't need to preserve user code, because it has full access to .WMC files and only declares user functions that you define in the user code modules.

This makes for a better-protected system but imposes some restrictions. The file structure closely parallels the structure of applications written to the Windows API, but I found it hard to get used to with MFC. When building MFC applications, you don't define window class member functions; you define global functions, which are called by member functions in protected modules. Blue Sky is working on changes in the MFC module structure that should make things more straightforward.

WindowsMaker supports controls in the client area (by modifying a dialog box to act as the client window) and MDI applications. However, its MDI support is more limited than Case:W's.

Final Thoughts

There are some difficulties common to both packages. The most significant is the conflict between integrated environments if you use a compiler with its own IDE. Case:W and WindowsMaker want to be your primary working environment, and getting them in sync with a compiler IDE is difficult. However, if you usually edit/compile/debug using command-line tools, you won't find this much of a problem. Also, I tested these products with small applications. Coordinating interface development with large sections of back-end code could prove more difficult. Finally, as a minor complaint, neither directly supports Windows 3.1 common dialogs.

But that's the bad news. Overall, I got hooked quickly on both these packages. They cut a huge chunk out of up-front development time, and they make especially nice additions to OWL and MFC. ■

Steve Apiki is a technical editor for the BYTE Lab. You can reach him on BIX as "apiki" or on the Internet at apiki@bytepb.byte.com.

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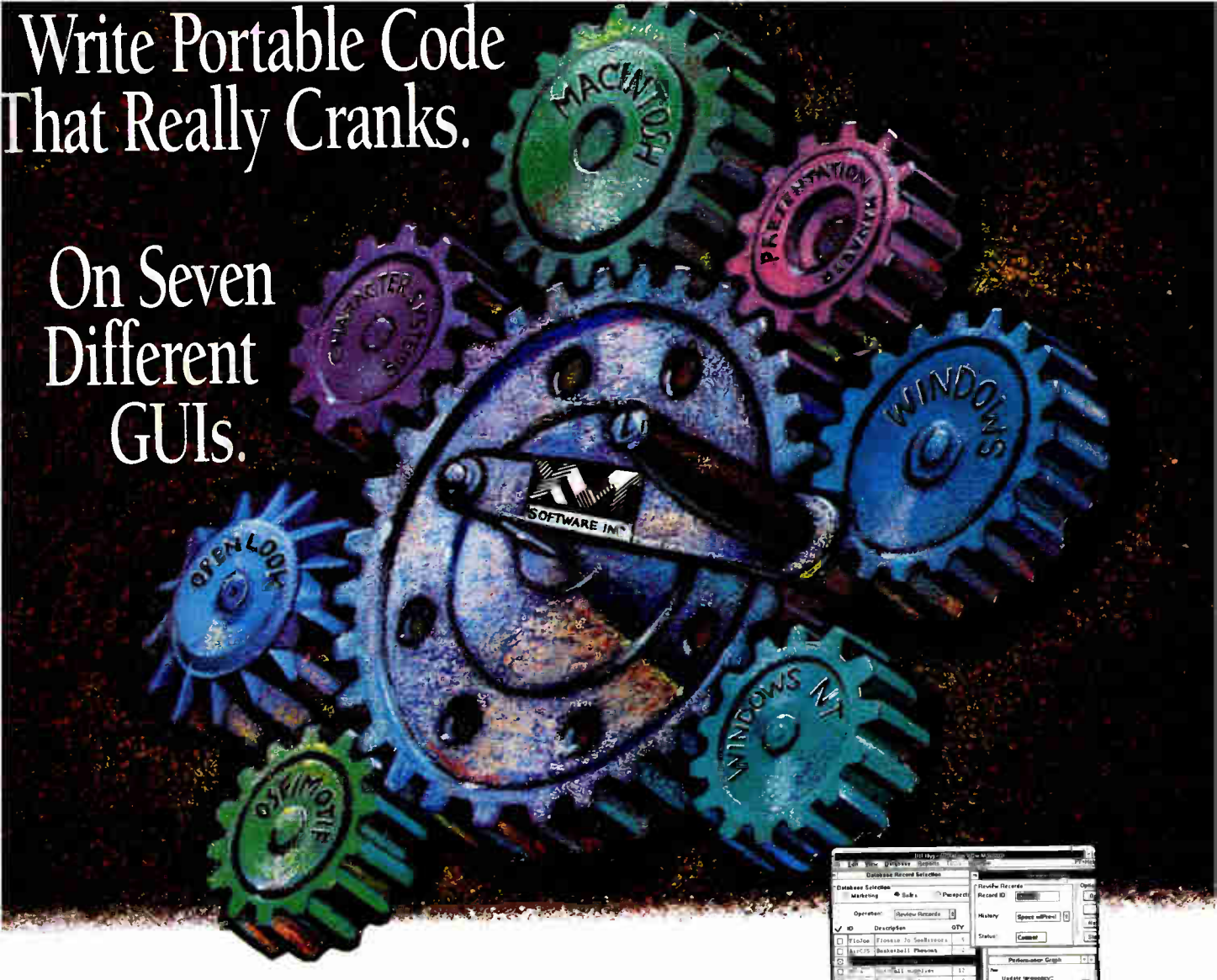

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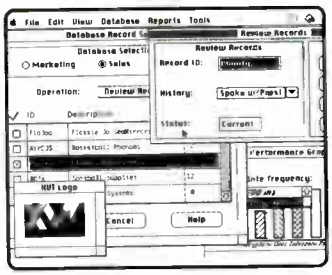
▲ Microsoft Windows & Windows NT



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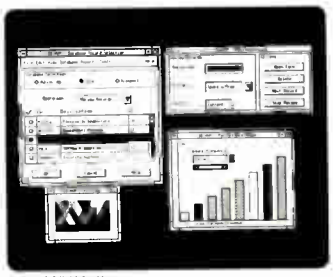

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APPLICATION

Topas 4.0 Simplifies 3-D

TOM YAGER

Among the new features of Topas 4.0 are bump and procedural maps, which give greater control over lighting and surfaces.

Topas, the 3-D modeling, rendering, and animation software from AT&T Graphics Software Labs, has long been a mainstay of graphics professionals. Now the audience is greater, with nongraphics types becoming interested in creating their own realistic 3-D images for logos, virtual prototypes, architectural previews, commercial animation, and business presentations.

The latest version of Topas continues to serve this audience with some enhanced features. But its commonsense interface also gives business people who are new to 3-D the tools to produce dynamic 3-D images and animations for presentations and other projects.

The Nickel Tour

Topas 4.0 is a complete 3-D graphics system designed for 386- and 486-based computers. It combines three vital components that all professional 3-D systems should address. First, it is its own modeler. With Topas, you can create 3-D objects from scratch or import and modify objects created elsewhere. Second, Topas has a built-in renderer, which uses the PC to calculate surfaces, the part of every object (real or simulated) that reflects light and shows the object's color, texture, and other visual attributes. The renderer then converts those calculations into graphics for your monitor or printer. It is the effectiveness of the renderer that determines how close your 3-D images come to reality.

And finally, Topas animates 3-D graphics. Topas can make objects move along a path you specify, make the objects change shape and surface characteristics, alter the point of view (or camera), adjust lighting, and control other elements that define a scene. A low-quality version of an animation can be created and played back directly by your computer. You can record one frame at a time to videotape or recordable laserdisc (or film, for that matter) to create high-resolution smooth motion.

Topas runs under DOS and manages its own extended and virtual memory. You'll need 8 MB of RAM, a compatible mouse or tablet, and a graphics display. Topas runs on many kinds of displays, including VESA (Video Electronics Standards Association)–compatible VGA controllers. I was disappointed to find there was no support for so-called "hi-color" VGAs. While Topas will run in any resolution supported by your VESA VGA, it will support a maximum of only 256 colors. In its defense, Topas does more with a 256-color palette than any graphics package I've seen. For more colors, you'll need more expensive Truevision Targa, Targa+, ATVista, or compatible boards. Drivers for the display-board component of Matrox Studio (see "Style Meets Substance in Matrox Studio," November BYTE) were not ready in time for this review, but they are on the way.

Topas operates with either one or two monitors. By making changes to an editable configuration file, you can direct the program's menus, wireframe object display and creation, and full-color rendering to either monitor in a two-monitor system. In the BYTE Multimedia Lab, I ran Topas with both a Diamond Stealth VRAM VGA and a Truevision ATVista with 4 MB of display memory.

One aspect of Topas that catches some people off guard is its security block. Topas will not run on any system that does not have the block plugged into its parallel port. This is the least intrusive of the copy-protection schemes I've seen; it actually controls not how many copies you make but how many you use at once (one). I sometimes find myself juggling around the many blocks I have because every block wants to be first in line. I wish security blocks weren't necessary, but I understand the need for them.

Getting to First Base

The previous version of Topas was short on packaging and documentation. The new manuals are a big improvement, and they include a well-done tutorial booklet that teaches you 3-D fundamentals and walks you through a few sample scenes. The reference manual, however, is laid out in the same structure as the program's pull-down menus. The manual should have been split between guide and reference sections, since material is needlessly duplicated.

Topas needs the most work in its online help. This version is the first with help, but it's not terribly useful. The help system is also linked to the menu structure, and it gives you a few scant words of explanation for any menu item you click on—but there are no keyword searches, no main index, and none of the structure you expect from a help system. Still, the documentation, particularly the tutorial, will get you up to speed fast, and Topas's commonsense interface makes trips back to

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TOPAS 4.0 SIMPLIFIES 3-D

the manual unnecessary after a while.

In a one-display system, all your drawing, menu selections, rendering, and animation take place on the same screen. Most functions are spread across the top of the screen in the ever-present menu bar; the rest are in the materials palette, activated by sweeping the mouse or tablet pointer off the bottom of the screen. That latter gesture may sound odd, but it becomes quite natural after a few uses. Topas is dominated by an "action-selection" paradigm: You choose first the action you wish to carry out, then the object or objects you wish to affect. This takes some getting used to, since most graphics programs use the "selection-action" model.

The lines between the modeler, renderer, and animator in Topas are blurry, because all functions are always available through a single menu hierarchy. Consequently, there's no abrupt shift from one module to another as your work progresses. Topas's modeler is impressive; it is easier to build new 3-D objects from scratch here than in any other PC package I've worked with. Right from the start, every object is 3-D—even the "flat" ones. As soon as you stretch out a rectangle or close a polygon, it gets assigned default color and surface properties, and you can render it immediately.

Topas offers both polygon and spline-based object-building tools. The menus offer an assortment of simple shapes, which you can combine to create more complex objects, and Topas includes a selection of scalable fonts. Release 4.0 adds the ability to read and make 3-D shapes from Adobe Type 1 fonts, including those used with Adobe Type Manager. I think that new users would get a lot of mileage out of the 3-D text and basic shapes alone—they're all that's needed to create most kinds of business graphics.

Topas's modeler can help you create more complicated drawings than the standard objects can provide. Its 2-D polygon and spline shapes are the basic building blocks of custom objects, and you can hand-draw them, import them, or trace bitmap graphics. They can be given depth in a remarkable number of ways, from simple extrusion (like pushing Play-Doh through a cutout in the shape of your 2-D object) to lathing (i.e., rotating a 2-D shape around an axis to create a cylindrical object such as a vase, a flashlight, or a bowling pin) to cross-section modeling (i.e., wrapping a skin around a shaped frame). Objects are brought together through grouping, and any operation that can be carried out on an object can be applied to the whole group. When you need more precision, an operation can be restricted to a single polygon within an object.

The modeler also offers you plenty of ways to modify the objects you create. One of the more interesting and useful functions is Drill, which cuts a hole through an object in the shape of a polygon you draw. Topas 4.0 adds the ability to drill to a certain depth—a powerful function that can be used to make an object appear engraved, for example.

Render Me This

Your model exists as a wireframe drawing until you kick in the renderer, which offers you a wide selection of shading methods, including flat, metallic, Gouraud, and Phong. Each object or polygon within an object can have its own surface properties, which include not only the shading method, but also the color, transparency, highlights, and other elements. Most surface properties are set through the materials palette, which also controls the color of

BYTE ACTION SUMMARY

- **WHAT TOPAS 4.0 IS**
  A professional 3-D modeling, rendering, and animation program for 386- and 486-based PCs. It is designed to be used both by experts and those new to 3-D.
- **LIKES**
  Simple, commonsense interface; performance; multilayer object maps; and rotoscoping.
- **DISLIKES**
  No surface preview; poor object map-positioning tools; and poor on-line help.
- **RECOMMENDATIONS**
  The best PC 3-D system for the money, Topas is easy to learn and use, it's adaptable to varying hardware configurations, and it produces stunning results.
- **PRICE**
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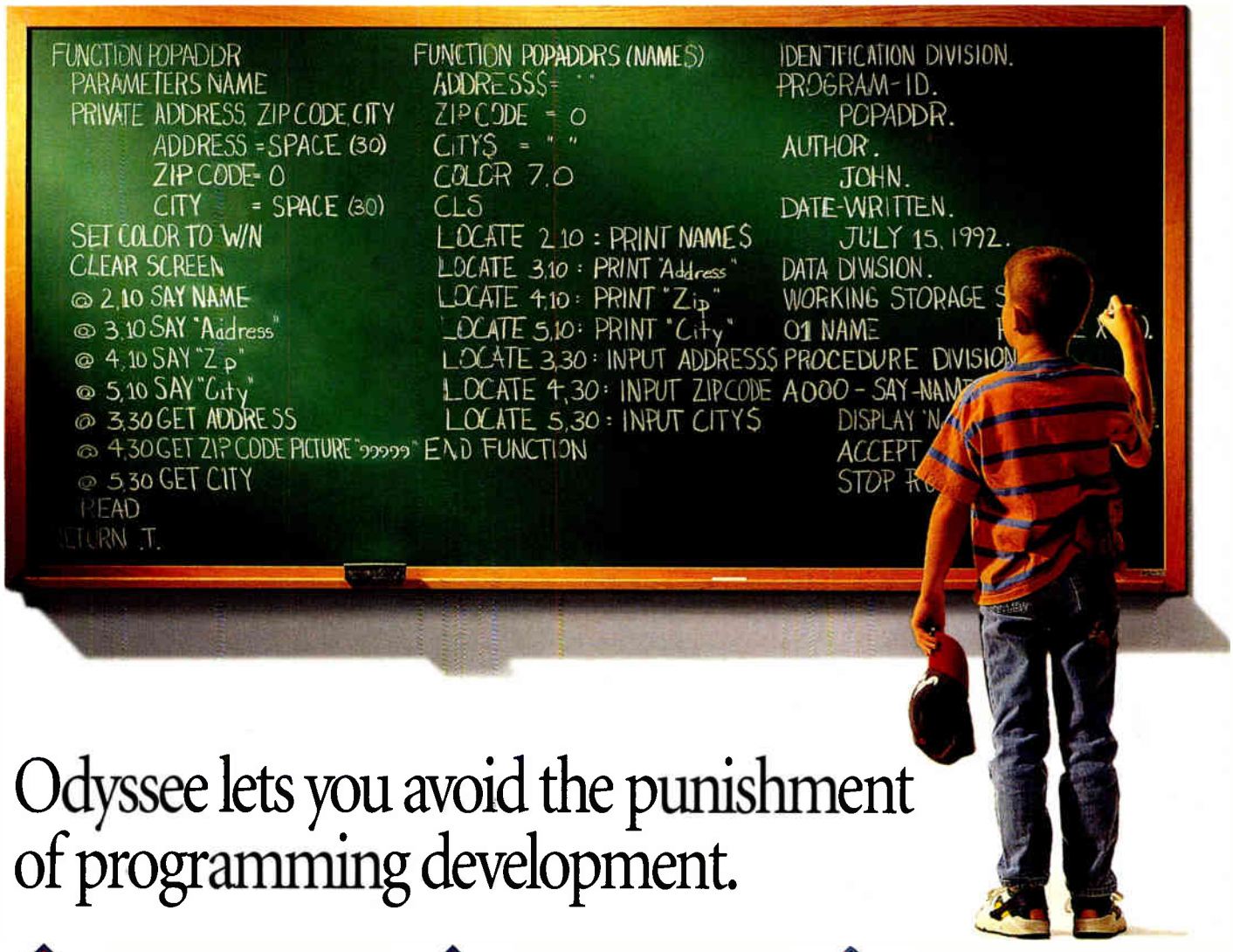

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the background and ambient lighting.

The materials palette can create surfaces that have only a single color; that's obviously not enough. For better than that, you must turn to Topas's object-mapping capability. An object map applies an image, usually taken from a graphic on disk, to an object's surface. You'd use object mapping, for instance, to put the text on the label of a champagne bottle. The new Topas adds procedural maps, images computed on the fly that look much like wood, clouds, marble, and other patterns occuring in nature (and some that occur only in your mind). Release 4.0 also adds bump, luminance, shininess, and other kinds of special object-mapping techniques that use a mapped image to change the way light reflects from an object.

A single object can now have up to 255 maps. Topas lets you create any combination of maps you like, which gives you the ability to create everything from decals to topographical effects. Maps are positioned on objects by sliding around a scaled version of the map inside a rectangle that roughly approximates a flattened version of the object you're mapping.

One of my key gripes about Topas is that it lacks a surface preview facility (except with procedural maps). Most 3-D packages let you see the surface you're working with mapped to a small shape—usually a sphere. With Topas, you must render an object to see the effects of the surface properties and maps you've applied. However, it's easier now than in previous releases, because the renderer will render a selected object, group, or rectangular window. I'm also not a fan of the map-positioning tools, which are too primitive for irregularly shaped objects.

Lights play an important role in 3-D, and Topas has a lot going for it here. In addition to the ambient light that washes over a whole scene, you can add spot, distant, and omnidirectional lights to your scene. These appear as objects, and you can move and color them as you would any object. One extremely helpful feature is the Light View, which puts a camera inside a light (usually a spot) so you can see exactly what it's pointed at. Another unique lighting method is animated sunlight, which lets you place your scene at a specified position on the earth and have a sun (i.e., a distant light) animated accurately according to the time of day, date, and weather conditions.

Topas's renderer creates realistic-looking shading (see the screen). A special type of map, the environment map, lets objects reflect the background and the objects around them. This usually requires ray tracing, a time-consuming operation for a

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PC. Topas does it by placing a camera inside the object that's being environment-mapped and spinning it around to create a panoramic map that reflects the object's surroundings. The effect is impressive and faster to create than ray tracing.

Move That Thing

Topas can create killer static images, but its forte is animation—created, as is everything else, on the main interface display. Most animations are created through keyframes: You drag objects from one spot to another and tell Topas how long you want it to take for the objects to move from here to there; then, Topas generates the in-between frames to create smooth motion. A new addition to Topas is path-based animation. Now you can draw paths, tracks that the objects follow as they move through your animation. The path and keyframe animation methods are interchangeable—you can view the movement you generate in paths or keyframes through Topas's animation-editing interface.

One good reason to make VGA a part of your setup is Topas's ability to generate disk-based animation. You can generate Autodesk Animator–compatible FLI or FLC files or Topas's own MVY movie file format. FLI and FLC files are widely supported, with playback utilities for various platforms available both commercially and in the public domain. Topas includes PLAYMVY, a DOS program that plays all of Topas's supported disk-animation formats. While disk-based animation is rarely the final destination for a 3-D package the caliber of Topas, it provides a valuable check and gives you an inexpensive way to share your work.

A far more interesting destination for Topas animation is video. The BYTE Multimedia Lab has a Panasonic AG-7750 professional Super-VHS VCR. Topas supports built-in VCR control through several VCR controllers, including the Videomedia V-LAN external controller and the Diaquest DQ-422 internal card. Topas's video device control is impressive. You can find specific locations on tape, do time-code striping, and capture video frames from within Topas and use them as maps.

But most interesting by far is Topas's rotoscoping. With this, you can use *moving* video as an object map. Topas automatically captures one frame at a time from a video source you specify (you can also use VGA movie files) while the animation is being recorded. When you play it back, the result is smooth animation of the objects you moved and perfect reproduction of your moving-video source in the surface of the object you selected.

Putting It All Together

Topas is a rich, complex program, and much of its worth lies in its unique usability. I appreciate this because I'm no 3-D expert; for me, 3-D is simply a means to an end. Topas has become an extension of my imagination, because its interface places few obstacles in the road between an image in my mind and a rendered scene.

There are some changes I'd like to see made, but Topas 4.0's enhancements place it comfortably at the top of 3-D systems in its class. In fact, the power Topas delivers for the price, combined with its ease of use, places it in a class by itself. ■

Tom Yager is director of the BYTE Multimedia Lab, a multimedia consultant, and author of Multimedia Producer's Handbook *(Academic Press, forthcoming). He can be reached on BIX as "tyager" and on the Internet at tyager@bytepb.byte.com.*

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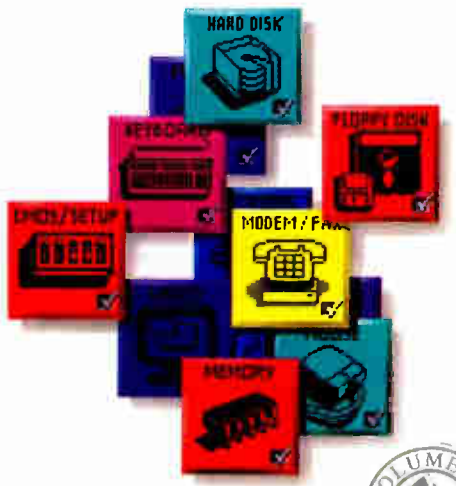

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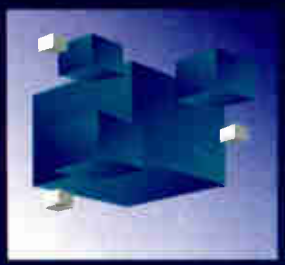

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SYSTEM

Commodore Gets Tough

TOM YAGER

Backed by 68040 processors and a more powerful operating system, Commodore Business Machines' two newest Amigas provide fresh ammunition to compete against today's multimedia-capable Macs and PCs. For Commodore, the new 3000T-040/200 and 4000-040/120 are important products in the Amiga's evolution.

The original Amiga 1000 was ahead of its time, with world-class graphics and animation, four-channel digital audio, and a multitasking operating system. But Commodore has been rightly criticized for failing to update the Amiga. Small advances, such as internal expansion and faster CPUs, seemed overshadowed by the awkwardness of the Amiga's user interface, the low-resolution graphics, and the sluggishness with which Commodore brought out new products.

Things have changed. Ever since the introduction of the Amiga 3000 in 1990, Commodore has been working diligently to update its hardware and software offerings. And even though display performance for 256-color video modes continues to be slow on the latest 68040-based models, these systems should do a lot to dispel the Amiga's reputation for being underpowered.

Both of these new Amigas feature modular 25-MHz 68040 processors. The 3000T-040 tower system is more expandable, with five Zorro (Amiga) slots and two dedicated ISA slots. The 4000-040 desktop machine is somewhat less expandable but boasts a new video controller, an IDE hard drive controller, and a high-density floppy drive.

Family Portrait

Both systems use the 25-MHz 68040, the same chip and speed used in Mac Quadras and Nextstation machines. Commodore packaged this power into two shapes. For those who crave space, the 3000T-040 (see the photo) has the expansion slots, the three half-height drive bays, and the 280-watt power supply for demanding configurations. The 4000-040 crams the same performance into a compact desktop case and also features some key architectural differences.

I tested both systems in BYTE's Multimedia Lab, where I ran LightWave 3D, ARexx, and a public-domain Mandelbrot generator to measure the systems' performance. The systems came installed with the newest version, 2.1, of AmigaDOS and with version 3 of the Workbench graphical environment. I created my own 3000T-040 by adding the 68040 CPU module to the lab's existing 3000T. That machine also has a Video Toaster installed in it, as well as Commodore's new 386SX Bridgeboard PC emulator.

The 68040 CPU (and associated components) is mounted on a daughtercard that plugs into a 200-pin expansion bus on the systems' motherboards. This is a smart design—it took me approximately 10 minutes to upgrade a 3000T from its standard 25-MHz 68030 to the more powerful 68040.

The 4000-040 is in many ways a departure for Commodore. First, the on-board hard drive controller has been changed from the Amiga-standard SCSI to IDE. SCSI has always been my preference, but IDE drives are sometimes easier to come by. The standard 3½-inch floppy drive is now a 1.76-MB device, a welcome step up from the long-standing 880 KB. Another plus in the 4000-040 is that Commodore finally brought the Amiga's video up to modern standards. In most video modes, the Amiga 4000-040's on-board video controller puts out 256 colors from a palette of 16.7 million (as do most Macs and some VGA-equipped PCs).

Like other recent Amigas (including the 3000T), you can use an ordinary VGA monitor with the new models. The new video controller still supports optional genlock (video overlay) and all the old Amiga video modes. If your applications software gets confused, however, the 4000-040 can emulate an older graphics chip set.

To accommodate the 68040, existing 3000Ts require a new set of boot ROMs. In addition to updating the system software to get it working with the 68040, the new ROMs give you greater control at boot time. If you hold down both mouse buttons as you power up or reboot, a graphical menu appears that invites you to select your boot device from the drives attached to your system.

This is expanded in the 4000-040's ROMs, which not only let you choose your boot device, but also allow you to alter your configuration by enabling and disabling drives as you require. In addition, you can choose to boot without executing the Startup-Sequence script (which is the equivalent of DOS's AUTOEXEC.BAT), make minor changes to your display

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configuration, and check the status of expansion boards.

The Expanding Universe

Amigas have had internal expansion capability since the 2000, and these new systems are carrying on the tradition. Both machines have four types of expansion connectors inside: 100-pin Zorro II/III Amiga board slots, 16-bit ISA bus slots, 200-pin CPU module sockets, and video expansion slots. The 3000T-040 has five Zorro expansion slots for Amiga-specific peripherals, two of which are in line with ISA slots to conserve space. There are also two ISA slots off by themselves, giving you enough room for a total of five Amiga and two PC boards. The 4000-040 has a total of four Zorro slots. Three of these slots double as ISA slots; the fourth is in line with the video slot.

BYTE ACTION SUMMARY

- **WHAT THE AMIGA 3000T-040/200 AND 4000-040/120 ARE**
  Amigas with 25-MHz 68040 processors in tower and desktop cases, respectively.
- **LIKES**
  Excellent integer and floating-point performance; smarter boot ROMs; significant operating-system enhancements; high-density floppy drive on the 4000-040.
- **DISLIKES**
  Commodore forbids expansion by owners; 256-color video modes on the 4000-040 are slow.
- **RECOMMENDATIONS**
  These are fast, stable, and affordable systems for 3-D, video, and multimedia, as well as for general applications.
- **PRICE**
  Amiga 3000T-040: $5998
  Amiga 4000-040: $3699
- **FOR MORE INFORMATION**
  Commodore Business Machines, Inc.
  1200 Wilson Dr.
  West Chester, PA 19380
  (215) 431-9100
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The Amiga isn't designed to run ISA boards. The ISA slots are intended for use with one of Commodore's Bridgeboards, self-contained PCs that run DOS applications asynchronously, sharing resources with the Amiga. The Bridgeboards plug into a Zorro/ISA in-line slot, driving the ISA bus and giving the Amiga a split personality. Running a PC inside your Amiga might seem an odd thing to do, but Commodore has engineered it so well that I cannot imagine running an Amiga without it. I use the Bridgeboard to hook my 3000T into the DOS networks in the Multimedia Lab. Software included with the Bridgeboard copies files between DOS and Amiga file systems. The PC on the Bridgeboard can use Amiga hard and floppy drives, and you can connect drives meant just for DOS.

Expansion Concerns

All this expansion capability is great, but whether you actually *can* expand your own Amiga is another question entirely. To insert an expansion board, add a hard drive, or change your system's jumpers (things that are all clearly documented in the Amiga manuals), you must break a warranty seal. Commodore's policy stipulates that only authorized Amiga service centers can open the case, and only they can reseal it.

While I understand Commodore's wish to protect itself from any damage that might be done by botched expansion attempts, the way Amigas are sold makes the policy unrealistic. In the U.S., Amiga dealerships aren't always just around the corner; the notion of shipping my Amiga to a service center to get an expansion board installed doesn't thrill me. Of course, not every dealer will charge you to open your case, and most current Amiga owners simply disregard Commodore's edict that users stay out of their own machines. But in this age of the power user—the very audience Commodore is targeting with these high-performance systems—it's a pity Commodore is sticking with a restrictive policy that Apple and most PC manufacturers parted with long ago.

The Amiga's New Clothes

AmigaDOS 2.1 (and some of the releases that preceded it) goes a long way toward addressing the issues that have kept the Amiga down all these years. Some of the changes are obvious: Workbench's Windows-like 3-D shading of window borders and graphical interface elements, for example. Other changes are less obvious, with the expansion of the Amiga's standard software set being foremost among them.

One of Commodore's strengths is the loyalty of its customers and software developers. The latest AmigaDOS/Workbench setup includes two key packages that were once sold separately by third parties: ARexx and CrossDOS. ARexx has been an Amiga mainstay for years. It is to the Amiga what GWBASIC once was to DOS, except that ARexx is, in some ways, more powerful. Rexx, the IBM-born programming language now seen in OS/2, has been adapted and given some Amiga-specific twists. It plugs into AmigaDOS's interapplication communication mechanism (port- and message-oriented) and can drive applications remotely.

Virtually every Amiga program written or updated in the last few years can be driven by ARexx, with one stand-out example being the Video Toaster. The entire switcher interface can be manipulated with simple ARexx commands, and even ToasterPaint has an ARexx port. It's ARexx that allows the Toaster to be driven remotely by video editors and other devices. This is possible because ARexx listens to the Amiga's serial port and the Toaster listens to ARexx.

CrossDOS is a nifty driver that lets you access DOS disks from an unmodified Amiga. After the driver is installed, any DOS disk you insert into the Amiga's floppy drive gets mounted and masquerades as an Amiga file system. No operation is blocked—you can even DOS-format blank disks. The Bridgeboard provides the ultimate PC connection, but CrossDOS is a comfortable compromise.

Video Entrenchment

My tests showed applications performance to be two to three times better for the new machines than for the 68030-based Amigas. The new operating-system software looks better, is more stable, and has more standard features than any previous release, and Commodore's hardware design is solid and sensible.

Amigas are now firmly entrenched in video, 3-D, and multimedia production markets. World-class applications like the Video Toaster, Scala, Deluxe Paint, and AmigaVision (included with every Amiga) show the value and viability of the Amiga in the markets it dominates. The performance boost, coupled with other software and hardware enhancements, brings the Amiga into the 1990s. ■

Tom Yager is director of the BYTE Multimedia Lab, a multimedia consultant, and author of The Multimedia Producer's Handbook *(Academic Press, forthcoming). He can be reached on BIX as "tyager" and on the Internet at tyager@bytepb.byte.com.*

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In The Beginning, There Was One 3.5" Drive.

SONY

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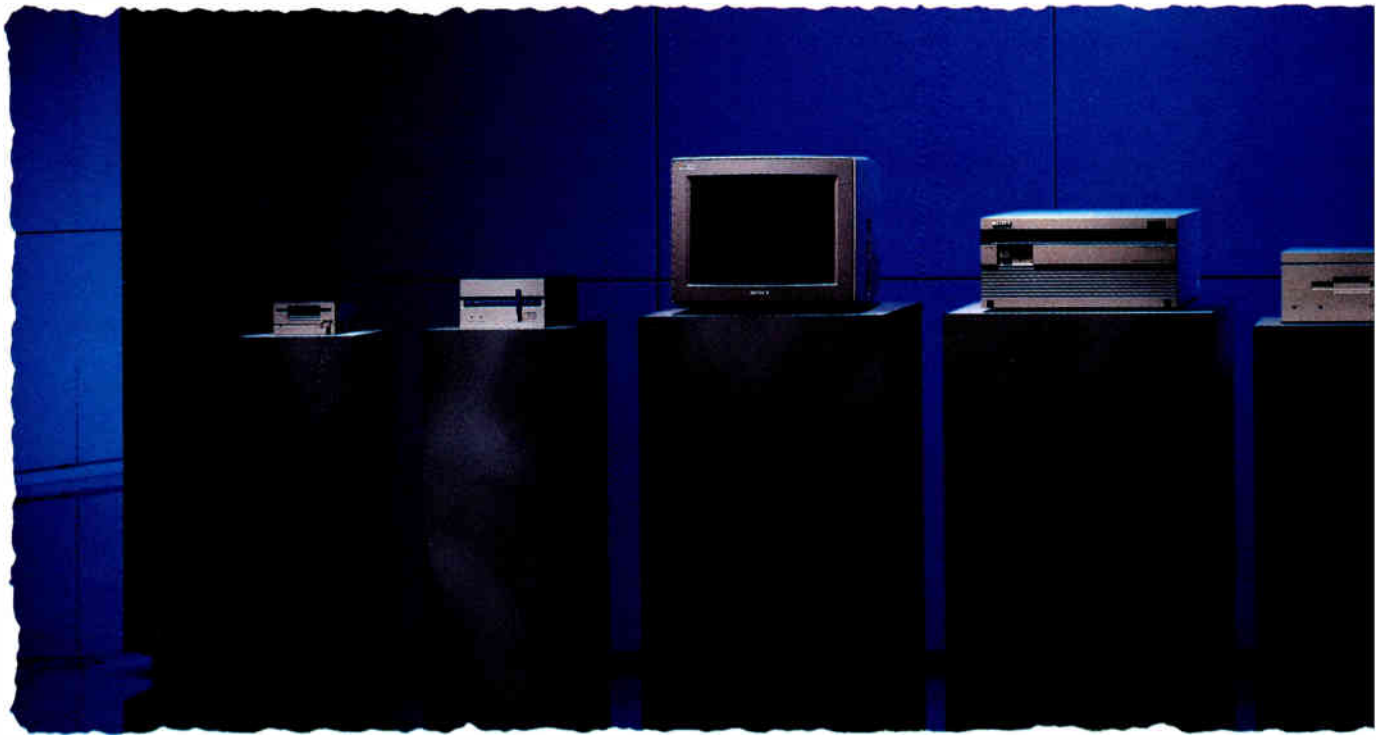

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1984: The first multi-frequency monitor.
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1987: The first DAT drive.
1988: The first 5.25" rewritable optical drive.
1989: The first DDS tape drive.
1990: The first writable CD.
1991: The video/computer integration protocol (VISCA™).
1991: The first 3.5" rewritable optical drive.
1992: The first portable CD-ROM XA player.

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HARDWARE

Photography by the Numbers

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You never have to buy another roll of film again. Or do you? Electronic photography has made terrific progress in the last few years. Take away the film, and cameras produce instant results, cost nothing to operate, and use no ecologically damaging film and chemical waste to be concerned about. Sounds idyllic—what's the catch?

Until a short time ago, the prices of electronic cameras would have made anybody shudder. Top-rated models like Kodak's DCS sold for $25,000—well out of range for most potential users. Low-end models such as Canon's Xapshot and Logitech's Fotoman sold for less than $1000, but they took pictures that looked more like still frames from an inexpensive camcorder. As the market continues to mature, manufacturers are building more mainstream models.

For several weeks, I've been shooting with two cameras in the $10,000 price range: Kodak's DCS 200ci and Sony's ProMavica MVC-7000 Still Video camera. These two cameras are nothing short of amazing. I've used a few of the $1000 electronic cameras before, and I wasn't impressed. But the DCS 200ci and the MVC-7000 are professional cameras, and, by any metric, they take high-quality pictures.

The Sony MVC-7000 (left) and the Kodak DCS 200ci (right) take pictures without film. Images are stored digitally on magnetic media.

Kodak's DCS 200ci

The DCS 200ci is the little cousin of Kodak's larger DCS 100 digital camera. Both models use a high-resolution CCD (charge-coupled device) array to capture color images digitally. The $25,000 DCS 100, which is built around a Nikon F3 camera body, is intended for full-time photojournalists and press photographers. The downsized DCS 200 is built around the smaller Nikon 8008s camera, and using it is like using the 8008s as a film camera. If you set the camera to auto-focus and auto-exposure, it's no harder to use than an Instamatic.

There are four models of the DCS 200: color or monochrome, with or without the internal hard drive. Any model can use external hard drives for extended shooting. Prices start at $8495 for the black-and-white model with single-image storage. I tested the $9995 DCS 200ci, the color model with the internal hard drive.

Kodak's contribution to the DCS 200 was in crafting a camera back that looks like a roll of film to the Nikon 8008s body. A 1524- by 1012-pixel-resolution CCD array mounts where the film would be, and the image memory, hard drive, batteries, and processing unit make up the rest of the back. There's a small LCD to show you how much space you have left on the disk and a 25-pin SCSI connection for attaching the DCS 200 to your Macintosh or PC. The integration to the Nikon body is incredibly well thought out. The back snaps onto the body and attaches securely with one screw.

The fact that the Nikon doesn't know about the digital back presents a few tradeoffs. The Kodak CCD array is physically smaller than a 35mm frame, so you can't use the entire viewfinder. To help you compensate for this, Kodak replaces the standard viewfinder with a custom one that grays out the edges of the frame. Consequently, you can't use the 8008s's famous "matrix metering" mode. Matrix metering is a sophisticated technique that sets the optimal exposure level for each photograph.

The hard drive takes between 3 and 6 seconds to transfer the captured image from the CCD array to the hard drive, so you can't set the Nikon to shoot at multiple frames per second. On the plus side, because of the small CCD array, any lens will behave as if it had a focal length 2.6 times its size. The standard 28-mm Nikkor AF lens gives you the same field of view as a standard 70-mm lens. For this review, I borrowed a 70- to 210-mm auto-focus zoom lens, which worked like a 200- to 500-mm zoom.

After you take a picture, there's a brief lag as the camera back hums to life, and a soft purr as the image transfers to the hard drive. To see your pictures, you have to connect the camera to a computer. The DCS 200 connects through a SCSI cable to either a Mac or a PC (equipped with a Future Domain 1660 SCSI adapter). I didn't have the required adapter handy, so I didn't have a chance to try out the PC software. The DCS software comes as a Photoshop

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Photo 1: *The resolution of the Kodak DCS 200 results in sharp, clear images at 1524 by 1012 pixels. The single-chip arrangement yields colors that are slightly softer than those you get from Sony's three-chip setup, and large neutral areas often have a subtle mottling effect. If you print the full image at 300 dots per inch, it measures about 3½ by 5 inches.*

Photo 2: *The Sony MVC-7000's resolution is lower than that of the Kodak camera, but its three CCD chips yield more accurate colors. Notice the slight pixelation in the doll's eyes. If you look closely at the blue button, you'll also see a bit of video bleed of the blue onto the gray background. The 768- by 493-pixel image printed at 300 dpi would be about 1.75 by 2.5 inches.*

plug-in (or on the PC as a PhotoStyler driver). On either platform the interface is the same: The camera sends the computer a series of thumbnail images. You select one and acquire it into a new document, like using a scanner.

Inside the camera, color images are stored in a compressed format. The pixels in the CCD array are covered with an RGB filter. When you transfer the image to the computer, an interpolation routine in the Photoshop or PhotoStyler module figures out the 24-bit color of a pixel by looking at adjacent pixels. You tell the interpolation routine what color light you shot with by selecting one of the standard settings or by clicking on a white area and letting the software do a dynamic white balance. The result is a crystal-clear, 1524- by 1012-pixel image (4.5 MB in size) with very good, albeit slightly mottled, color (see photo 1).

Sony's ProMavica MVC-7000

In the strictest sense, the Sony MVC-7000 ($7500 for the body; about $8900 as tested) isn't really a digital camera but rather an electronic camera. It captures your images on CCD elements, but instead of storing them digitally, it stores them as analog video still images onto removable floppy disks. Each disk can hold 25 complete video frames, or 50 images when stored as fields.

The entire Mavica line uses this still-video technique to capture and store data. What sets the 7000 apart from its lesser (and less expensive) brethren is that it uses three separate CCD elements to capture the red, green, and blue information for each pixel. The difference between images from the 7000 and the single-chip cameras is much like the difference between your home camcorder and those used by professional news crews.

What we normally think of as resolution limitations in video isn't due to the format as much as it is to the monitors we see it on and the fact that TVs and monitors usually use low-bandwidth cabling (RF or composite video). In either case, your home camcorder playing through your TV set typically provides about 200 lines of information. The MVC-7000 will record and play back images with over 500 lines of resolution. To capture the images at 768- by 493-pixel resolution, you have to connect to a high-quality video-capture device through RGB connections. In the field, you can use the camera's playback capability to preview your shots on a portable monitor.

The MVC-7000 doesn't have the look and feel of a conventional camera. It's an odd cross between a video camera and a large 35mm camera. The controls have video camera markings on them but were placed as they might be on a 35mm camera. Like a 35mm, the 7000 has automatic exposure, a self-timer, and a connection for a flash. A white balance control tells the camera how to compensate for odd lighting. My test camera came with an 8- to 48-mm 10× zoom lens. As with the DCS 200, the CCD elements in the 7000 are smaller than the equivalent 35mm film; the zoom worked more like a 40- to 250-mm lens.

The 7000 camera uses standard interchangeable Sony battery packs. The floppy disks are special Mavipak Hi-band disks, and you will want to take plenty of them along with you. I had only four of them, and I often had to use the preview monitor to pick out and delete some

BYTE ACTION SUMMARY

- **WHAT ELECTRONIC CAMERAS ARE**
  These cameras capture images electronically without film.
- **LIKES**
  No film is required, results can be previewed quickly, and output is exceptional.
- **DISLIKES**
  Lower resolution than film.
- **RECOMMENDATIONS**
  The resolution of both models makes them perfect for small images or newspaper-type pictures printed with coarse halftone screens; they're not good enough for shooting full-page glossy magazine images.
- **PRICE**
  Kodak DCS 200, $9995 (as tested)
  Sony MVC-7000, $8900 (as tested)
- **FOR MORE INFORMATION**
  Eastman Kodak Co.
  U.S. Marketing Operations
  343 State St.
  Rochester, NY 14650
  (800) 242-2424
  (716) 724-6888
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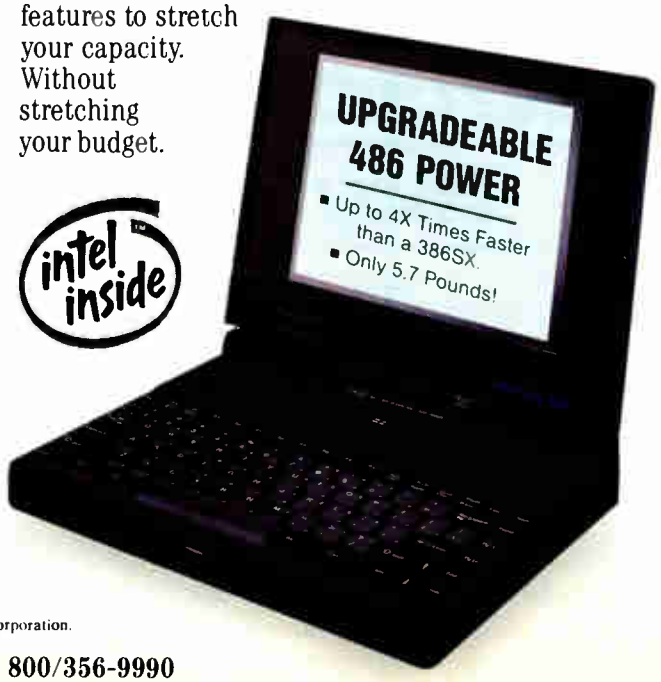

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images to make room for new ones. One distinct advantage of the video format is that the camera can record images very quickly. The 7000 can shoot a continuous 2.5 frames per second.

The camera body costs $7500, but accessories are not cheap. The tested model included the 8- to 48-mm zoom lens and sells for $8900. Other optional lenses include a 5-mm wide-angle lens ($2305), a 9.5- to 123.5-mm zoom lens ($3200), and a 7.8- to 78-mm zoom lens ($4180). A 10-pack of still-video floppy disks is priced at $105.

Like the DCS 200, the MVC-7000 is easy to use and takes gorgeous pictures. The three-chip arrangement eliminates the color mottling that the DCS 200 has and that you often see on cheaper still-video cameras. I captured my test shots on Truevision's ATVista board in a PC. Sony recommends the Macintosh or PC Truevision boards or its stand-alone video digitizer. You can use lower-quality digitizers, with a corresponding loss in quality. The MVC-7000 image in photo 2 has more accurate color than the DCS 200 image, but, at the same size, the image shows more pixelation and a bit of video bleed.

A Digital Future?

I do a fair amount of work with images in newsletters and other desktop-published documents. Either one of these cameras would be wonderful for shooting pictures for catalogs and product sheets. The resolution of both models makes them perfect for small images or newspaper-type pictures printed with coarse halftone screens, but not good enough for shooting full-page glossy magazine images. There's no film costs with electronic photography, and there's no film waste or processing chemicals. That fact alone should give electronic photography a clear advantage in a world with ever-increasing concern for the environment.

Kodak is targeting the DCS 200 at professionals who use images but don't make their living in photojournalism. The company suggests that the DCS 200 will be popular with scientists, real estate salespeople, and others who need high resolution but not the extreme ruggedness of the DCS 100, the DCS 100's preview monitor, or the fast shooting times. In a pinch, you could probably use your F3-based DCS 100 to drive tent pegs into the ground; the lighter-weight 8008s-based DCS 200 isn't going to take that kind of abuse.

Instant video preview, quick-change batteries and disks, and dazzling color distinguish the Sony MVC-7000. The 7000 is selling well to photojournalists, sports photographers, and others who might otherwise shoot with Kodak's more expensive DCS 100. If you lean toward the still-video solution, you'll need a high-quality video-capture board for your computer.

If $10,000 is too rich for your blood, the still-video option has several lower-cost solutions. Sony's ProMavica line also includes the lower-resolution, single-chip MVC-2000 for under $4000. Canon's still-video line starts with the RC-250 (also known as the Xapshot) and goes up to the new RC-570, similar in capability and price to Sony's MVC-2000. Right now, people using electronic cameras may be members of a small clique, but that will change as the costs continue to drop and cameras and computers continue to converge. ■

Howard Eglowstein is a BYTE Lab testing editor who holds an S.B. from MIT. You can reach him on BIX as "heglowstein."

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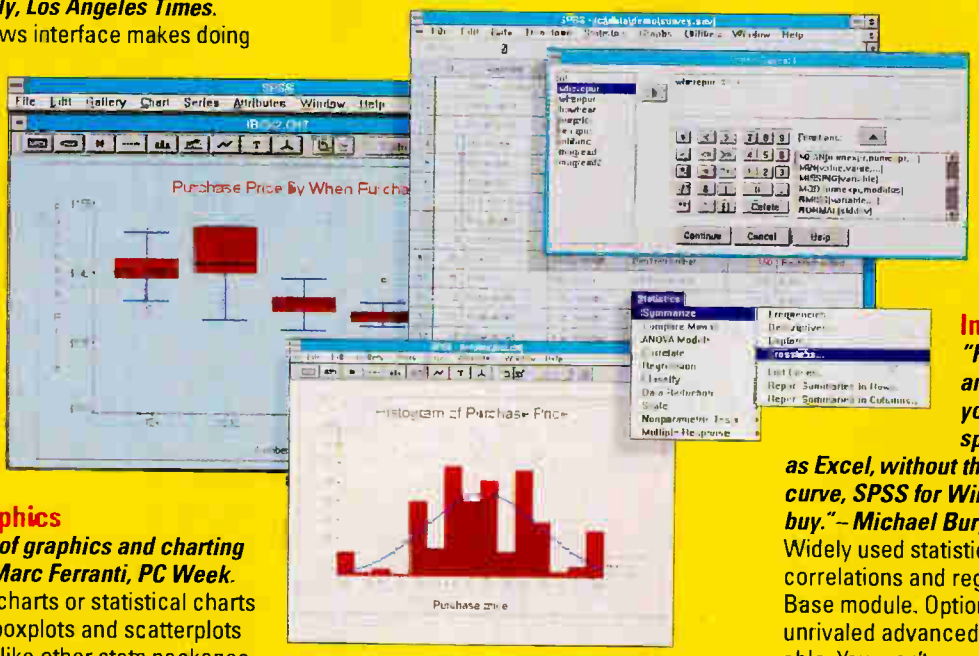

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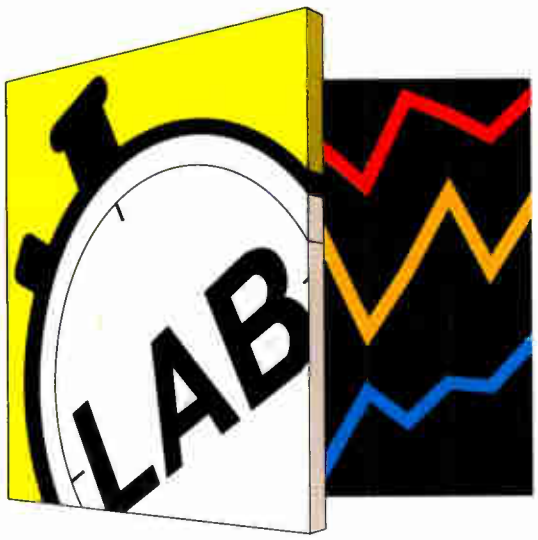
How to Give Windows a Workout

RICK GREHAN

BYTE's low-level Windows benchmarks exercise GDI, memory management, and file I/O routines



This month's roundup of Windows accelerators (see "Making Windows Rock and Roll," page 202) introduces the BYTE Lab's newest set of low-level Windows benchmarks. These tests complement the Windows application benchmarks that have helped us evaluate Windows products throughout the last year.

In addition to augmenting BYTE Lab evaluations, the latest tests allow us to easily put a Windows benchmarking tool into the hands of readers: As with our other benchmarks, we will freely distribute the low-level tests to anyone who requests them. The new tests also create a better balance in the testing the BYTE Lab does for Intel-based systems. We now have low-level and applications-level benchmarks for MS-DOS and Windows.

BYTE's new Windows low-levels are a comprehensive collection of tests that exercise Windows' GDI (Graphical Device Interface), memory management, and file I/O routines. We wrote the benchmarks in Borland's Turbo Pascal for Windows.

In this issue's roundup, we relied heavily on the graphics portion of the new benchmarks. This component ascertains how rapidly the system can execute some of the basic graphics calls within Windows—namely, those that display pixels, lines, rectangles, polygons (filled and unfilled), and ellipses. The graphics section of the benchmarks also exercises text display and BitBlt operations.

As we geared up for the accelerators roundup, we spent some extra time testing the benchmarks' graphics routines to get some preliminary data and to seek out any bugs left in the software. It was during this testing that we discovered something that might cause the benchmarks—as they were then constructed—to yield erroneous results.

At the heart of each test is a tight loop surrounding the Windows call under scrutiny. For example, the portion of code to test the SET_PIXEL() function might be

```
FOR I:=1 TO
  NUM_OF_ITERATIONS DO
    SET_PIXEL(hDC,xloc[i],
      yloc[i],color[i])
```

As you can see, the loop is simply "stepping through" an array of screen coordinates and corresponding colors. (The coordinates and colors are generated by a random-number generator beforehand.) This loop is preceded by a routine that turns a software "stopwatch" on, followed by another routine that turns that stopwatch off. The idea, of course, is to focus on timing the SET_PIXEL() routine and as little else as possible. Since we would test all the accelerators on the same platform, the fixed overhead of the loop would become a negligibly small constant.

However, many of the Windows accelerators we tested are designed to be coprocessors. That is, when the benchmark software issues a Windows GDI call, the accelerator card's software driver takes over to pass the command and its arguments to the board; then it returns immediately to the benchmark program without waiting for the board to service the request. Consequently, the software stopwatch records the time it took the driver to transfer the request to the board, not the time it actually took the board to service that request. The benchmarks may conclude that the GDI call is running faster than what the user actually experiences.

Therefore, the customized version of the benchmarks enables us to time how long the tests actually ran on-screen. To do this, we solicited the help of Thumper, the BYTE Lab's computer-controlled testing station for laptop battery life (see Reviewer's Notebook in the December 1992 BYTE). Thumper has electronic fingers and electronic eyes. With its fingers, Thumper simulates a user actually working with a laptop; with its eyes, Thumper watches to see when a laptop's screen blanks off.

We created an "on-off" light—a small rectangle at the bottom of the display that we could turn on (i.e., fill with white) just before the FOR loop in the code above and turn off (i.e., fill with black) just after the FOR loop. With one of its electronic eyes trained on that bar, Thumper acted like an ideal lab technician with a stopwatch. Thumper simply timed how long the rectangle was white, and that told us how long it took the FOR loop to execute. Knowing the number of iterations of each loop, we tracked how many GDI calls per second the benchmarks were making. (Again, the small constant overhead of the loop itself would factor out, since we ran the tests on the same hardware and only changed the accelerator cards.)

The "Thumper-ready" version of the benchmarks worked quite well and gave consistent results. The adventure also yielded some information that we'll be able to feed back into BYTE's "regular" Windows benchmarks, as well as producing ideas for other testing chores we could assign to Thumper. It's likely you'll see Thumper again in the future, keeping watch in ways we never dreamed of when we designed it. ■

Rick Grehan is technical director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. You can reach him on BIX as "rick_g."

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The Evolution of CAD

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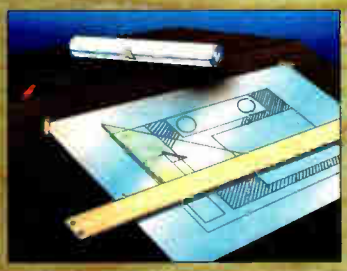

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BOOK AND CD-ROM REVIEWS

HUGH KENNER

GOINGS-ON AT THE EDGE

Complexity: The Emerging Science at the Edge of Order and Chaos
M. Mitchell Waldrop
Simon & Schuster, $23,
ISBN 0-671-76789-5

The growth of any plant from a tiny seed, the unfolding of a program from a few lines of code, "the self-organized flocking of simpleminded birds"—well, any of those, the messy as much as the lively, can be generated by "incredibly simple, even elegant theory." So an economist named Brian Arthur assures us.

Arthur means three things at least: (1) That a general theory underlies this array of examples and many more; (2) That a computer program to emulate, say, the flocking of those birds can be very simple; and (3) That the decisions made by live birds likely resemble those in the program, which has just three rules: (a) Maintain a minimum distance from anything else, including other birds; (b) Try to match velocities within the neighborhood; and (c) Move toward what you see as the neighborhood's center of mass.

It seems a reasonable guess that simpleminded birds in the real world are making decisions like those. Certainly, they swoop as though possessed by a corporate mind: much like an economy, which can languish, swell, panic, triumph, and never seem to be following a checklist. An economy is also like the birds in not needing to settle down to a stable state.

True, classical econ had always assumed that not settling down, as portrayed in every day's headlines, was something theory shouldn't so much as mention. Classical econ had nothing to do with swoops. It preferred systems nested near the median of stability: systems from Adam Smith's preindustrial world. Small perturbations would diminish till they vanished: negative feedback in action. And the optimum product would emerge, at the optimum price.

But an industrial economy seems never to settle down. Its elements seem to be patterns and possibilities. It lacks a stable state—one symptom of positive feedback. And examples abound of something suboptimal grabbing the market seemingly for keeps: the QWERTY keyboard, the gasoline engine, the VHS video format.

After 1982, when he'd grown pretty well convinced that he knew how an economy worked, Arthur began to encounter difficulty getting colleagues to stay orderly till he'd finished a lecture, let alone publish his papers. Between 1982 and 1987, "My hair turned gray." In 1987, in New Mexico, everything changed.

Arthur is a focal figure in M. Mitchell Waldrop's *Complexity*, an engrossing story of the mavericks who have been gathering at a queer outfit called the Santa Fe Institute. Nobel physicist Murray Gell-Mann was a founding father; members have included computer scientist John Holland, whose simulations of neural networks started 40 years ago, and ex-hippie Chris Langton, who got a glimpse of some principles of artificial life while recovering from a near-fatal hang-glider crash.

The Institute's theme is "flux, change, and the forming and dissolving of patterns": a metascience, "just as 'hard' as physics ever was," of which our curricular sciences are special cases. Waldrop was especially cunning in starting his narrative with the "Aha!" insights of a maverick economist; any reader with a credit card feels touched by the economy. As he shifts focus to figure after figure, Waldrop shows the resources of a competent novelist. We hover at kaffeeklatsches, sit in on lectures, draw benefit from summaries, while gradually a Science of Complexity grows glimpsible.

Readers of James Gleick's *Chaos* will remember critical zones where a change in the tenth digit will make all the difference between overt pattern and mess. For Waldrop's Santa Fe gang, what's interesting isn't periodic mess but the periodic onset of Pattern right near Mess to the Max.

If they're right, we draw close to a general statement about suddenly emergent patterns, such as amoebas, alphabets, animals, and our ancestor Adam. ■

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. His recent books include Mazes *and* Historical Fictions. *You can contact him on BIX as "hkenner."*

MODERN COMPUTER DESIGN

A Guide to RISC Microprocessors, Michael Slater, ed., Academic Press, $49.95, ISBN 0-12-649140-2.

A Guide to RISC Microprocessors assembles 35 articles on the subject of RISC chips from the pages of Michael Slater's newsletter, the *Microprocessor Report*. Some articles contain added material that brings them up to date. The three articles in the first section form the best introduction to RISC I have ever read. Some terms and concepts may be fuzzy if you haven't done any reading on computer architectures before, but if you're interested in learning about RISC and microprocessors in general, this is the place to begin.

The rest of the book examines seven popular RISC architectures in six sections (why Hewlett-Packard's PA-RISC doesn't merit its own section is never explained). Here, the going is rougher for interested laypeople, but much of the material remains understandable.

One glaring omission is the absence of material about IBM's RISC System/6000 architecture, especially given the fact that IBM and Motorola are jointly developing the RISC System/6000–based PowerPC. Understandably, more recent developments in the RISC arena (e.g., the Texas Instruments Viking SuperSparc and DEC's Alpha) are also not represented.

A Guide to RISC Microprocessors has taken its place on my bookshelf next to Hennessy and Patterson's *Computer Architecture: A Quantitative Approach* as an indispensable reference to modern computer design. It doesn't disappoint.

—Bob Ryan

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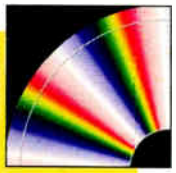

WRAPTURES & REELS

Wraptures One, $129, and Wrapture Reels One, $199, from Form and Function, 1595 17th Ave., San Francisco, CA 94122, (619) 536-9999; fax (415) 664-4030.

One of the best CD-ROM collections of 24-bit clip art and QuickTime video clips I've seen comes from Form and Function. Wraptures One contains clip-art images, and Wrapture Reels One includes QuickTime videos, masks, and sounds.

Wraptures features a variety of high-quality 24-bit PICT images of surfaces such as crinkled paper, marble, brick, wood, metal, and star fields. Many of these images come in several bit depths and sizes. The small-size images are carefully designed so they can be repeatedly "tiled" as either a backdrop or a texture that you can wrap around 3-D objects. Other images include sunsets, clouds, and mountains. A Browser application, written in MacroMedia Director, provides a good tutorial on how to use the material, navigates you through the files, and copies a selection to your hard disk.

Wrapture Reel contains several 24-bit, broadcast-quality QuickTime clips, including sunsets, clouds, waterfalls, a flock of birds flying overhead, and over a dozen high-quality sounds. The package includes Apple's QuickTime Extension and Aladdin Systems' freeware Popcorn QuickTime player. Also included is HyperCard 2.1, for operating a Browser stack. Some clips are interesting (especially the storm over Easter Isle), but I wonder how useful they are.

You're free to distribute the material as part of a finished presentation or product as long as it's not part of a source library for other multimedia tools.

—Tom Thompson

MIND-BOGGLER

Mazes for the Mind: Computers and the Unexpected, Clifford A. Pickover, St. Martin's Press, $32.95, ISBN 0-312-081-650.

First, forget this review. Run, leap, rush, scurry, and scoot to your nearest bookstore and get this book. Now, be prepared to have your mind taken apart, rearranged, and handed back to you.

Every now and then, a book comes along that reminds us what computers are all about—not spreadsheets and databases, but the expansion of mind and soul. Clifford Pickover's *Mazes for the Mind: Computers and the Unexpected* reminds us with a sustained, mind-twisting clash of logic, beauty, and pattern that requires whole-brain thinking. You cannot simply read this book, nor can you hope to devour it in one or two sessions. Sustained, deep-level thinking is simply too difficult. This is a book for grazing ideas, covering reams of paper with patterns and thoughts, rushing to the computer exclaiming, "Aha! I understand!," and creating short programs that generate beautiful designs.

Pickover's chapter titles are hoaxes to entrance you into a world of knowledge. Who would expect that chapter titles like "How to Stuff an Elephant Into a 24-Dimensional Sphere" and "Fractal Spiders" would ensnare you in a world of practical 4-D geometry, genetic music, and fractal applications?

By the time you finish this book, you will have practical experience on the worldwide spread of Cro-Magnon man, enjoyed a wild game of computer esophagus where you attempt to take over your body's internal organs, heard the music of your genes, constructed aesthetically pleasing mazes, designed fractal feathers, used time machines, and played bizarre chess games.

Who could suspect that computing the length of a roll of toilet paper would make interesting reading? Then again, how about "Squashed Archimedean Model of a HyperToilet Paper" for an interesting topic?

If you were asked to pick 10 mathematical formulas that changed the world, what would you select? Would you recognize the 10 formulas that were issued on Nicaraguan postage stamps? As if all this wasn't enough, there's also a section titled "Strange Technology," where...well, maybe you should explore that one for yourself.

If you haven't done much creative thinking recently—the type of thinking where you feel your entire body has been hard at work—it's time for Pickover's book.

—Raymond GA Côté

MUDDLE OF EXCELLENCE

Obfuscated C and Other Mysteries, Don Libes, John Wiley & Sons, $39.95 (book/disk set), ISBN 0-471-57805-3.

Don Libes has assembled a collection of C programming examples that stake their reputation on being impenetrable, obtuse, and bewildering. Here is assembled a collection of code so bizarre as to be entertaining.

Obfuscated C presents the winners of a yearly Obfuscated C competition that started in 1984. This contest prides itself on driving C compilers to their limits with tricks, conjuring, and imagination. The clear champion of obfuscation bundles four eminently useful functions. Compiled one way, the source code produces a program to solve differential equations. Set a few flags, and it recompiles to a program that reverses the order of lines in a text file. Run this program on its own source code, and it sorts lines. Run the sort algorithm on the original source code, and you produce a program that generates Fibonacci numbers.

Of course, you would *never* use any of these tricks in your own programs. To help maintain your professional equilibrium, Libes intermixes chapters of obfuscation with chapters dedicated to pure elegance—truly writing better, cleaner, faster code. He covers topics such as a proper use of longjump and pointers to functions, undefined compiler behaviors to avoid, and creating faster memory allocation algorithms.

In short, Libes presents C at its best and worst. You'll have hours of fun trying to decode the contest winners. And best of all, you'll also acquire a diverse set of useful software tools.

—Raymond GA Côté

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JEAN RENARD WARD
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DIGITIZER RENAISSANCE

The pen computer is reviving interest in digitizing-tablet technologies

Most computer users today use a mouse as their pointing device, but it wasn't always that way. Before personal computers, most people used a digitizing tablet with either a puck or a stylus as their drawing and pointing device. In the early 1980s, thousands of copies of AutoCAD, VersaCAD, and other electronic drafting and design programs came bundled with a digitizing tablet. Then users became accustomed to the mouse as the Macintosh, Windows, and other GUIs became popular. Now pen-based computers, which integrate digitizers into their displays, may change preferences back again.

Pen vs. Touch

Digitizing tablets differ from touchscreens, although some designs use similar technologies. Touchscreens are just what their name implies: a touch-sensitive display, used to read the position of a fingertip (see "Keyboards Without Keys," July 1992 BYTE). Fingertips are large and slow. As input devices, they're good for picking out items and perhaps dragging them around, but they're not very good for writing.

While touchscreens use a finger for input, digitizing tablets use a pen to capture gesture commands, written characters, electronic ink sketches, and annotations. If a tablet responds to finger *and* hand touches, resting your hand on the tablet while writing can create errors.

Digitizers offer higher accuracy than do touchscreens, and this makes them better suited for pen systems. The accuracy required for electronic ink is high. The human eye can discern printed line widths of less than 0.001 inch. An ink line on paper measures about 0.003 inch with smooth edges, while a pixel on a typical high-resolution LCD is much larger—about 0.01 inch with square edges. A character needs to be drawn at least 20 to 25 LCD pixels (0.20 to 0.25 inch) high on a pen computer display to look good. Contrast that with handwritten characters, which are usually only 0.10 to 0.20 inch tall.

Until recently, most digitizing tablets were opaque and sat on the top of a desk completely separate from the display. With the advent of pen computers, the emphasis has moved to transparent tablets integrated with a flat-panel LCD. Indeed, the defining hardware element of pen-based computers is the combined digitizing tablet and LCD. For the primary person-machine interface, good reliability, accuracy, look and feel, and responsiveness are critical. If users do not feel comfortable with the hardware input device, they will reject pen computing technology.

Digitizer Background

A digitizing tablet has three major components: a tablet, a pen (or stylus), and a controller. The tablet consists of a sensing area that detects the pen position. This surface

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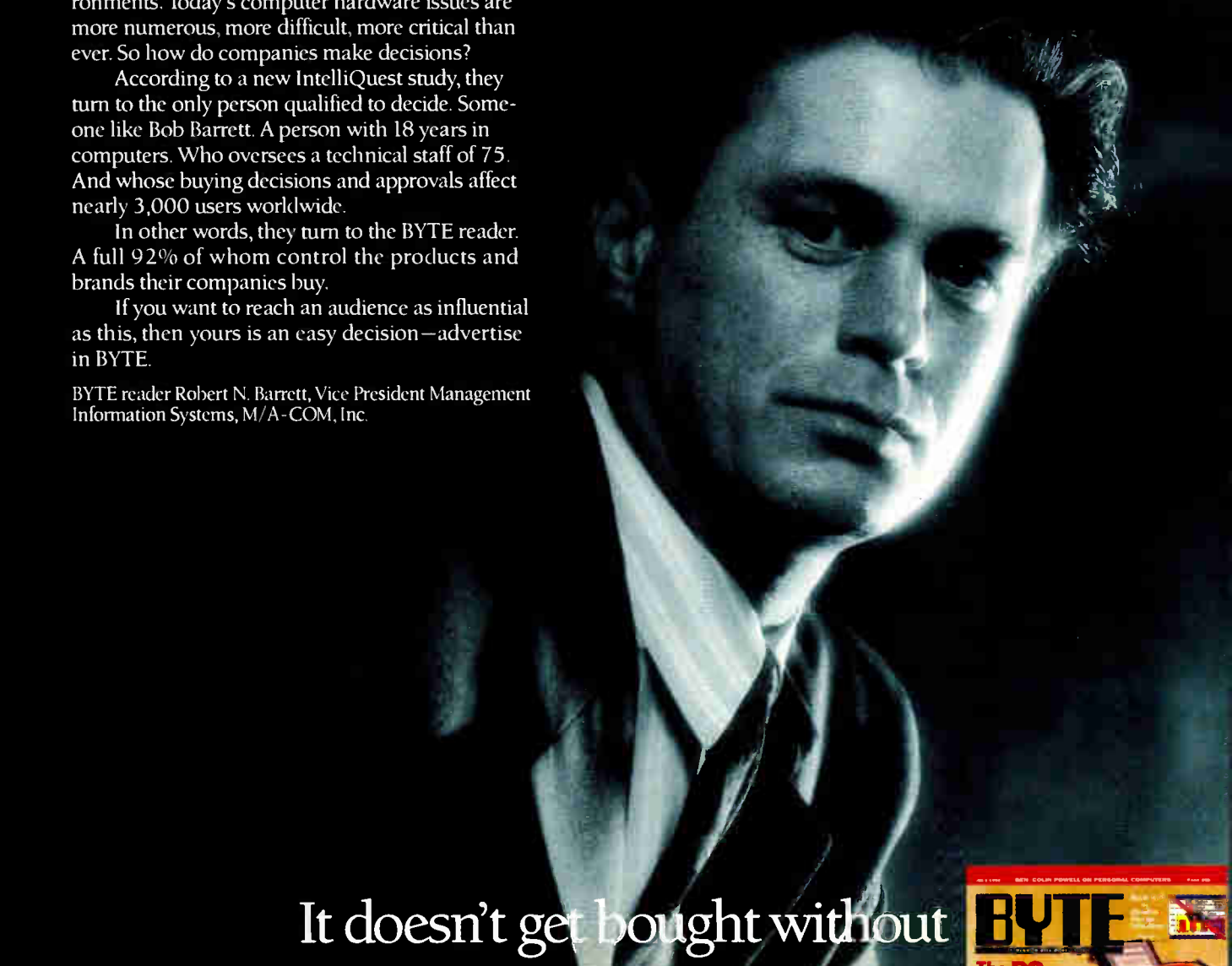

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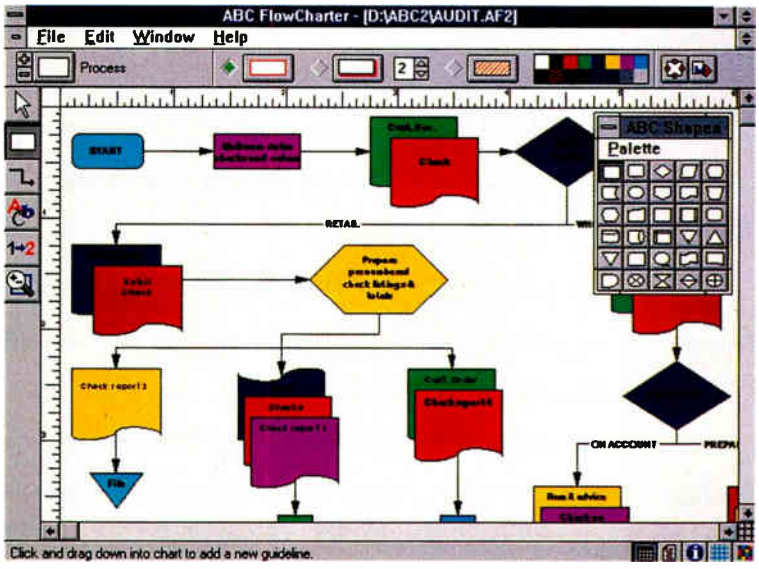

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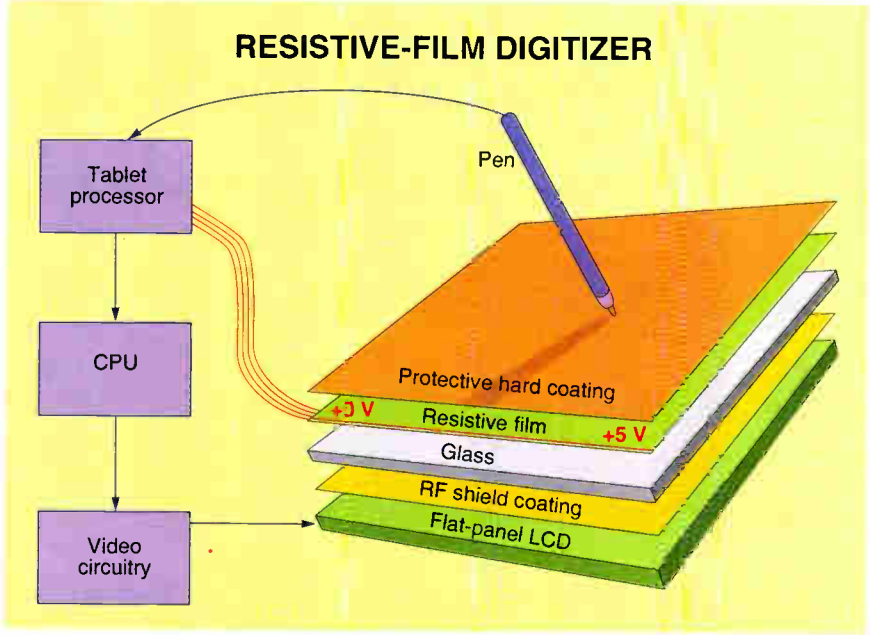

Figure 3: *In the resistive-film design, an insulating glass surface is coated with a transparent, slightly resistive conductive coating. The tablet processor applies a 0-V AC current to one edge of the tablet and +5 V to the opposing side. Voltage ranges from 0 V to 5 V as the pen moves across the surface. The tablet controller calculates the pen's* x *position and then applies voltage to the top and bottom edges to determine the* y *value.*

demonstrations of handwriting recognition, where the writing is small and the electronic ink is removed immediately and replaced with font characters: You don't get a chance to see the ink. While many current designs have this problem, it is easy to correct.

The pen's electromagnetic-coil design can also result in *tilt* errors. The coil, located inside the body of the pen, sits an inch higher than the pen tip when the user is holding the pen in a normal writing position. This means that if the user tilts the pen too much while writing, inaccuracies can result.

Interference is another disadvantage of electromagnetic grids. The electromagnetic fields that these tablets use are seriously disturbed by metal frames, ground planes, and harmonics from internal digital electronics. (These tablets typically use a frequency of around 120 kHz for the signals between the tablet and the pen.) As a result, the tablets must be custom-designed for each pen computer. Even changing the type of LCD in the same product (e.g., to a color or high-resolution LCD) would probably require reengineering the digitizer.

Still another design problem is that the grid can't be put in front of the LCD without putting dark lines across the display. The common solution is to put the grid underneath the LCD, but this adds to the problem of electromagnetic disturbance. Some vendors have experimented with transparent materials for putting an invisible grid in front of the LCD, but the results don't yet work reliably and aren't completely transparent.

Manufacturers using this type of technology include Calcomp, Hitachi, Kurta, Logitech, Summagraphics, and Wacom. Wacom uses a unique electromagnetic approach to making a cordless, passive pen, called *electromagnetic resonance*. The tablet grid alternates between a transmit mode, during which it sends a 20-microsecond radio frequency pulse, and a receive mode, during which it listens for 20 µs for a reflected signal from the pen. The pen contains a small coil-and-capacitor resonant circuit. The pulse from the tablet produces electromagnetic resonance in the pen circuit; the energy is briefly stored in the pen circuit and then reemitted at a slightly different frequency. The tablet controller samples the grid and detects the reemitted signal.

This technique has the unique advantage of providing a passive, unpowered pen—one that does not require batteries. However, the grid generates a strong, continuously transmitted signal that consumes more power than a digitizer with a tethered pen. The Wacom digitizer is used in

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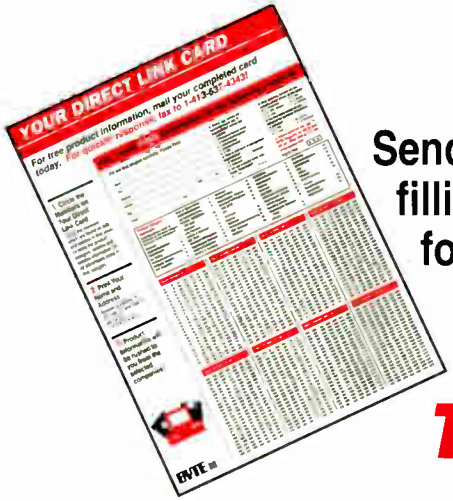

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NCR's System 3125 and Samsung's PenMaster computers.

Electrostatic Grids

Electrostatic grids work very much like electromagnetic grids, with two main differences (see figure 2). First, the grid wires are connected at only one end, not in a loop, since the controller uses them to generate electrostatic, rather than electromagnetic, signals. Second, the pen has a capacitive probe at its tip, rather than a coil inside the pen body. The probe, a simple metal tip with a rounded end, might look like an empty ballpoint cartridge. As the pen tip approaches the tablet surface, capacitance between the two couples the energy between the objects. The pen then transmits a signal through a connecting cable to the tablet processor, which calculates the current position. Using a tip probe avoids tilt problems associated with electromagnetic coil designs.

Electrostatic grids come in two designs: a straightforward *x*,*y* grid and a *charge-ratio* approach that uses a single grid of specially contoured etches. Both are easily built using a standard printed circuit board. Summagraphics uses the charge-ratio design in some of its opaque tablets.

Electrostatic-grid tablets usually sit on top of the LCD, which shields the grid from computer interference. Unfortunately, the grid lines are visible and interfere with viewing. Manufacturers are working to make the grid lines less visible.

Resistive Film

The active area of a resistive-film sensing tablet consists of a substrate of dielectric (insulating) material, usually glass, coated on the top surface with a transparent, slightly resistive conductor such as indium tin oxide (see figure 3). Electrodes on the edges put a 5-volt signal (usually AC) on one edge of the tablet, and 0 V on the opposite edge. The pen is a metal probe that touches the film. The controller reads the voltage that the pen picks up: 1 V near one edge, gradually increasing to 5 V as the user moves the pen to the other edge. It applies the voltage first on the left and right sides of the tablet to calculate the *x* axis, and then to the top and bottom edges for the *y* value.

Another design, in which the pen provides the 5-V signal, has four electrodes at the four corners of the film. These electrodes measure the different currents that are picked up from the pen when the user drags it across the tablet surface.

After the controller measures the voltage (or current, depending on the design), the sensors notify the tablet controller, which converts the sensors' data into digital values. The controller microprocessor then calculates the *x*,*y* coordinates of the pen's contact point. One potential advantage of many of these designs is that they can accept finger input as well as pen input.

Due to their low cost, resistive-film designs are also popular for touchscreens. Because the design consists basically of a film on a piece of glass, resistive film is easy to adapt to the displays of existing notebook computers.

Due to their low cost, resistive-film designs are popular for touchscreens.

Some manufacturers put a second conductive coating on the bottom surface of the substrate to shield out RF noise, or put a second, hard coating over the resistive film to protect it against scratches. Some designs also use various linearization patterns with the electrodes to simplify the controller's calculations.

Resistive-film digitizers have several disadvantages, including their inability to sense pen proximity. Unlike with other designs, the pen must touch the screen before the digitizer can record its position, so it is impossible to put up a status cursor when the user is moving the pen above the display. (Go Corp. claims that its PenPoint operating system's user interface dispenses with status cursors completely, but they are very common in current pen applications.)

Another problem is image clarity. Depending on the thickness of the film and hard coating, the optical transmissivity of some digitizers can be as low as 70 percent. This low transparency reduces the contrast of the LCD image, making it harder to read.

Still another disadvantage is that microscopic cracks in the film can cause large position errors. These cracks can develop from simple thermal stresses from transitions from a warm room to cold outside air, and small scratches in the film can occur from normal everyday use. The errors they cause look like small black holes on the display. You can draw around these spots, but not on them. MicroTouch adapted a touchscreen product to the pen computing market by using soft pencil lead in the pen tip to prevent scratches. Some vendors of resistive digitizers, such as Graphics Technology, use harder film materials.

If the electrical contact between the pen and the film is poor, the digitizer can produce erratic data. The cause of the poor contact might be oil or grease on the surface, high contact resistance if the pen touches down lightly, or a *soft landing* (i.e., when the user touches down at the start of a stroke). For this reason, the tablet electronics are often adjusted to require the user to press down hard on the tablet. That can be tiring if the user works with the pen for long periods. Nevertheless, resistive-film digitizers have been used successfully in the original Grid Systems GridPad, NEC's UltraLite SL/20P, and other early pen computers.

Capacitive/Electrostatic Film

Capacitive-/electrostatic-film technology combines many of the advantages of electrostatic and electromagnetic grid designs with the low cost and easy manufacturing aspects of resistive film.

The active area is a transparent substrate of glass or plastic that has been coated on its underside with a sheet of a transparent conducting material such as indium tin oxide (see figure 4). The film is not on the exposed front surface of the glass (where it could be scratched or damaged), and it needs to be only moderately conductive, so it can be quite thin. Some films offer well over 90 percent transmissivity: That is about as transparent as the LCD glass itself.

The 0-V and 5-V AC voltages applied on the edges of the tablet create an electrostatic field over the glass, and a capacitive probe tip in the pen picks up this signal through the glass. The pen measures an electrostatic field from the whole tablet, rather than a direct voltage at a single point of contact. For this reason, the small defects in the film that hurt resistive-film tablets have no effect here. Scriptel exploited that attribute in its capacitive-/electrostatic-film digitizers by intentionally placing a pattern of quarter-inch holes in the film to reduce power use.

Like the grid-based electrostatic designs, this technology is not as affected as other digitizer technologies are by the metal and electronics in the rest of the pen computer. Proximity sensing is also very good; capacitive-/electrostatic-film digitizers can sense the pen even when it is held several inches above the surface; however, the further the probe moves from the surface, the lower the accuracy. Power use can easily be as low as 15 milliwatts while active,

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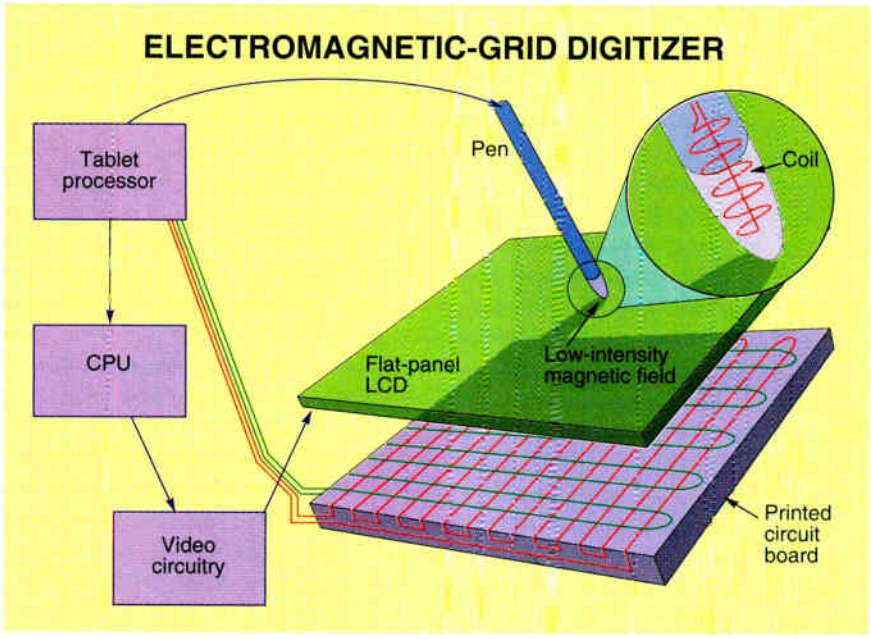

Figure 1: *In an electromagnetic-grid digitizer, a continuous electromagnetic wire grid acts as an antenna on the tablet surface. When the pen approaches the surface, a wire coil inside the pen generates a low-intensity magnetic signal that induces a small voltage in some of the grid wires. The tablet processor then detects the voltage and translates it into* x,y *coordinates.*

sits on top of or underneath the display. The pen is the pointing device. It can have an active element (i.e., the transmitter) that sends a signal to the tablet (i.e., the receiver), or it can receive signals from the tablet. The tablet controller consists of an IC or other electronics that scan the tablet's active area, detect the position of the pen, and translate the changing position into a series of *x,y* coordinate pairs.

Many input-device designs match this broad definition of a digitizing tablet. Designs have been based on practically every physical effect described in a college physics textbook, including electromagnetic fields, electrostatic signals, surface acoustic waves, sonar, resistive films, pressure-sensitive sheets, strain gauges, and magnetostrictive pulses. There are technologies based on evenly spaced grids, phased-spacing grids, solid sheets, transparent films, linear transducers, microphones, delay lines, and AC and DC signals.

The first digitizing tablet, the 1956 Rand tablet, consisted of a grid of conductive wires covered by a rectangular frame, with a special electronic writing pen. A small electromagnetic coil in the tip of the pen received an AC signal by way of a connecting cable and transmitted it to the grid. As the user wrote on the tablet, the coil in the pen passed over the tablet grid, and the controller read which *x* and *y* wires picked up the strongest signal. The controller measured the position of the pen 60 times per second. Many current tablet designs work the same way.

In all designs, the controller sends a stream of *x,y* position coordinates to the main computer at between 60 and 400 points per second. A rate of 120 pps is considered the minimum for good character recognition. A note-taking application without handwriting translation needs the same high performance to display accurate, smooth electronic ink.

With so many digitizer designs available, selecting the right digitizer for a pen-based computer is an exercise in trade-offs. Decision factors include the precision required in sensing the pen's position, the speed at which the user is likely to move the pen across the tablet, the weight and durability of the materials used, the power drain on a battery-powered system, and electromagnetic interference.

Only four of the above-mentioned technologies are currently used in pen-based systems: electromagnetic grids, electrostatic grids, resistive films, and capacitive/electrostatic films.

Electromagnetic Grids

Today's electromagnetic-grid digitizers are modern variations on the original Rand design. The active area in an electromagnetic tablet contains a grid of fine con-

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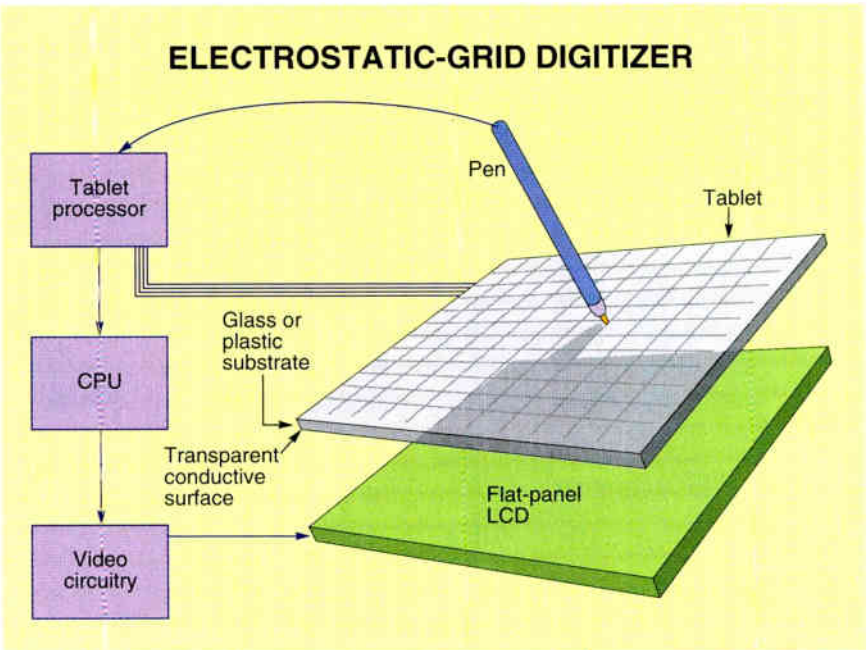

Figure 2: *The tablet controller in an electrostatic-grid digitizer generates electrostatic signals across a wire grid on the tablet surface. A capacitive probe in the pen tip couples with the tablet and transmits received signals through a tether to the tablet controller, which calculates the pen's position.*

ductors—wires, or conductive traces on a printed circuit board—wired as loops to generate an electromagnetic field (see figure 1). The grid is usually on the bottom surface of the LCD in a pen system; otherwise, the digitizer's wires would create dark lines over the display.

As the pen approaches the grid edges (within an inch or so), the electromagnetic field becomes distorted and less accurate. The dimensions of the grid and the size of this *low-accuracy* area near the edges of the grid define the tablet's *active area* (the grid area that reports coordinate-pair data accurately). The spacing of the conductors on the grid affects accuracy: Closer spacing allows more exact positioning.

In the traditional implementation, the grid is either drawn on a printed circuit board with a rigid epoxy substrate or manufactured on a transparent Mylar film base. The epoxy board is more expensive and more complex to manufacture than the Mylar film. It also is heavier and has a larger footprint, because space is required around the edge for the tablet circuitry. A grid made with flexible conductors on Mylar film can be folded around a shielding spacer so that the sense wire returns are under the grid. This helps to reduce size.

In most electromagnetic tablets, the grid detects a signal from the pen. The pen contains a small wire coil that generates a low-intensity magnetic field. When the pen is close enough to the surface of the digitizing area (within its proximity), the magnetic field induces a slight electric current in the grid that's inversely proportional to the distance between the conductors and the pen coil. The tablet processor samples the grid periodically and detects the current. These data samples are then translated into the *x,y* coordinates that indicate the pen's contact point.

Most grid-based tablets use the strongest signal wires in the *x,y* grid lines to get a coarse pen position and then compute a fine position by interpolating the signal readings from the two or three strongest pickups on the grid. A variation on this approach is to use a *phased* grid with two sets of *x* wires at different spacing. The controller computes the position from the relative signal strength in the two sets of wires, rather than by checking individual wires for the strongest signal. It then uses the same method to find the *y* position.

Many electromagnetic tablets show a *velocity error* when the pen is moving diagonally at a fast speed. The error results from the delta time between the position readings. It may not be noticeable if the user is writing only small characters, but it can be very large for fast sketch drawing, flourishes on signatures, and tracing of straight lines. Unfortunately, many vendors demonstrate their designs only with

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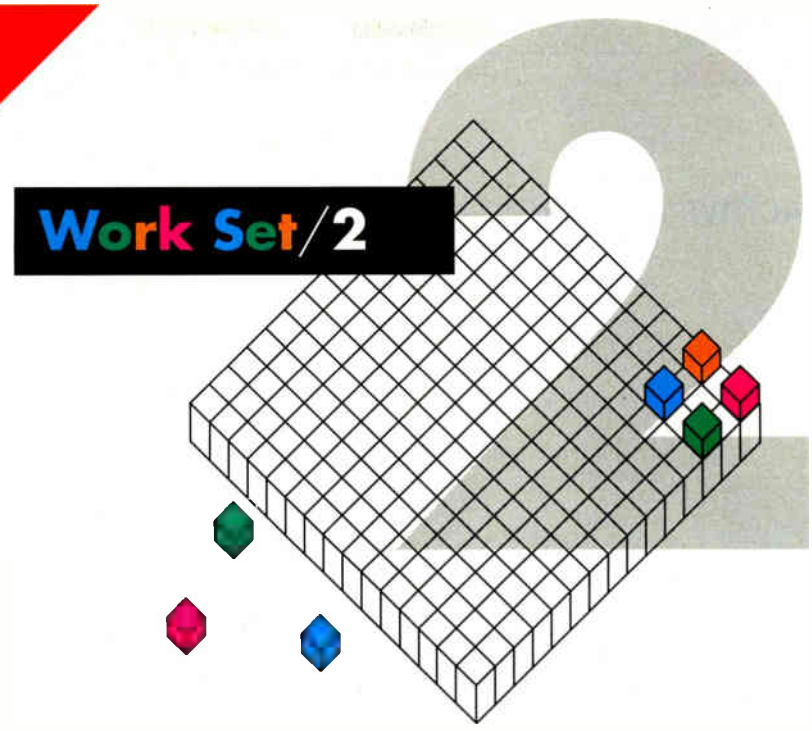

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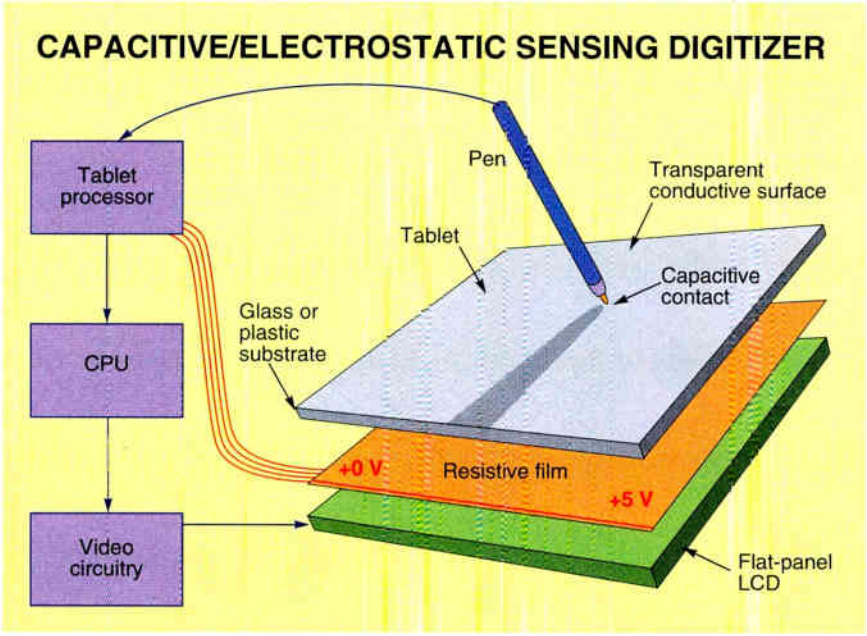

Figure 4: *Capacitive/electrostatic technology uses a transparent substrate of glass that's coated on its underside with a sheet of a transparent conducting material. The 0-V and 5-V AC voltages, applied on opposite edges of the tablet, create an electrostatic field over the glass. A capacitive probe tip in the pen picks up this signal, which varies in strength over the tablet surface.*

and much less when the pen is idle. That is about equal to the best power consumption of any of the other current technologies.

Scriptel has announced agreements with several pen computer manufacturers to use its technology in their pen computing products. Currently, Arthur Dent Associates uses Scriptel's digitizer technology in its WriteAway digitizer add-on for off-the-shelf portable notebook computers. Dauphin uses it in the D5000 pen computer.

Other Options

Several other digitizer technologies could also be used in pen computers, although the four main technologies discussed above are the most acceptable. Science Accessories has been selling different designs of sonar-based digitizers for several years. In one design, the pen contains a clicking sound source that makes a distinct sound pulse 60 times per second. Two small microphones in front of the user pick up the pulses and, measuring the time delay for the sound to reach the microphones, compute the position of the pen by triangulation. This should not be confused with the surface acoustic wave technologies used in some touchscreens. There, the sound wave propagates through the glass; here, it moves through the air.

This technology doesn't lend itself very well to the portable aspect of pen computers because it has some problems when objects (e.g., an elbow) come between the pen and the microphones. However, for a low cost, you can have a large-area digitizer that works on a regular desk, and by adding a third microphone, you can even digitize objects and gestures in three dimensions.

Other devices, such as light pens, mice, and pure touchscreens, have been used as pen-input devices but are far from ideal. Light pens aren't as common as they were 20 years ago, and they have the disadvantage of working only with CRT displays, not with the LCDs that have become synonymous with pen systems. A light pen consists of an optical sensor in the tip of a pen: As the electron beam of the CRT scans the display, the sensor picks up the exact moment it passes under the pen. The control electronics compute the position of the electron beam from timing circuitry connected to the display.

Since light pens depend on the scanning of the CRT, their accuracy is that of one CRT pixel: 640 by 480 pixels, or a bit better than 0.02 inch on a typical display. Depending on whether the display is interlaced, a light pen can read only 30 or 60 pps—far short of the rate needed for good character recognition. Nonetheless, light pens have been making a small comeback with the new interest in pen computing.

The mouse became popular for personal computing less than 10 years ago. Unlike a tablet, which reports absolute physical position, a mouse reports relative motion; thus, mice are unacceptable for use in pen computing. Even a small pen-shaped mouse requires that the user never lift it—the device doesn't work when it's lifted. The effect is very clear if you ask a user to write several sentences using a mouse and then using a pen. Steve Levine, designer of Wang's Freestyle product (another 1989-vintage pen computing system), called this "writing with a fat potato."

Current digitizers involve many difficult and limiting trade-offs in hardware design—trade-offs that can have a direct impact on the usability of pen computing hardware and software. In spite of 35 years of evolution, many current digitizer designs have substantial limitations when installed in pen computers. Tomorrow's designs must improve performance, and the underlying manufacturing technology must better integrate the display and the digitizer, before this technology can fully meet the requirements of pen computer users. ■

FOR FURTHER READING

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BARRY NANCE

OS/2's System Object Model

IBM offers an object-oriented programming tool to developers who write code for the OS/2 2.0 environment. Interestingly, the tool isn't a C++ compiler (IBM says that it will release a C++ compiler sometime in the future). It's a language-neutral object-classification system embedded in the operating system itself. Known as the System Object Model, it's the foundation on which the Workplace Shell is built. You can use SOM to extend the Workplace Shell or to build your own extensible object systems.

SOM is helpful when you develop a large project or when you distribute a set of library routines in DLL form. The library routines might be ones you sell in the shrink-wrapped marketplace or ones you provide to other programmers in your organization. SOM is less useful for small projects; in fact, it takes a bit of extra work to use. In this article, I'll help you understand SOM so you can decide when it is the right tool for the job.

What Is SOM?

You use SOM's object orientation to develop and maintain your library functions and application code. Through this tool, you define and update class and method descriptions. By defining your classes and methods in SOM form, you impose organization on your code. You also take advantage of object-oriented features such as encapsulation, inheritance, and polymorphism. When you install OS/2, you get a DLL containing the SOM methods and classes that define the behavior of Workplace Shell objects such as folders, print destinations, and live objects.

SOM's language-neutral approach to object-oriented programming is a key innovation

For developers, the IBM C Set/2 package provides a SOM compiler, C header files, an IMPLIB library describing the functions in SOM.DLL, and the definitions of the classes and methods of OS/2's desktop objects. The supplied .SC files enumerate the methods and classes associated with each standard OS/2 object. As a developer, you use the SOM compiler, header files, DLLs, library files, and (optionally) definitions of the classes and methods of OS/2's standard objects to create your own classes and subclasses. You can also interact with Workplace Shell objects through their SOM interfaces.

The SOM compiler translates text files of SOM control statements (written in Object Interface Definition Language, or OIDL) into language bindings that you incorporate into your programs. The SOM control statements look like C but are really language-neutral descriptions of your classes, methods, and public/private data items. The SOM compiler emits its language bindings into .C and .H files; you then build on the files to create your software.

At present, the SOM compiler emits only source code files for C. IBM says that it is working with other language vendors (as well as within IBM) to bring SOM support to Pascal, COBOL, FORTRAN, C++, and SmallTalk programmers. I hope Borland, MicroFocus,

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Computer Associates (Realia), and Digitalk—to name but a few vendors—soon begin to provide support for SOM in their products. For now, though, you can use SOM effectively (for both client and library code) only if you have IBM's C Set/2. You can use SOM to help manage the development of DLLs that other languages will access, but it's certainly more elegant and reliable if the programmer using your DLL can do so through SOM classes and methods.

Application modules that interface with SOM-based objects do not need recompiling if changes to the object definition only add new methods; add, change, or delete private instance variables; insert new classes above existing classes in your inheritance hierarchy; or relocate methods upward in the class hierarchy.

You can define parent classes and child classes (subclasses) within SOM. Child classes inherit the attributes of their parents, and a child class can have unique attributes and new behaviors implemented in methods particular to that child. All SOM classes derive from the operating-system-supplied SOMClass class, which is the only class that is its own meta-class. A meta-class defines class methods, not object methods. While a parent of a class is another class from which instance methods and state descriptions can be inherited, a meta-class provides the *factory methods* (sometimes called *constructors*) that you use to manufacture objects.

SOM and the Workplace Shell

Suppose you want to add application-specific code to an OS/2 printer object. You might, for instance, need a printer object that notifies your application when the user chooses to change the hold/release status of the printer object. You would override the printer object methods whose SOM definitions are the following:

```
BOOL wpHoldPrinter();
BOOL wpReleasePrinter();
```

Including an `override` keyword in your method definition indicates that you want to add to one or more of an object's methods. In the overriding method, you can invoke the ancestral method (and all its processing) that you've overridden by calling `parent_wpHoldPrinter` or `parent_wpReleasePrinter`. In your child method, you just add the specific new behavior—in this case, notifying the user.

You can use the same technique to add a new page to an object's settings notebook, modify a folder object's behavior, or implement some other change to a Workplace object. You can also override a meta-class. You might want to do this to track object instances, perform automatic garbage collection, interface to a persistent object store, or hold information common to a set of object instances.

Using SOM can be fun, but now is a good time to tell you that you don't have to use SOM if you don't want to. OS/2 provides a Workplace API that you can use to change the desktop or objects on the desktop. The API includes such functions as `WinCreateObject`, `WinDeregisterObjectClass`, `WinDestroyObject`, `WinEnumObjectClasses`, `WinQueryObject`, `WinRegisterObjectClass`, `WinReplaceObjectClass`, and `WinSetObjectData`.

The WPObject Class

WPObject is the basis for all Workplace objects. It provides groups of methods for managing settings notebooks, saving and restoring states, storing object usage information, managing pop-up menus, setting and querying object information (e.g., views, style, and title), handling errors, managing memory (for object resources), initializing and terminating objects, and performing direct manipulation (e.g., drag and drop).

Each Workplace object inherits a set of standard pop-up menu items from the WPObject class. You add or delete menu items by overriding the `wpFilterPopupMenu` method. The WPObject class defines flag values for the standard pop-up menu items. These flag values are manifest constants in the toolkit header files and are prefixed by CTXT_. The `wpFilterPopupMenu` method responds with the flags that correspond to the pop-up menu items for an object. If you want to delete a standard menu item, you override `wpFilterPopupMenu` with a child method that invokes the parent but turns off the flag for that menu item. After invoking the parent method from within your code, you need only perform an AND on the parental flags with the complement of the value for the menu item you want deleted. For example, if you don't want the "Create Shadow..." menu item in your pop-up menu, you might code something like this:

```
Flags =
 parent_wpFilterPopupMenu(
   somSelf, ulFlags, hwndCnr,
   fMultiSelect);
Flags = Flags & ~CTXT_SHADOW;
return Flags;
```

Before I began exploring SOM, I figured that you had to program in Presentation Manager to use it. Wrong. SOM programming techniques can apply to *any* OS/2 programs or libraries you develop. Moreover, the SOM run-time environment is completely reentrant, so it permits concurrent execution by multiple threads. Within this environment, SOM automatically serializes updates to global resources. You can use OS/2 semaphores to control access to your own shared objects and instance data, if your design requires. And you can develop interactions between objects across process boundaries by using OS/2 interprocess communications facilities (e.g., shared memory).

I don't have room in this article to show you a complete SOM-aware PM program example, so instead I created a simple DLL containing methods for managing Lotus 1-2-3 spreadsheet files (with a .WK1 extension). The sample code doesn't use PM, but you can invoke the methods I supply from within a PM program.

The 1-2-3 Worksheet Object

The first step in using SOM—after poring through the IBM Technical Library manuals, of course—is to create an OIDL text file that defines your classes and methods. Here's mine:

```
#include <somobj.sc>

class: WkSheet;
parent: SOMObject;
data:
 integer4
  DefaultColumnWidth,public;
 FILE *Wk1;
methods:
int NameWorkSheet(
  char *Name);
void SetLabel(
 int Row, int Column,
 char *String);
void SetNumber(
 int Row, int Column,
 double Number);
void CloseWorkSheet();
```

Before you run the SOM compiler (SC.EXE), make sure you set the compiler's environment variables. SC.EXE uses these variables to find include files and to know what output files you want. By default (i.e., with no environment variables set), SC.EXE checks the syntax of your statements but produces no output.

What do these methods do? `NameWorkSheet` creates a .WK1 file and writes basic 1-2-3 information to it, such as the beginning-of-file record. `SetLabel` and `SetNumber` insert labels and numbers into worksheet cells. Both take row, column, and value parameters. `CloseWorksheet` writes the 1-2-3 end-of-file record and closes the spreadsheet file.

continued

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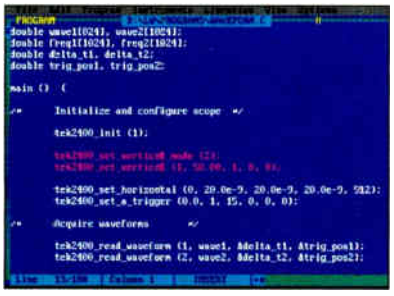

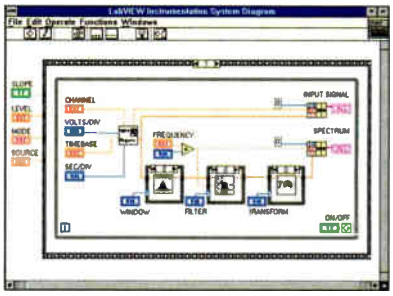

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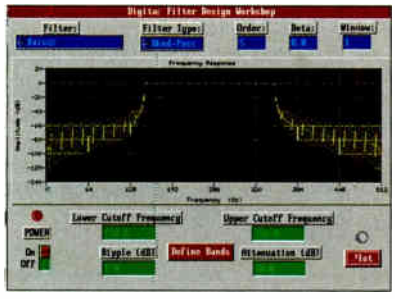

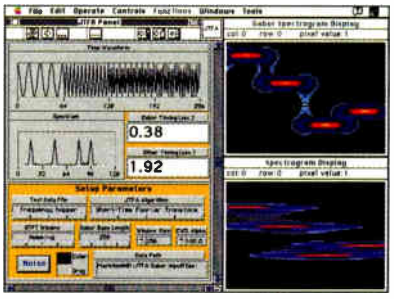

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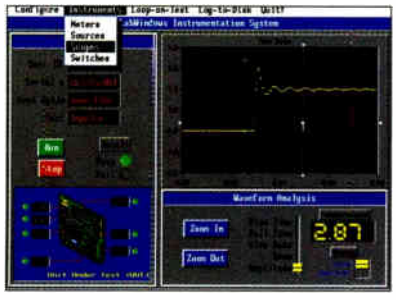

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Listing 1: *Anatomy of a SOM object. I wrote the code shown in boldface; the SOM compiler generated the rest.*

```
/* FileName: wksheet.c.
   * Generated using:
   *     SOM Precompiler spc: 1.22
   *     SOM Emitter emitc: 1.24 */

#define WkSheet_Class_Source
#include <stdio.h>
#include <string.h>
#include "wksheet.h"

void  WriteLabel(FILE *Wk1, int Row,
        int Column, char *String){
      static char   buffer[200];
      static char   f;
      static short int t, 1, c, r;
      f = 0x7F;
      c = Column;
      r = Row;
      t = 0x000F;
      1 = strlen(String) + 7;
      buffer[0] = 39;
      strcpy(&buffer[1], String);
      fwrite(&t, 2, 1, Wk1);
      fwrite(&1, 2, 1, Wk1);
      fwrite(&f, 1, 1, Wk1);
      fwrite(&c, 2, 1, Wk1);
      fwrite(&r, 2, 1, Wk1);
      fwrite(buffer, strlen(String) + 2, 1, Wk1);}

void WriteNumber(FILE *Wk1, int Row, int Column,
       double Number){
      static double n;
      static char   f;
      static short int t, 1, c, r;

      f = 0x02;
      c = Column;
      r = Row;
      t = 0x000E;
      1 = 13;
      n = Number;
      fwrite(&t, 2, 1, Wk1);
      fwrite(&1, 2, 1, Wk1);
      fwrite(&f, 1, 1, Wk1);
      fwrite(&c, 2, 1, Wk1);
      fwrite(&r, 2, 1, Wk1);
      fwrite(&n, 8, 1, Wk1);}

FILE  *CreateLotusFile(char *FileName){
    static FILE *Wk1;
  static char String[101];
    static short int BOFRec[3] =
      {0, 2,     /* record type & length */
       0x0406};  /* file format revision number */
    static short int WinRec[18]=
      {7, 32,    /* record type & length */
       0, 0,     /* cursor column and row */
       0x0071,   /* format (unprotected general) */
       11,       /* default column width */
       6, 20,    /* columns & rows on screen */
       0, 0,     /* left column, top row */
       0, 0,     /* number of title columns, rows */
       0, 0,  /* left title column, top title row */
       4, 4, /* top left coordinate, column & row */
       72,       /* number of columns in window */
       0};       /* unused */
    static char HidCol[36]=
      {0x64, 0, 0x20, 0,
            0, 0, 0, 0, 0, 0, 0, 0,
            0, 0, 0, 0, 0, 0, 0, 0,
            0, 0, 0, 0, 0, 0, 0, 0,
            0, 0, 0, 0, 0, 0, 0, 0};
    strcpy(String, FileName);
      if (strchr(String, (int) '.') == NULL)
        strcat(String, ".WK1");
        Wk1 = fopen(String, "wb");
        if (Wk1 == NULL)
          return NULL;
        fwrite(BOFRec,  6, 1, Wk1);
        fwrite(WinRec, 36, 1, Wk1);
        fwrite(HidCol, 36, 1, Wk1);
      return Wk1;}

int  CloseLotusFile(FILE *Wk1){
       static char EOFRec[4] = {1, 0, 0, 0};
       fwrite(EOFRec, 4, 1, Wk1);
       fclose(Wk1);
       return 0;}

/* ---------------------------------------------------------- */
SOM_Scope int SOMLINK NameWorkSheet(
        WkSheet *somSelf,char *Name) {
  WkSheetData *somThis = WkSheetGetData(somSelf);
  WkSheetMethodDebug("WkSheet","NameWorkSheet");
  _Wk1 = CreateLotusFile(Name);
  if (_Wk1 == NULL)
    return (int) -1;
  return (int) 0;}

SOM_Scope void SOMLINK SetLabel(WkSheet *somSelf,
        int Row, int Column, Char *String){
  WkSheetData *somThis = WkSheetGetData(somSelf);
  WkSheetMethodDebug("WkSheet","SetLabel");
  WriteLabel(_Wk1, Row, Column, String);}

SOM_Scope void SOMLINK SetNumber(WkSheet *somSelf,
        Int Row, int Column, double Number){
  WkSheetData *somThis = WkSheetGetData(somSelf);
  WkSheetMethodDebug("WkSheet","SetNumber");
  WriteNumber(_Wk1, Row, Column, Number);}

SOM_Scope void SOMLINK CloseWorkSheet(
        WkSheet *somSelf){
  WkSheetData *somThis = WkSheetGetData(somSelf);
  WkSheetMethodDebug("WkSheet","CloseWorkSheet");
  CloseLotusFile(_Wk1);}
```

Listing 2: *Using a SOM object. You're not required to write a PM application in order to use SOM objects. Any OS/2 program can call them.*

```
#include <stdio.h>
#include <string.h>
#include "wksheet.h"

WkSheet *WK1;
void main(int argc, char *argv[]){
    printf("Creating a worksheet object (TEST1)\n");
    WK1 = WkSheetNew();
    if (_NameWorkSheet(WK1, "TEST1") == -1){
      printf("Could not name worksheet object.\n");
      return;}
  _SetLabel(WK1, 0, 0, "Column 1");
  _SetLabel(WK1, 0, 1, "Column 2");
  _SetLabel(WK1, 0, 2, "Column 3");
  _SetNumber(WK1, 2, 0, 2.0);
  _SetNumber(WK1, 2, 1, 4.0);
  _SetNumber(WK1, 2, 2, 8.0);
  _SetNumber(WK1, 3, 0, 12.0);
  _SetNumber(WK1, 3, 1, 14.0);
  _SetNumber(WK1, 3, 2, 16.0);
  _CloseWorkSheet(WK1);}
```


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My WkSheet class has two instance variables, one private and one public. The private variable is a FILE* pointer I use to hold the return value from the fopen call. Notice that I could switch to the lower-level open, or even to DosOpen, within the method without changing its published interface. The other instance variable is DefaultColumnWidth. I don't actually use this variable in my sample code, but I inserted the item into the OIDL statements to show how to declare a public variable that users of the DLL code can access.

The SOM compiler used my WkSheet class declaration to generate a class data structure in the .H file:

```
SOMEXTERN struct
WkSheetClassDataStructure{
 SOMAny *classObject;
 somDToken DefaultColumnWidth;
 somMToken NameWorkSheet;
 somMToken SetLabel;
 somMToken SetNumber;
 somMToken CloseWorkSheet;
} WkSheetClassData;
```

The SOM compiler reads the OIDL and writes a series of output files. When you include the generated .H file (WKSHEET.H) in your source code, you get C prototypes for my methods, as well as access to my public variables.

The generated WKSHEET.C file (see listing 1) is more interesting. All that I wrote was the implementation code for the methods I defined. The SOM compiler provided a useful skeleton for the entire DLL creation process. I compiled WKSHEET.C with the C SET/2 compiler, as follows:

```
icc /Ge- wksheet.c som.lib
     wksheet.def
```

The /Ge- option tells the compiler and linker to produce a DLL file. I didn't have to modify the generated .DEF file at all; it correctly called out all the options necessary to turn my compiled methods into a DLL.

I ran IMPLIB to create an export library that you can link your client program with. Copying the DLL file into a LIBPATH directory completed the development process and made the library available to (in this case) the imaginary programming team.

Listing 2 shows what a sample client program might look like. CLIENT.C declares a pointer (WK1) to a WkSheet object and creates the object by calling WkSheetNew. CLIENT.C then uses SOM-generated macros from the .H file to put information into the cells of the spreadsheet file. You might compile and link CLIENT.C with the command

```
icc /Gd- /Se /ss+ /Ms /Gm+
 client.c wksheet.lib som.lib
```

to produce CLIENT.EXE. /Gd- specifies static linking of run-time libraries. /Se allows both ANSI and SAA (Systems Application Architecture) C language constructs in the source program. /ss+ permits the use of // to indicate comments in your code. /Msz specifies system (rather than what's called *optlink*) calling conventions. And /Gm+ links your program with the multithreaded versions of the compiler-supplied run-time libraries.

SOM Appeal

It's the language-neutral aspects of SOM that appeal most to me. I write library routines for a team of nearly 40 people at my company. I can't yet effectively use object-oriented techniques in my work; not every programmer is skilled in C (or C++ or SmallTalk). When SOM capability comes to other languages (e.g., COBOL), I'll be able to use SOM to package my routines for public consumption by the team. In C++ or SmallTalk, for example, you and all the other programmers must work in the same language environment. But when other languages begin supporting SOM, the pressure for every programmer to code in the same language—if the team wants to take advantage of object-oriented features—goes away.

It's clear that SOM does a good job of helping programmers hide the implementation details of their code. The example I've provided shows that I can add new methods quite easily. I might add new methods to the WkSheet class to write other types of worksheet cells besides labels and numbers. However, if I sold you the DLL file (without source code) in the shrink-wrapped marketplace, and if I refused to add new features to the DLL, you could bypass my rudeness and use SOM to create child methods of the WkSheet class yourself. Your child methods could write the additional cell types into the worksheet file. If you wished, you could even create subclasses of the WkSheet class that would inherit the properties and methods of the parent class.

The Drawbacks

You now probably think that SOM is the next best thing to sliced bread, or that I believe SOM is the answer to all my programming problems. Not so. The fact that SOM supports only C at the present time is a big drawback. I've got my fingers crossed, hoping other language vendors evaluate SOM and conclude that it's a useful tool. There just aren't enough C programmers on all the large-scale PC-based development projects to make C the only language choice.

But no matter what languages eventually support SOM, SOM is firmly rooted in OS/2. You won't be able to use it to help you develop DOS or Windows applications. I'm not sure this is a terrible disadvantage, though. A lot of organizations are doing in-house, large-scale, PC-based development projects within the framework of OS/2 2.0. Shrink-wrapped software products are the ones that will feel left out, because they can't use SOM in all the different operating environments.

Here's a nit: When you create an object with the SOM-generated <*classname*>New macro, you can't pass additional parameters to the object creation process. Thus, you can't set instance variables for the new object to values that have particular meaning for that instance of the object. I couldn't, for example, do an fopen call to create the worksheet file inside the WkSheetNew call—I didn't yet know the name of the file. I had to implement a separate method—NameWorkSheet—that would accept a filename parameter.

SOM can help you manage your development efforts so that you produce better-quality software that's more reliable and easier to maintain. However, you have to spend some up-front design time thinking about your code from an object-oriented viewpoint. During later coding and testing, you'll reap some rewards from that up-front design.

It's during the maintenance of your software that you will realize the most gains from using SOM. You and the other programmers on the development team will break existing code less often. People on the team will get fewer bug reports. And the team will be able to update the software more easily, without having to wade through reams of code that by rights should not need to come under public scrutiny to determine whether it's affected by a maintenance change. ■

Editor's note: *The source code for listings in this article is available electronically. See page 5 for details.*

Barry Nance, a programmer for the past 20 years and a BYTE contributing editor, is the author of Using OS/2 2 *(Que, 1992),* Network Programming in C *(Que, 1990), and* Introduction to Networking *(Que, 1992). He is the Exchange Editor for the IBM Exchange on BIX, where you can reach him as "barryn."*

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BARRY NANCE

YOUR OWN DEVICES

Writing DOS device drivers is easy—if you have a model to follow

The *DOS Technical Reference* offers detailed help for writing device drivers. Unfortunately, it's all detail; there's no overview of where to start or what to do first. If you could look at a simple example, the fog would slip away and you'd be able to clearly see what's going on.

Here's a simple—yet useful—example. Only 6 KB of assembly language source code, PRDEV is a character-mode device driver that supplements the DOS-supplied LPT1 and PRN drivers. When you copy a text file to the device name PRN1, the PRDEV device driver gets control. The text prints with extra margins at the top and bottom of each page, and PRDEV inserts a formfeed at the end of the printout to eject the page. PRDEV helps make your printouts look better, and it keeps you from having to reach for the formfeed button on your printer after each printout.

PRDEV's device name, PRN1, could just as easily be PRN. DOS would then replace its own driver with the one in PRDEV.

Every device driver has two entry points. The first, the *strategy routine*, simply saves a pointer to an area of memory containing a request header. The second, the *interrupt routine*, actually does the work. In PRDEV, the work consists of transferring characters from the device request to the printer via INT 17h. As they go by, PRDEV analyzes the bytes it prints. PRDEV counts characters, automatically sending a CR/LF pair if more than 80 pass by between CR/LF sequences. PRDEV also counts lines per page, inserting formfeeds if it sees more than 59 lines on one page. If you have MASM (Microsoft Macro Assembler) or TASM (Turbo Assembler), you can easily change these thresholds to suit your preferences.

How does PRDEV recognize the end of a printout if it "sees" the output characters only one by one? In the same way that a network operating system separates printouts from different workstations—PRDEV looks for periods of silence between characters. A period of 5 seconds triggers PRDEV to send a formfeed character to the printer.

For each call, PRDEV switches to its own private stack. It never has to worry about DOS not providing enough stack space. After processing a request, PRDEV sets the DONE bit in the request header to make DOS happy.

Besides initializing on the INIT request, PRDEV has to handle only one type of device operation, the OUTPUT command. However, PRDEV contains stubs for all the device-driver routines that a block-mode (or more complicated character-mode) driver would need. PRDEV doesn't respond to IOCTL, Media Check, Input Status, Input Flush, or other such driver requests, but the stubs are there to make PRDEV a better template. You can expand on the code to add functions, or you can use PRDEV as the basis for a new device driver. ■

MAC/Tom Thompson

ZoneRanger Rides Again

Here's a freeware gem for all us MacFolk laboring away on application code. ZoneRanger, written by Joshua Golub, scans and displays the composition of an application's zone (i.e., the memory partition set up for it by System 7.0's Process Manager). ZoneRanger displays all active application zones (including the hidden MultiFinder and File Sharing applications) and the System heap. You select your application's zone and get a graphical display of its handles, pointers, and free blocks. Handles are marked locked, purgeable, and whether or not they belong to a resource.

Pressing the mouse on a block in the display pops up a hexadecimal dump of the block's header information and contents. Pressing the Option key summons Balloon Help on the fly. There's a "side door" into your debugger, and you can force the zone's heap to be compacted and purged. These features help you flush out subtle memory management problems in your code.

UNIX/Ben Smith

Hexpert

Simple and useful: Those are the words that come to mind when using Hexpert. Hexpert is a program for visually editing binary files such as core dumps and data files.

Hexpert is like the binary editor you find with the MS-DOS Norton Utilities. You can search for character strings and hexadecimal strings. You can view bytes as hexadecimal or ASCII characters. You cannot insert or delete characters, however. (This is usually a dangerous thing to do in binary files.)

The program was written by Dominic Alston. It has been around for a few years and isn't written to ANSI C, but it compiles and links well enough if your compiler doesn't strictly enforce ANSI standards.

Hexpert uses the Unix curses library for handling terminal screen-specific operations. It doesn't recognize screen sizes greater than 23 rows. However, when you need a Unix binary-file editor, you'll be happy to find anything that works. Hexpert works well.

Editor's note: *Software Corner highlights public domain, freeware, and shareware programs. The programs are available electronically. See "Program Listings" on page 5 for details. We solicit your contributions. We pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

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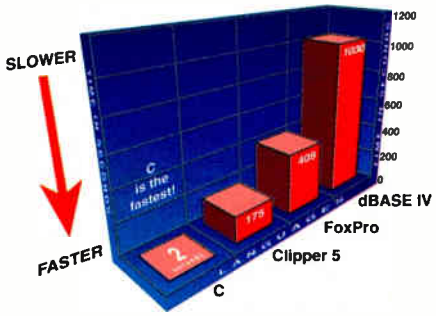

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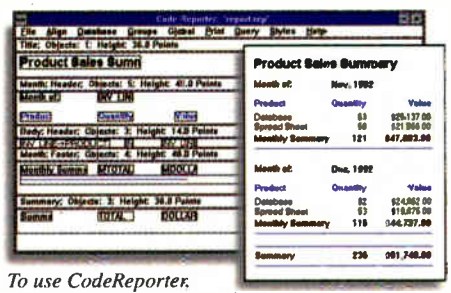

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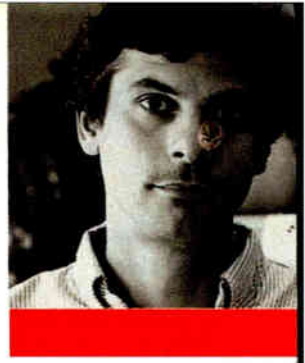

JON UDELL

CONNECTING WINDOWS TO DATA WITH ODBC

Every time you turn around, it seems Windows has sprouted a new modular extension, complete with an acronym, a DLL, an API, and an SDK (Software Development Kit). I've been exploring two of the latest: Open Database Connectivity and the Messaging Applications Programming Interface. Twin pillars of the Windows Open Services Architecture, ODBC and MAPI provide standard ways for Windows applications to converse with databases and to send and receive mail. These technologies promise to make "information at your fingertips" a practical reality. I'll focus on ODBC here and delve into MAPI in another column.

You can build and distribute ODBC applications today—the SDK will have shipped by the time you read this. Sometime next year, Microsoft will likely bundle ODBC with a future version of Windows, just as MAPI now comes with Windows for Workgroups.

Exploring ODBC

Microsoft's new Windows database, Access, is the first commercial product I've seen that uses ODBC. Access can speak natively to a variety of ISAM (indexed sequential-access method) files, but it connects to server-based SQL (Structured Query Language) data sources through ODBC.

The core component of ODBC (i.e., ODBC.DLL) is a generic "driver manager" that rides herd over one or more drivers for the specific data sources to which ODBC gives access. A Windows program called the ODBC Administrator registers and configures data sources. I used it, for example, to install the SQL Server driver. To complete the job, I had to feed SQL Server a file of stored procedures that tailors it for ODBC client requests. Then I attached a SQL Server table to an Access database and was able to query and update the foreign data through ODBC as though it were native to Access.

That's nifty but not really earthshaking. Products like Software Publishing's InfoAlliance and Gupta Technologies' Quest have been doing this kind of thing for quite a while. Clearly, these sorts of products can speak to diverse data sources, but what about ordinary Windows applications?

To get the full story, I asked Microsoft for the ODBC SDK. It provided me with a second driver—one that talks to dBase files—and the tools and information that I needed to write my own ODBC-aware applications. (The kit also comes with the source code for a sample driver and a testing tool that exercises all the functions of an ODBC driver.)

The Open Database Connectivity model is a profoundly enabling technology

ILLUSTRATION: JOHN NELSON © 1993

I won't pretend it was a piece of cake, but before long I was filling WordBasic listboxes with data drawn interchangeably from dBase and SQL Server sources. That really grabbed my attention. Part of my job is to figure out how to deliver enterprise data to editors who live almost exclusively in their word processors and are reluctant to switch to a separate database program. If I can put the data right into their documents, I will make them very happy.

I'm also looking for a solution that will migrate cleanly from the Xbase files we share today to the SQL repository (as yet unspecified) we expect to be using in the future. My Word for Windows listbox experiment proved both concepts. ODBC does indeed enable a document-centered, database-neutral approach to data management.

SAG Specifications

ODBC follows closely the recommendations of the SAG (SQL Access Group). That consortium has specified both a standard SQL grammar and an API (or call-level interface) that clients use to connect to and interact with servers. ODBC drivers can and do differ in their degree of support for the SAG specifications. In terms of SQL grammar, for example, the ODBC specification defines three conformity levels: minimum, core, and extended. With respect to the API, the specification defines core, level 1, and level 2 conformity. In both cases, the term *core* denotes SAG compliance.

The dBase and SQL Server drivers I've used, for example, conform only to minimum SQL grammar. That meant that I could create and drop tables but not alter them, could not create indexes or views, and could work only with character data. The core grammar plugs these gaps and adds positioned update/delete, functions such as SUM, subqueries, and a full complement of standard data types. To the core grammar, the extended grammar—

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which surpasses the SAG specification—adds binary data types, outer joins, and procedures.

While these drivers fall short of the SAG core in terms of SQL grammar, they exceed it with respect to the API—both conform to level 1. The core API provides only basic connection, query, and commit/rollback semantics. Level 1 adds data-dictionary APIs, options for controlling connections and statements, and driver-specific connection dialog boxes. (This last feature enabled my test application to greatly simplify its connection logic by relying on dialog boxes embedded in each of the drivers I used.) Level 2 enhancements include support for arrays of parameters and a sophisticated scrollable cursor model.

Driver Classes

ODBC drivers belong to two general classes. Single-tier drivers (e.g., the dBase driver) process API calls and implement SQL directly. Multitier drivers (e.g., the SQL Server driver) process API calls but pass SQL statements to a server. To programs and users, though, the data sources these drivers present look and act just the same.

When my WinWord macro (actually, the DLL I wrote to support that macro) issues the ODBC `SQLDriverConnect` call, the driver manager puts up a standard dialog box that lists "dBase" and "SQL Server" (the names I assigned using the ODBC Administrator). Based on my choice, the macro retrieves values from either a local dBase file or a remote SQL Server table. But none of my code—the macro, the supporting DLL, or the SQL statements embedded in that DLL—refers explicitly to either data source.

The dBase driver is, literally, a dBase engine driven by a SQL syntax. You can do some very interesting things with it. An instance of the driver points to a (local or network) directory that contains one or more dBase files. These files appear as SQL tables that you can join and update. That gives ODBC programs more control over dBase data than some full-blown Xbase products offer.

While ODBC is being billed primarily as a means of connecting to enterprise data, its flat-file support will also greatly benefit applications that create and manage private data. It's a trivial matter to create an Xbase table, insert values into it, and run queries against it.

A communications program that might otherwise implement its own proprietary database of modems or phone numbers can now use what will be, in effect, a Windows API for persistent storage. If the program later needs to migrate that storage to a different flat-file format or to a server, it's no problem.

Multitier drivers connect ODBC clients to servers directly or indirectly through gateways. The driver might involve itself in low-level client-to-server communication, but it's not required to do so. The SQL Server driver, for example, leans on the same named-pipes driver and underlying NetBEUI or IPX transports that other Windows–to–SQL Server agents use. You can toss `dblib` (i.e., the proprietary SQL Server API), though, since the ODBC API replaces it. That's a wash if you care only about SQL Server, but a huge win if you plan to switch someday to Oracle, NetWare SQL, or some other server.

How does ODBC handle features that are specific to individual servers? First, there's a notation for standard SQL extensions such as date-time literals and outer joins. Most servers offer these features using a proprietary syntax; ODBC's "escape clauses" enable programs to use them

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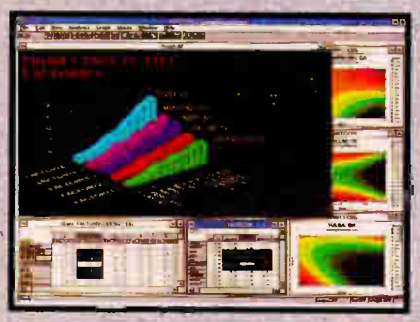
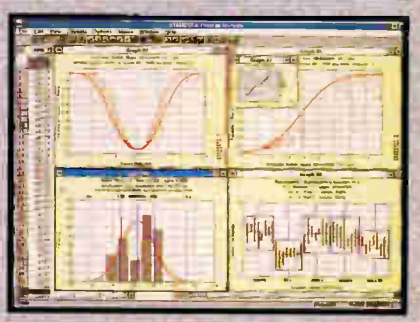
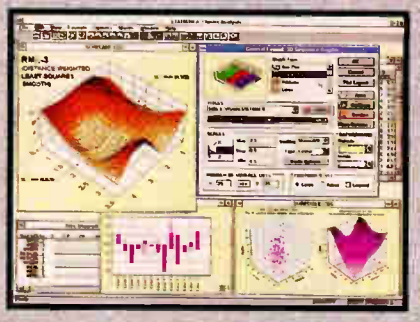

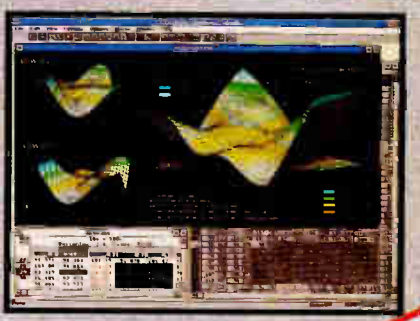
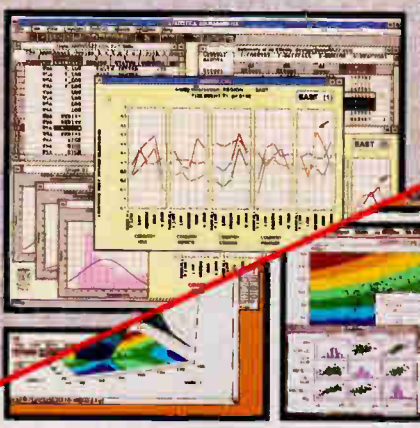
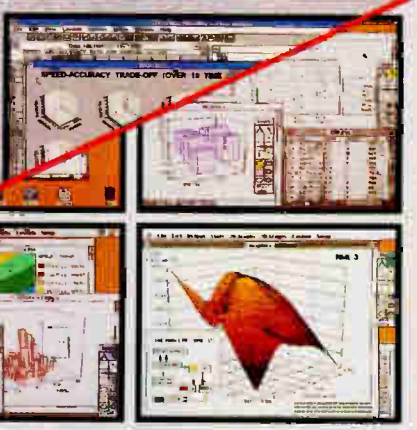

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portably. Second, ODBC will pass statements that don't conform to its notion of SQL grammar straight through to the server. Use of such grammar is then no longer portable, but applications can exploit vendor-specific extensions through ODBC.

Key ODBC Objects

From a programmer's perspective, the key ODBC handle-based objects are environments, connections, and statements. There is one environment per application instance. The environment maintains state for one or more connections, so your program can talk to dBase on connection handle 1 while it talks to SQL Server on connection handle 2. (You can't mix connections, though; there's no way to join a dBase table to a SQL Server table.) With a level 1 driver, you can control options such as the auto-commit mode and the transaction isolation level on a per-connection basis. Given a valid connection, you allocate a statement handle that you then use to submit SQL text and retrieve results. Options you can control at the statement level include asynchronous processing, query time-out, and size (in rows) of the maximum result set.

As you negotiate connections and submit statements, the driver manager tracks state transitions. It will report an appropriate error if, for example, you try to call `SQLFetch` before executing a query. (Because the driver manager handles this chore, specific ODBC drivers don't have to—a nice benefit of the layered driver architecture.) You can execute a one-off query directly, or you can prepare a query for deferred (possibly repetitive, possibly parameterized) use. You can also choose to bind application storage to result columns in advance of a query or to transfer data after the fact. With a level 2 driver, you can use a scrollable cursor and can control its sensitivity to change in the underlying tables.

Most flexible is a *keyset-driven* cursor. In this case, the driver stores keys for an entire result set and uses the cached keys to detect deleted or changed rows. A *mixed* cursor extends this treatment to huge result sets by maintaining a virtual keyset.

The Floodgate Opens

There's nothing fundamentally new about ODBC. Pioneer Software's Q+E tool set attacks the same issues in much the same manner. "We were doing ODBC before ODBC was cool," a Pioneer representative told me. Macintosh System 7.0's Data Access Manager and Data Access Language—which are finally picking up steam after two years—offer another variation on the same theme. Despite the availability of these and other technologies, I haven't yet noticed a flood of database-enabled software.

ODBC, riding the Windows juggernaut, seems poised to open the floodgate. Both Pioneer and Apple, by the way, will offer ODBC-compliant products. No one loses in this deal. Pioneer's database tools will find a wider audience once they can leverage ODBC's momentum, and Apple's DAL figures to be one of the more powerful and versatile drivers in the ODBC suite. From my own selfish perspective, I see ODBC as a profoundly enabling technology that I can't wait to apply. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell" or on the Internet at judell@bytepb.byte.com.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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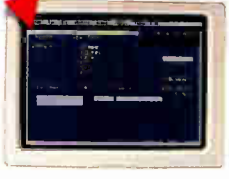

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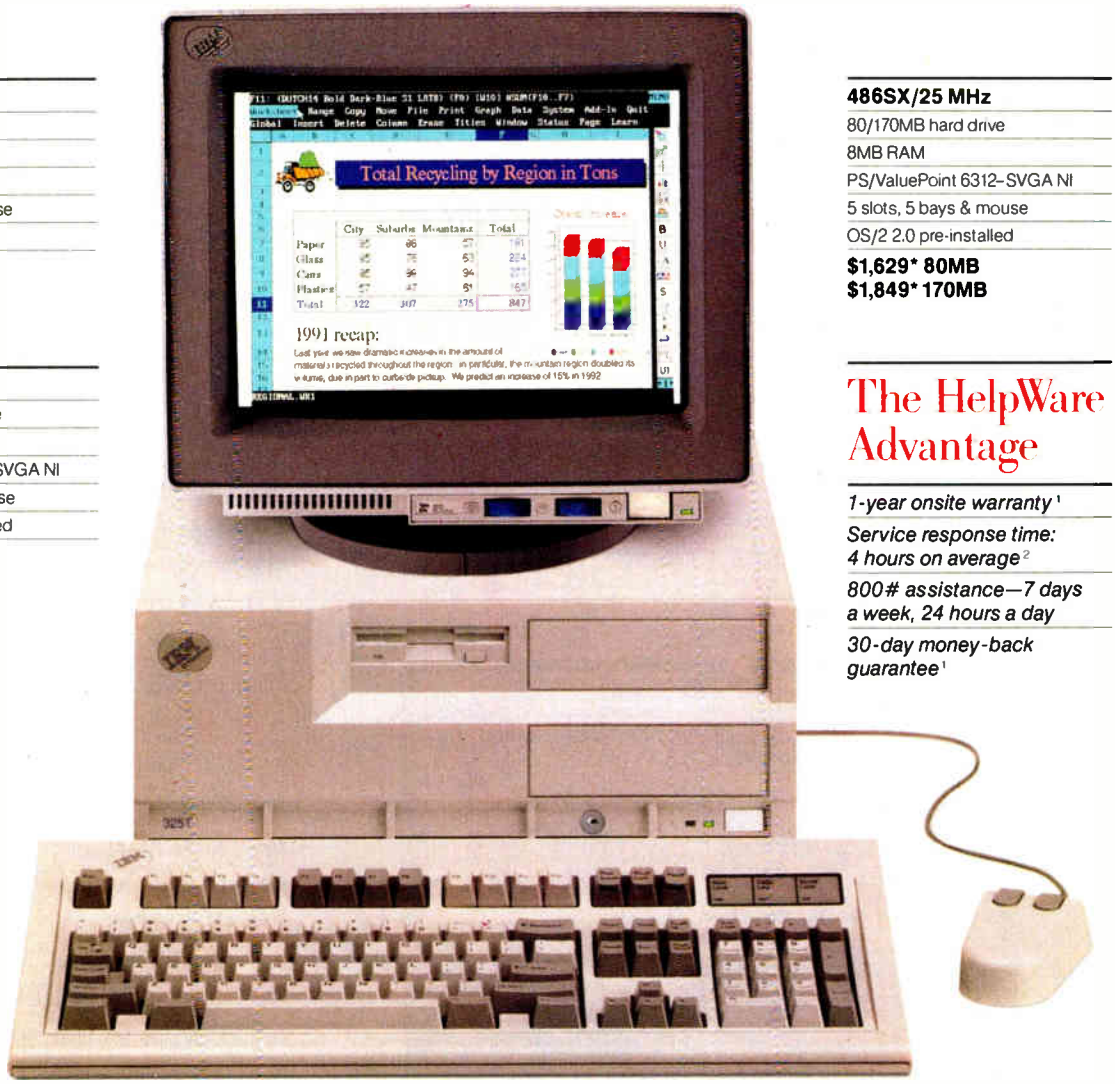

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The European Connection

I need to be connected to the Internet for commercial communications. I've checked UUNET, PSINet, and other local Internet.com service providers, but the prices are outrageous—between $200 and $2000 per month. Therefore, I hope to set up my own node on a DOS computer. Could you recommend a source of information to complete such a project?

Frederick Campion
Malmö, Sweden

The idea of accessing the Internet from a PC is not as far-fetched as one might at first assume. You can set up modem-based connections for E-mail and Usenet news, even from a DOS-based machine. One way is to use the public domain program uucp. The newest version of MKS Toolkit (available for $249 from Mortice Kern Systems, 35 King St. N, Waterloo, Ontario, Canada N2J 2W9, (800) 265-2797 or (519) 884-2251; fax (519) 884-8861) includes an easy-to-install-and-manage uucp that does all its scheduled communications in the background (as a TSR program).

The difficulty starts when you try to access the Internet using TCP/IP so that you can browse and grab files from any accessible system. This is what is meant by really being "on the net." There are plenty of TCP/IP packages for DOS. The problem lies in making that physical connection. At that point, you're talking about big-time networking, and that's where services like UUNET come into play. If you're part of an organization that already has direct access to the Internet, all you have to do is convince your network administrator to let you tap in.

I suggest that you use a more appropriate operating system, such as one of the many inexpensive versions of Unix that run on PCs. (See "Coherent Grows Up" in the August 1992 BYTE, and "Unix for Nothing," Letters, November 1992 BYTE.)

Another important resource is a new book, The Whole Internet, *by Ed Krol (O'Reilly & Associates, $24.95, ISBN 1-56592-025-2). This text explains not only how the Internet works, but also how to get around and find the information that you need.*—Ben Smith

Assembly Language Plus C

I wish to link an assembly language object module with a C object module in such a way that the assembly language module is the host module. In other words, my main program will be written in assembly language. All I need is to call a C subroutine from this host module.

I use MASM (Microsoft Macro Assembler) 4.0 and Microsoft C 6.0. There are no problems when I use the C module as a host. The process of calling an assembly language subroutine is described thoroughly in most books on the subject, but I can't find a description of how to make the process work the other way around. Can it be done?

Gerd Ehlert Schirner
Copenhagen, Denmark

The primary difficulty with calling C functions from a main assembly language program is that when a C program starts operation, it initializes a set of variables that library routines such as `malloc` *and* `fopen` *require and then calls the function* `main`*. If these variables are not properly initialized, the library routines may function initially but will eventually fail. Other library functions (e.g., string manipulation) can be used without difficulty.*

One solution to this problem is to link in and execute the normal C-library start-up routines and then call your assembly language program. The accompanying listings show a sample assembly language/C linkage. Listing 1 is a simple assembly language program with the distinguishing feature of having a `main` *routine that calls the routine in listing 2.*

When built using the commands shown in listing 3, the program runs through the start-up code and calls the assembly language version of `main`*, which then calls the subsidiary C functions. When your program is linked this way, you don't need to be concerned about which functions you call.*

The Microsoft C installation disks include the source code for the start-up code. If the start-up causes problems with your main assembly language routine, be sure to look through this code and make the necessary changes. The start-up code is rather small and fairly well documented.

The examples were written using MASM 5.10 and C 6.00a. This version of the assembler supplies some

Listing 1: *A simple assembly language program.*

```
        .8086
        .MODEL SMALL, C
        .CODE
PUBLIC          main
EXTRN           hello:NEAR
EXTRN           exit:NEAR
main PROC
        call hello          ; call the C module
        call exit           ; bye-bye and clean up
main ENDP
        END
```

Listing 2: *A C function to call from assembly language.*

```
void hello( void )
{
        write( 0, ''Hello World\n'', 11 );
        return;
} /* hello */
```

Listing 3: *Building the example.*

```
cl /c sample.c
masm core;
link sample core ;
```


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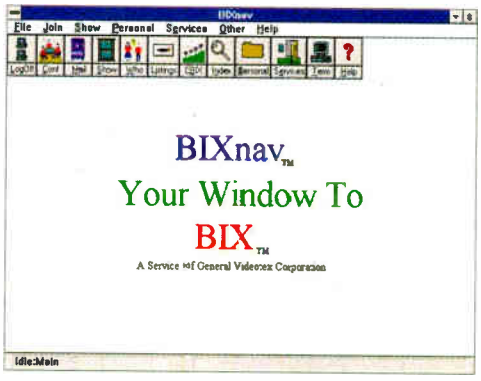

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macros to simplify communication with C (and other) functions. Since you are using an earlier version, you will need to set up your code and data segments differently and declare the `main`, `hello`, *and* `exit` *functions as* `_main`, `_hello`, *and* `_exit`.

—Raymond GA Côté

Swappy Floppies

Do any commercial programs let you format, read, and write Macintosh disks using a PC-compatible machine? I'm interested in exchanging data from my PC with my colleague's Mac.

Magarita Ruiz del Viso
Caracas, Venezuela

Depending on the model, you may not need any new software. Any Mac built since the introduction of the Mac IIx (in late 1988) has a high-density floppy drive, known in Mac circles as the FDHD. If your coworker's Mac has one of those, the AFE (Apple File Exchange) utility that came with the machine will read and write IBM-format 3½-inch disks.

Going the other way, the good news is that high-density PC drives can read raw data from a high-density Mac disk. The bad news is that the GCR (group coded recording) format used in the Macintosh low-density format is completely incompatible with the PC drive controller. You do have some options, though. Mac-In-DOS (DOS version for $199 and Windows version for $249 from Pacific Microelectronics, 201 San Antonio Cir., Suite C250, Mountain View, CA 94040, (800) 628-3475 or (415) 948-6200; fax (415) 948-6296) can read, write, and format high-density Mac disks on your PC. It's software only, so it should work on just about any PC with a 1.44-MB floppy drive.

To handle the low-density 400- or 800-KB Mac disks, you need hardware. MatchMaker ($149 from Micro Solutions Computer Products, 132 West Lincoln Hwy., DeKalb, IL 60115, (815) 756-3411; fax (815) 756-2928) is a half-length ISA board that lets your PC control a standard Mac external floppy drive.

—Howard Eglowstein

Fortysomething Eyesight

Does anyone make a DOS word processor for portable computers that presents or at least supports a 40-column screen, with its correspondingly larger letters, for over-40 eyes straining to read 10-inch monitors?

Richard Willis
Palma de Mallorca, Spain

There comes a time in life when reading that 10-point type becomes difficult. I myself have reached this golden age, and I've cranked up the text size to 12 or 14 points in Word for Windows. The domain of word processing programs with adjustable point sizes for screen text is pretty much dominated by Windows-based programs, but DOS programs are available.

Two DOS-based, WYSIWYG word processing packages I recommend are Signature (available for $495 from Xyquest, 44 Manning Rd., Billerica, MA 01821, (508) 671-0888; fax (508) 671-0858) and Eye Relief for Low Vision Users (available for $295 from SkiSoft Publishing Corp., 1644 Massachusetts Ave., Suite 79, Lexington, MA 02173, (800) 662-3622 or (617) 863-1876; fax (617) 861-0086). Eye Relief for Low Vision Users is designed for people with impaired vision, and it can increase text and menus to very large point sizes, with contrasting colors.—Stan Wszola

Ultimate Printer Driver

I write programs in BASIC, compile them using QuickBasic, and distribute them to my friends. I wrote the programs to support an Epson dot-matrix or compatible printer, but recently some people have tried to use my programs with laser printers.

What printer codes do I use for a laser printer and, for that matter, for other dot-matrix printers? I've been told that I should write to the manufacturer of each make of printer requesting the printer codes to use in BASIC that will make them work. Are there general printer codes that make all these printers output condensed or normal? Surely there is a better way than writing to every manufacturer.

Robert Gordon
Grass Valley, CA

You are facing the same problem encountered by every professional programmer: how to make your programs compatible with many different peripherals. Many programming shops don't waste time. They just buy a printer-driver package, such as the Slate Universal Printer Driver from The Symmetry Group (P.O. Box 26195, Columbus, OH 43226, (800) 346-3938 or (614) 431-2667; fax (614) 431-5734).

The Slate Universal Printer Driver sells for either $299 (DOS text) or $448 (DOS graphics) and supports over 750 printers. The Slate driver, like some other packages I've found, comes in C and BASIC versions. You could write a BASIC routine to access the code and use it with your program.

Many other QuickBasic printer-driver libraries are available that support a smaller range of printers (e.g., LaserJet printers and compatibles). Catalogs listing these packages and other programming utilities are available from The Programmer's Shop (90 Industrial Park Rd., Hingham, MA 02043, (800) 421-8006; fax (617) 749-2018) and Progammer's Paradise (1163 Shrewsbury Ave., Shrewsbury, NJ 07702, (800) 445-7899 or (908) 389-8950; fax (908) 389-9227).

Other options that are available to you include switching to Microsoft's Visual Basic for Windows and letting Windows handle printer problems or stripping out the Epson-specific CHR$ code and using standard PRINT statements.—Stan Wszola ■

The BYTE Lab welcomes your questions. Address correspondence to Ask BYTE, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. You can also send BIX mail c/o "editors."

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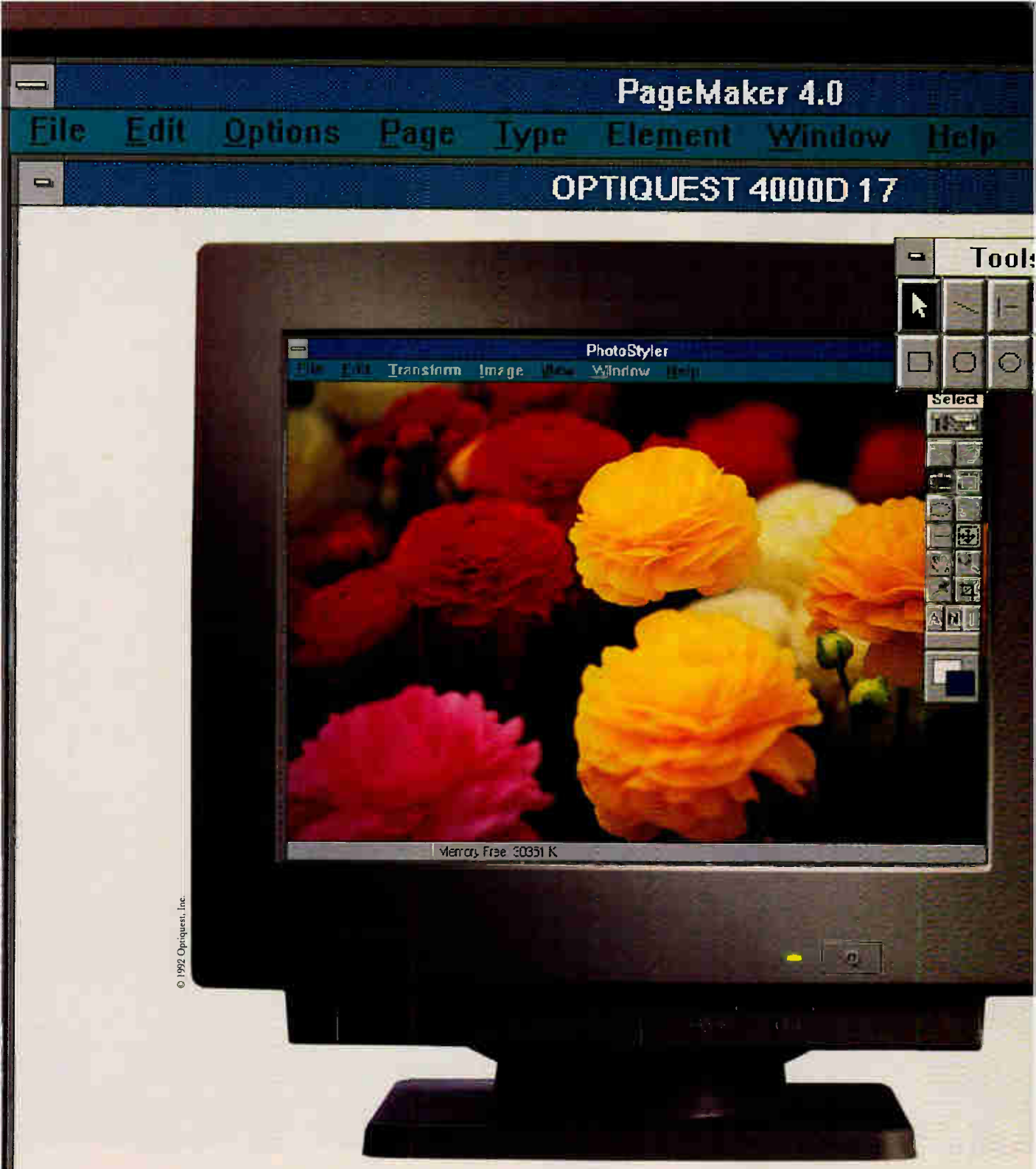

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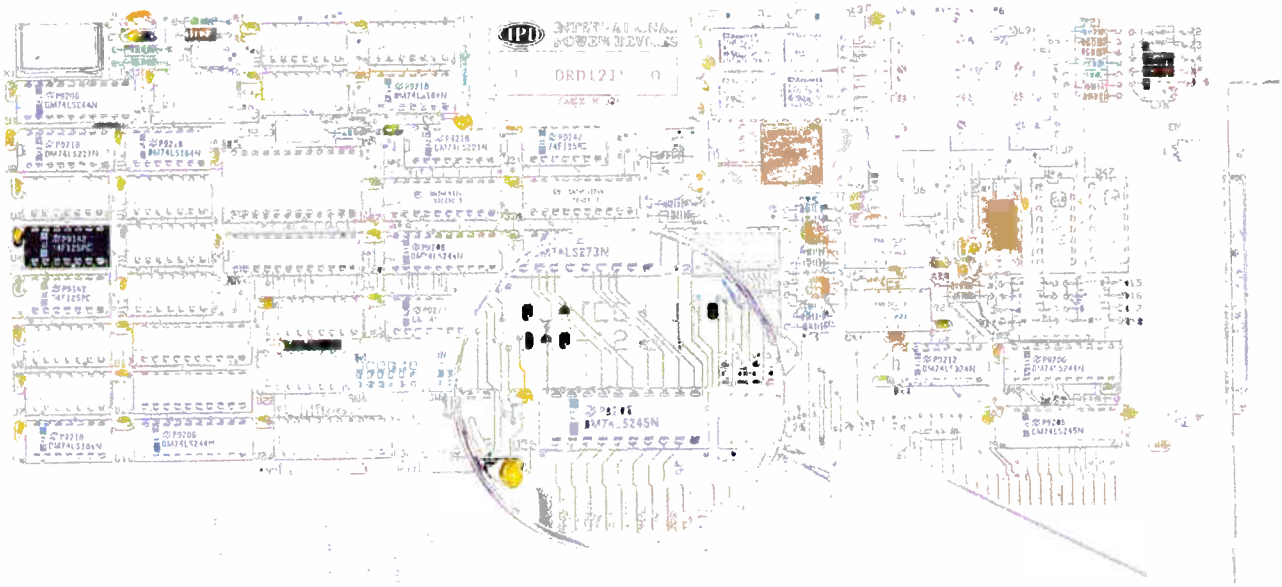

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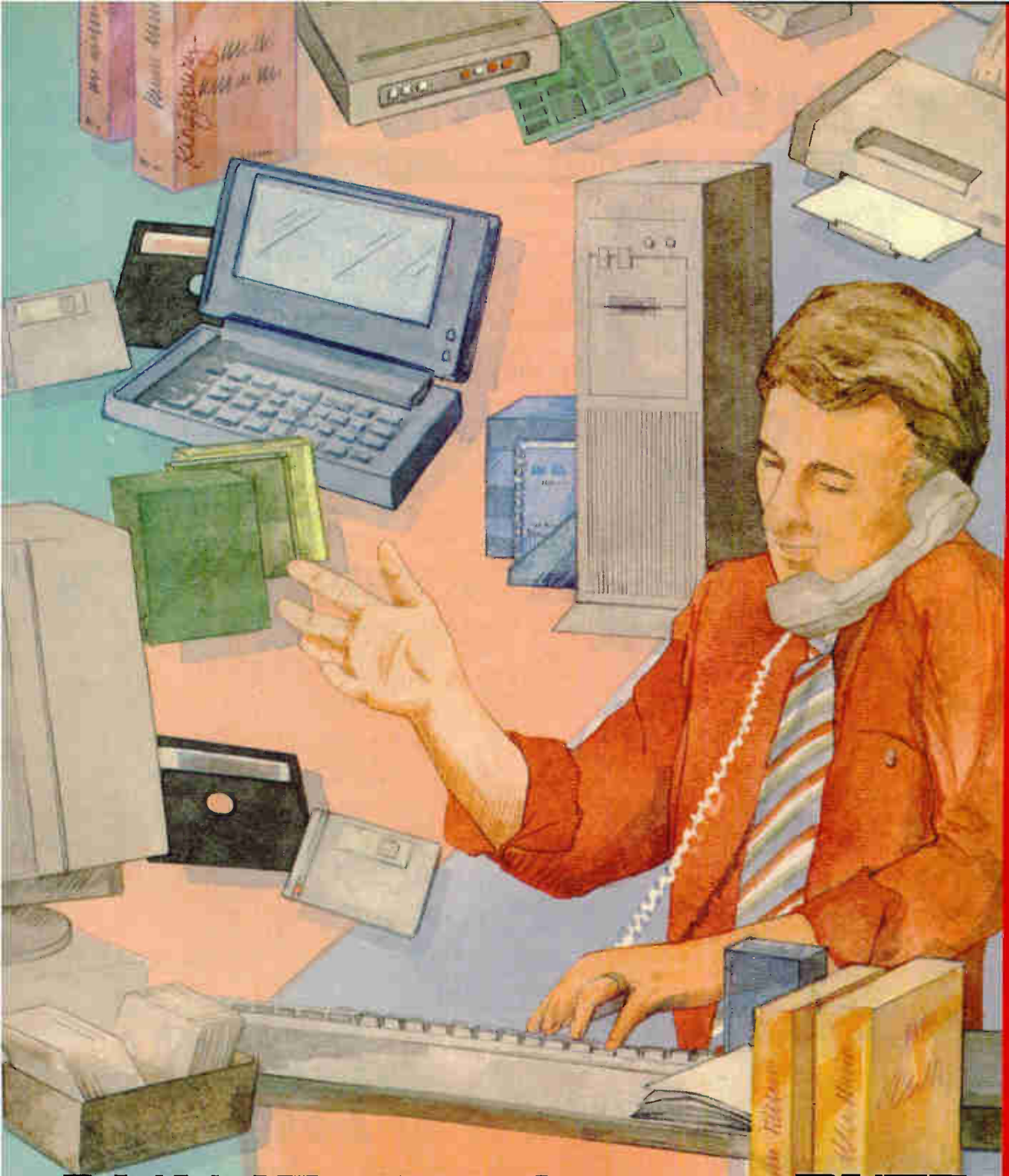
World Radio History



BYTE BUYER'S GUIDE

BUY IT THROUGH BYTE

Mail Order

The latest offerings from vendors supplying products of all leading manufacturers at extremely competitive prices.

284

Hardware/Software Showcase

This *categorized* four-color display section makes it easy to find Hardware and Software products from a wide variety of manufacturers and suppliers.

311

Buyer's Mart

From Accessories to Laptops to Word Processors, you can easily find the dealers you are looking for in this directory of products and services.

320

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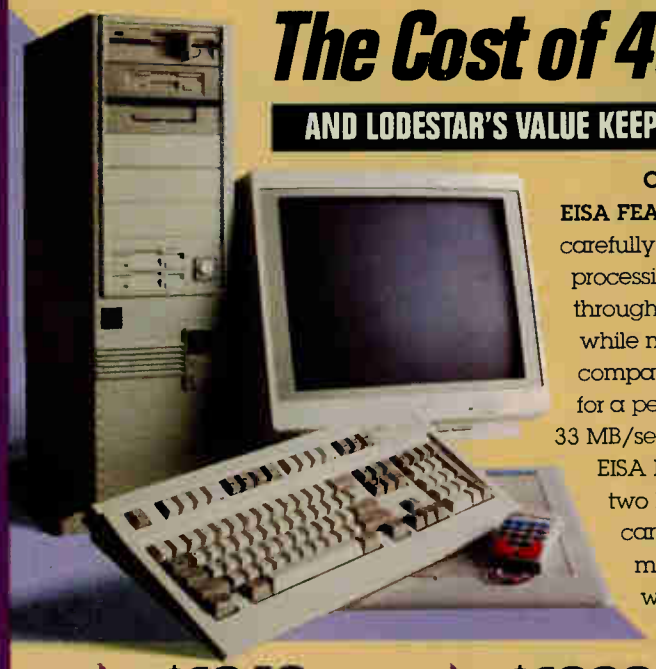
The Cost of 486 Power is Falling Fast.

AND LODESTAR'S VALUE KEEPS GOING UP:



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LODESTAR's bus mastering, intelligent expansion cards with their own I/O processors operating in parallel with the main CPU, frees up your load on the CPU. Bus throughput is improved by implementing direct memory access (DMA) and bus masters.

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- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0, Windows 3.1 & mouse
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486-DX2/50 $2219
486-DX/50 $2319
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- Enhanced 101-key keyboard
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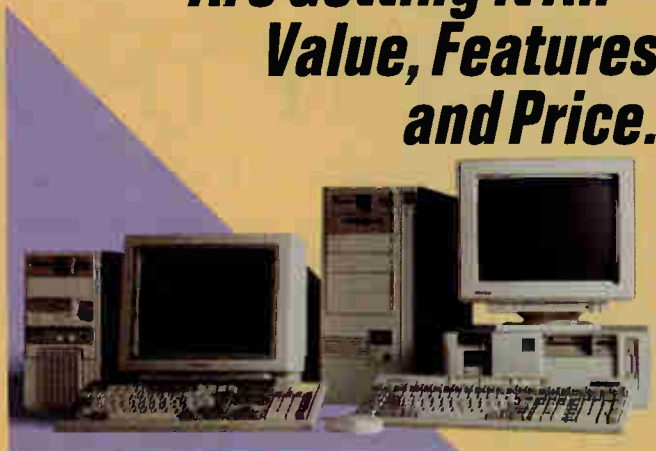
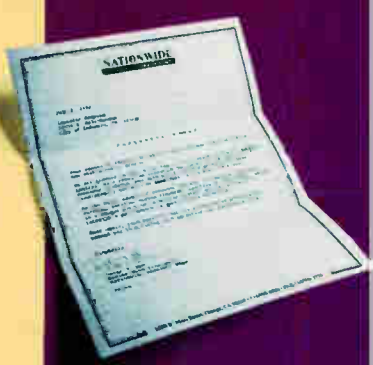
They keep coming to us because most other "upgradable" systems require purchase of a special CPU module board. This causes some performance loss due to speed adjustment. And they couldn't rely on those vendors being there when they needed to upgrade. Nor could they rely on sky-rocketing prices. So they've been calling LODESTAR.



World Radio History

How thousands of our customers are

BUYING DIRECT



We Won Again.
And you enjoy the benefits.
In their latest survey of QUALITY CONTROL, proven by this nationwide provider of warranty services, LODESTAR again has earned their rating EXCELLENT.

When they buy from us, they're buying directly from the factory. So they get more value with each purchase, and are always assured their system is backed directly by the people who assembled it.

THESE PRICES GUARANTEED THROUGH JAN. 31, 1993

SHIPMENT WITHIN 48 HOURS

Every system is individually pretested and burned-in for 72 hours prior to shipment.

We have the right system for you. If it's not already configured, we'll customize it.

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- 16-bit 1024x768 SVGA card w/1MB RAM
- 14" 1024x768 0.28mm dot pitch SVGA color monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
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- Mini-vertical case

386-SX/33 $1139

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386-DX Workstation

386-DX/25

- 4MB RAM expandable to 32MB
- 130MB 15ms IDE hard drive w/64K cache
- 1:1 interleave 2H/2F IDE controller
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 14" 1024x768 non-interlaced 0.28mm dot pitch SVGA monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Desktop or mini-vertical case

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StarFlex 3/486C

386-DX/25

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- 4MB fast RAM expandable to 32MB
- 130MB 15ms IDE drive w/64K cache
- 1.2MB 5.25" & 1.44MB 3.5" drives
- 1MB SVGA non-interlaced color card
- 14" 1024x768 non-interlaced 0.28mm dot pitch SVGA monitor, VESA 72Hz flicker-free display
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0, Windows 3.1 & mouse
- Enhanced 101-key keyboard
- Desktop or mini-vertical case

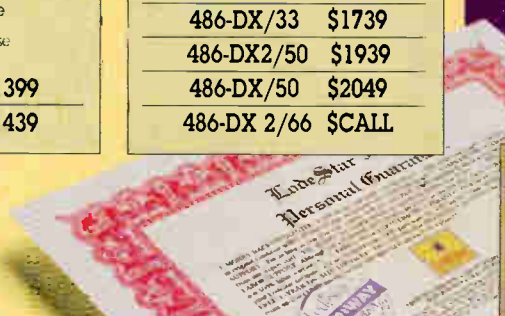
386-DX/33	$1489
386-DX/40	$1519
486-DX/33	$1739
486-DX2/50	$1939
486-DX/50	$2049
486-DX 2/66	$CALL

Your Assurance of Complete Satisfaction

OUR RISK-FREE GUARANTEE

Look for your comprehensive written guarantee when you take delivery of any LODESTAR system. This industry-acclaimed, FIVE WAY Personal Warranty proves our willingness to stand behind everything you buy from LODESTAR.

CALL FOR YOUR FREE COPY; we'll fax or mail it immediately. Use the LODESTAR FIVE-WAY GUARANTEE as your shopping guide; compare and question the others before ordering.



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All specifications subject to change without notice. 2-Year Parts Warranty applies to advertised LodeStar systems only. Money Back Guarantee does not include shipping & handling and all returns must be shipped pre-paid & in reasonable condition. Please call to confirm all warranty details. Photography is for illustration only. No surcharge on VISA, MasterCard & Discover. Purchase orders are accepted on approved credit. California orders add 8.25% sales tax. All product names, trademarks and registered trademarks are the property of their respective companies. © 1992 LodeStar Computer Corp.

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Use external monitor
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Enclosure for most desk top monitors

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Circle 255 on Inquiry Card (RESELLERS: 256).

World Radio History

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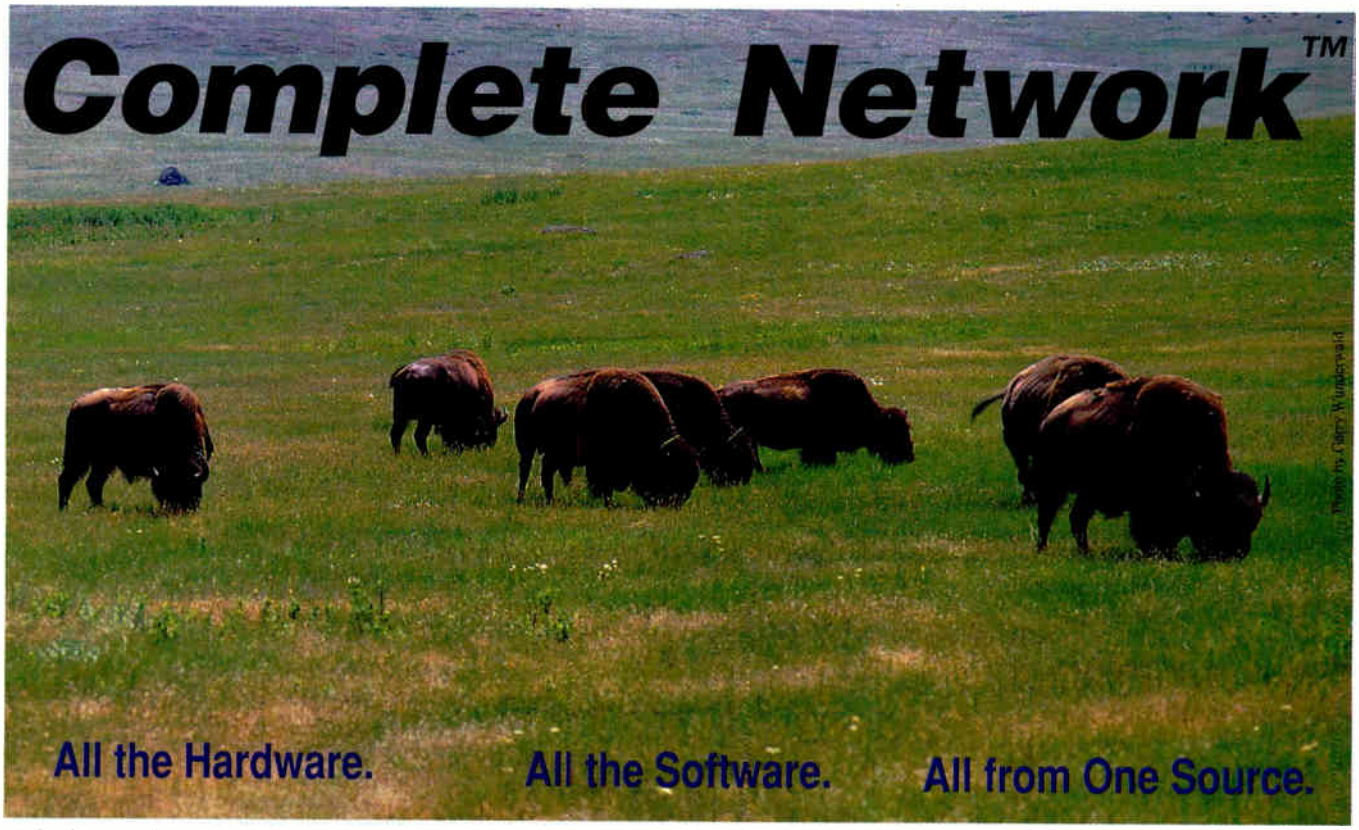

Industry Standard Hardware

Complete Network has Intel® EtherExpress16™ LAN Adapters for your network connections. Installation is easy because the cards are totally software configurable and automatically adjust for 8 or 16 BIT card slots. These *Plug 'N' Forget*™ cards from Intel set the standards for Ethernet LAN adapters.

High Performance Software

Complete Network features the WEB® 3.0 Network Operating System, winner of the LAN Times 1992 *Best of Times* award. WEB 3.0 is a fast and flexible system which is simple to learn and easy to use. It supports DOS and Windows™ and is Novell® compatible. WEB 3.0 provides the first peer-to-peer network to equal or exceed the performance of most dedicated server based systems.

WEB® LICENSED TECHNOLOGY

Everything Else You Need

Complete Network has everything else you need to set up your network: cable, connectors, terminators, and even a cable stripping tool.

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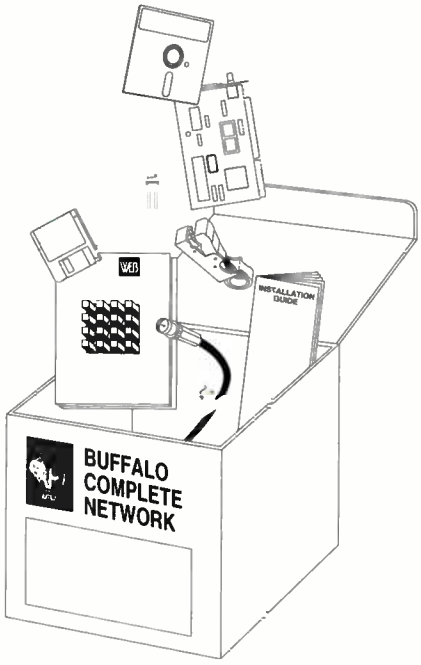

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An easy installation guide helps you quickly and easily set up your Complete Network

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With the Complete Network you can start with any number of nodes and add any number of nodes to your network at any time. Combine any of these packages, up to 255 nodes, to fit your needs.

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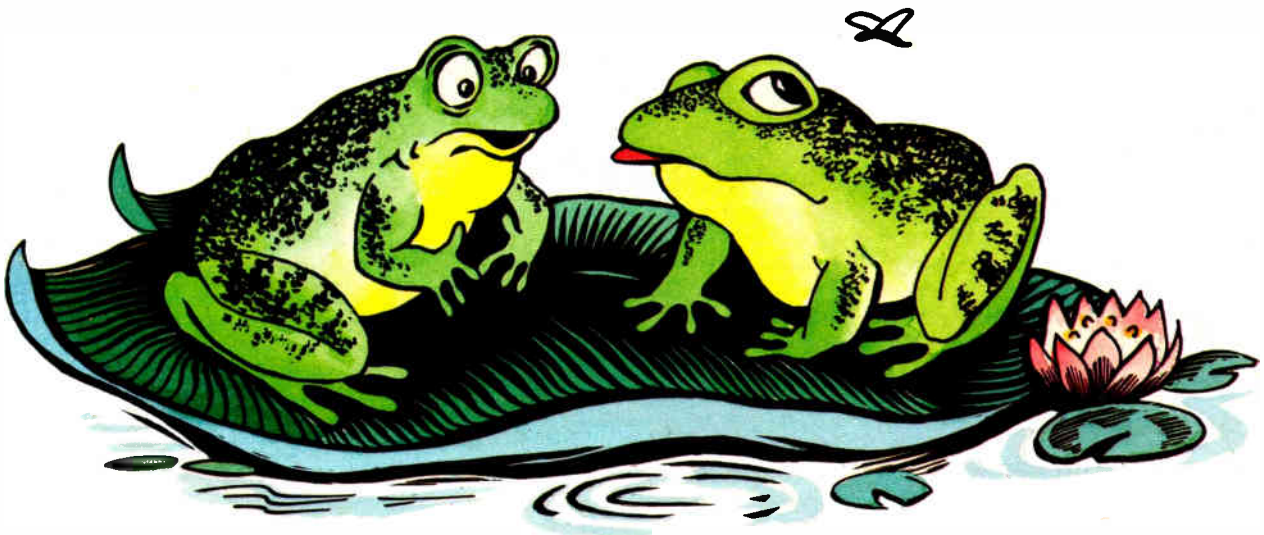
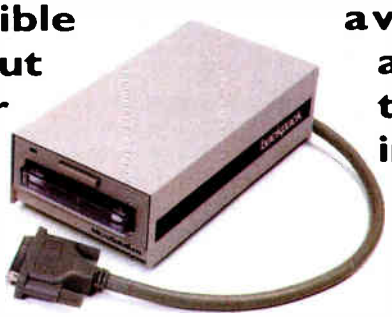
Circle 239 on Inquiry Card.

World Radio History

TWO COMPUTERS CAN SHARE ONE BACKPACK.



With Backpack, several computers can share a single tape drive. Backpack connects quickly and easily to the parallel printer port of any PC compatible or portable—without interface cards or tools! The Backpack tape drive is also easy to transport, making it ideal for transferring data from one computer to another. QIC 40 (40/120MB) and QIC 80 (80/250) tape, diskette and hard drive models are available. So share and share alike! Call today for more information.



backpack

MicroSolutions
Computer Products

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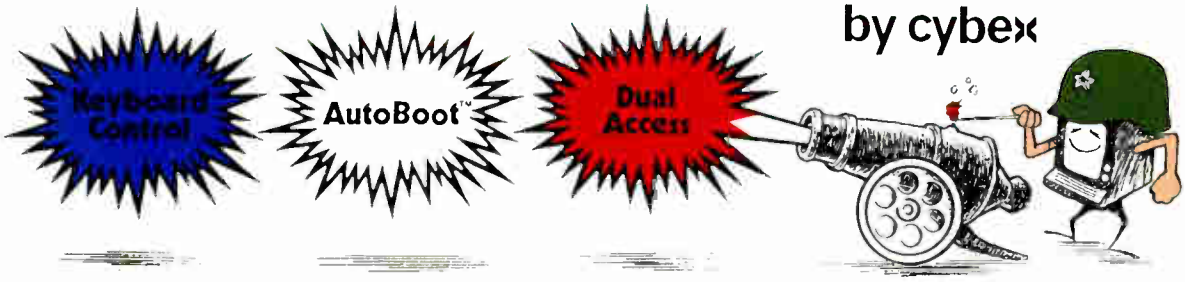
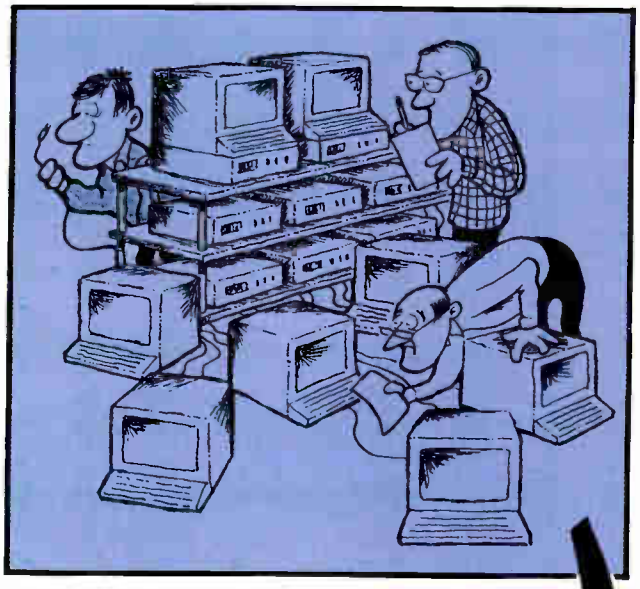
CONTROL UP TO 96 PC FILE SERVERS WITH 1 KEYBOARD AND MONITOR USING...

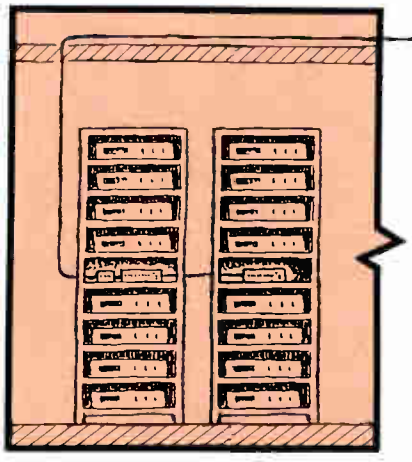
COMMANDER

by cybex

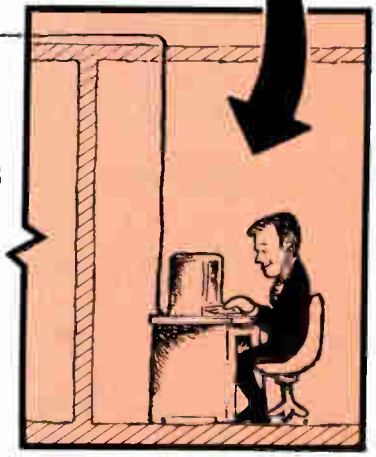


- Select via Keyboard
- Dual access up to 250 feet away (optional)
- No external power
- Mix PC, PC/XT, PC/AT and PS/2
- "AutoBoot™" Feature boots attached computers without operator intervention
- Shows PC power status





- PS/2 Mouse support available
- Each unit accommodates from 2 to 8 PCs
- Up to 12 units can be cascaded
- Mounting kit available for 19" and 24" rack installation



Dealer Program Available

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World Radio History

ARES GIVES YOU ONLY

The gods must be on ARES side. Running the ARES was a pleasure ...

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...the ARES 386-40 offers one of the best combinations of price, power and support on the market today.

-S. J. Vaughan Nichols
COMPUTER SHOPPER

ARES' 486 PC features several unexpected and pleasant surprises, making it one of the strongest contenders for your attention.

-Brad Thompson
COMPUTER SHOPPER

...ARES has put together a good computer, perhaps the best of the lot.

-Steve Gilliland
COMPUTER SHOPPER

Add up all (the) little extras, and ARES' 386-40 becomes one whopping good deal. ARES is getting a reputation for meticulous detail....
COMPUTER SHOPPER

As soon as you open the ARES box, you'll be impressed by the care and thoroughness with which ARES has packaged this machine.

-Steve Sagman
COMPUTER SHOPPER

I've seen Gateway's version of the 386SX...am I glad I finally chose ARES.

-Rick Slemmer
Grumman Aerospace

I firmly believe that you can't find a better company than ARES and you can compare them on all fronts. Service. Parts. Quality. Tech Support, and the friendliest damned people you'll ever talk to.

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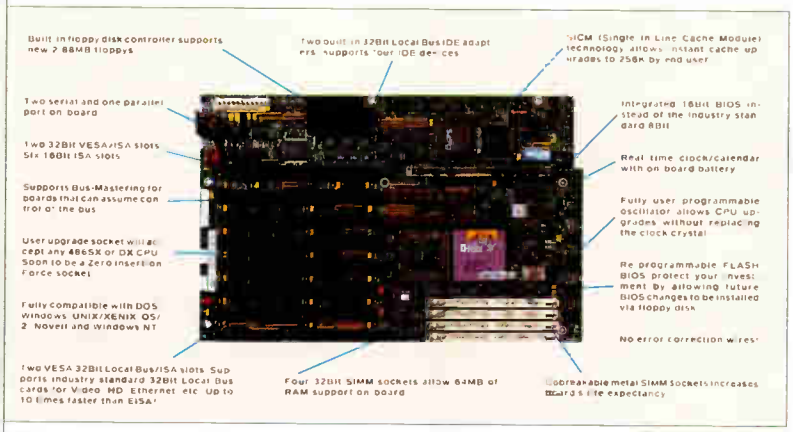
I am one who is known in various places as a hard man to deal with because I demand excellence in value and service as a principal of business. I find however that I don't need to demand it with your company. It is given as a matter of course.

-Ronald O. Koski
Adrian, Michigan

Many will follow a familiar path, others feel compelled to set their own distinct course. Those who choose ARES place themselves firmly in the second category. The new ARES VL-Bus motherboard represents a new beginning in PC performance by incorporating the compatibility of the VESA (Video Electronics Standards Association) Local Bus along with the unprecedented power of the Intel 80486 line of processors. Our steadfast goal is to make you an ARES customer for life by offering you guarantees and support policies that our competitors dare not match. ARES takes the time to do things right...recognized throughout the industry for our many design accomplishments, such as:



72 hour burn-in, followed by a rigorous 4-hour 100 point quality certification test, documented by a personalized 4-5 page printed report signed by a skilled ARES Technician.

ARES unpacks and tests ALL 'plug-and-play' components like keyboards and monitors. No other company does that!

All systems are custom packed in sturdy cartons surrounded by 360-degree solid foam packing. This protects your unit from even the most brutal pounding during shipment.

ARES cabinets are 1.5mm steel: thicker than anyone else's. This, along with an FCC-approved reflective finish, reduces interference to a minimum.

ARES seals all component screws in place for maximum security.

ARES 250-watt power supply is standard in desktop as well as tower systems.

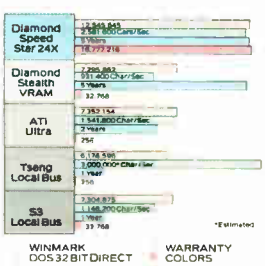
ARES technicians neatly fold and silicone all cables to their sockets, and braid all wires, tie them and seal them onto their fasteners. No ARES systems have better case airflow, increasing component life by keeping them cooler - often just 2-3 degrees above ambient room temperature!

Innovative Motherboards, Award Winning Video Cards, Superior Hard Drives... Uniquely Combined To Carry On The ARES Trademark Of Excellence.

It's The HEART Of ARES

With greatness of heart comes strength of body. And our strength lies in the multitude of ARES systems owners who express their enthusiasm and appreciation to us every day in customer satisfaction letters, follow-up calls, and on PRODIGY.

A personal computer company should do many things...It should inspire confidence and a sense of freedom. It should have a reputation that earns respect. It should, from day one, provide exactly what you need - both hardware and applications solutions. And do so without costly "free" software that you'll never use. It should offer a boundless horizon with the flexibility to grow and expand in limitless directions. THIS *IS* ARES! If you're looking for everything a personal computer should be, there is only one choice... ...AND ARES WAS THE CHOICE OF:



intel inside

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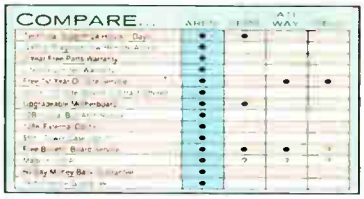
World Radio History

THREE SMALL FEATURES.

The soul of an ARES is found in the people that stand behind it. Our standards are the same as yours: quality first. Our technology may be envied and emulated throughout the industry, but our people, proud and dedicated, are our greatest asset.

Our objective is customer satisfaction. We begin with the highest quality product, and couple it with unparalleled service. We build a reliable product with dependable and responsive people to back it up. From the onset of design to the final process of packaging and delivery, quality is paramount.



ARES was the first to offer a two year warranty. The first with a 60 day no questions asked return policy. The first with IDE Quantum and Diamond SpeedStar. Among the first to provide 24 hour per day, 7 day-a-week technical support and to apply no surcharge on credit card purchases. ARES was the first - and virtually the only - firm that does not charge until shipment. And now ARES is the first to offer a fully upgradeable motherboard supporting 64MB of RAM and lightning fast 32bit Local Bus architecture. The very first. Ask our competitors if they can match ARES!

A free Fixup Disk enables you to restore lost files and connect to ARES bulletin board system via your modem to download free software. The disk also facilitates your modem link to QAPlus Remote Diagnostics, a system which lets ARES technicians support you remotely with diagnostic and repair services.

ARES operates a 24 Hour, 7 day a-week BBS system for your shareware and support needs.

A two year on-site TRW service (1 year free) includes air express parts replacements via Federal Express.

A Two year warranty on all components and lifetime warranty on labor.

A 60-day no questions asked return policy - with no restocking fee.

ARES technical support lines open 24 hours per day, 7 days a week. Should you need our expert help your wait will usually be measured in minutes, not days.

A Two year warranty on components from ARES - and from the component manufacturers. Quality through and through!

ARES 486-33EISA

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Intel 80487 Math Co-processor
256K External Cache
8MB RAM expandable to 64MB
Quantum 240MB SCSI Hard Drive
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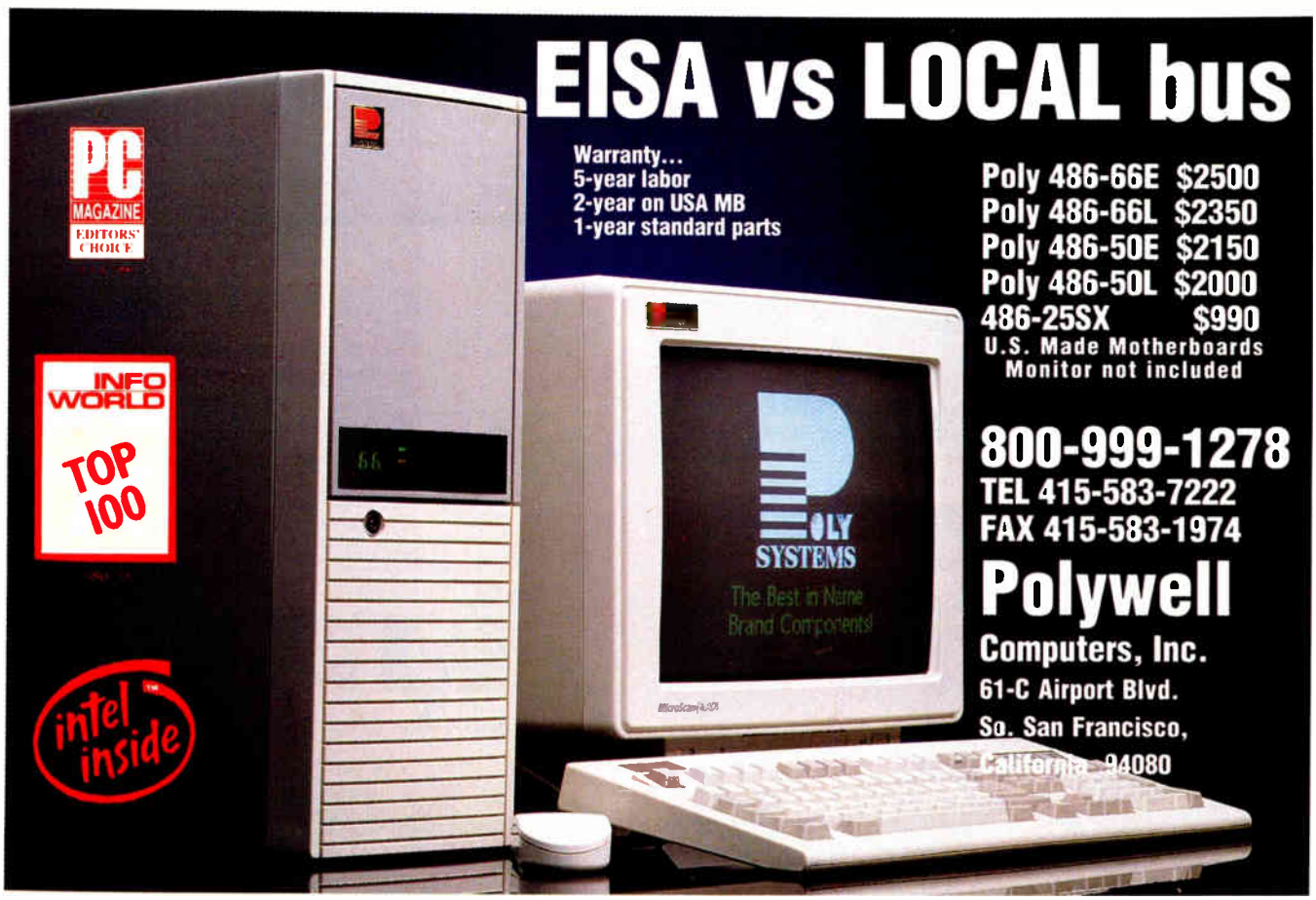

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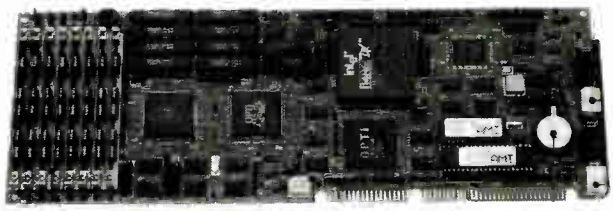

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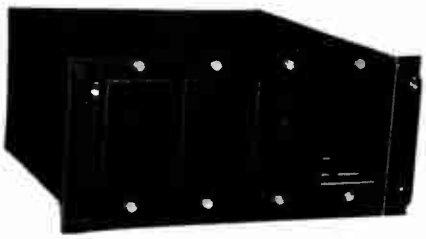

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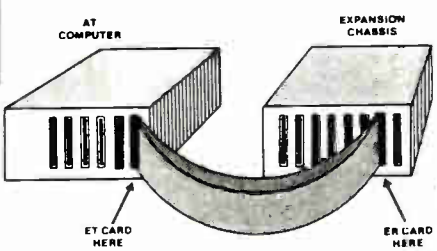

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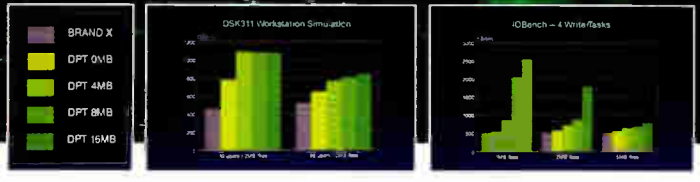

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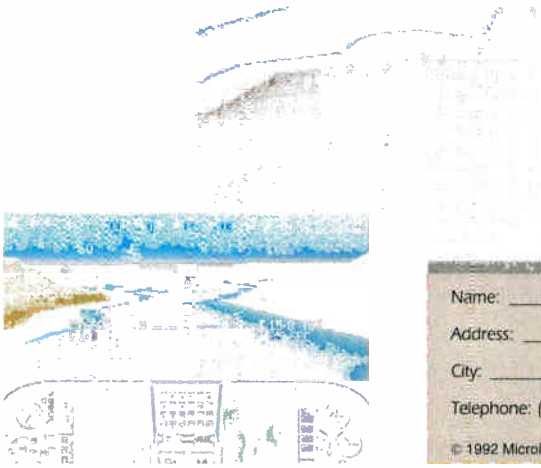

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T2000 SXE/T2100SX	2MB CARD	PA2000U	$89
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T3100 E	2MB MOD	PA8341U	$88
T3100 SX	2MB BRD	PA8308U	$88
T3100 SX	4MB BRD	PA8310U	$138
T3200 SX	2MB MOD	PA8307U	$88
T3200 SX	4MB MOD	PA8309U	$138
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Deskpro 386/16	2MB	108069W71	$348
Deskpro 386/16	1MB	108071-001	$98
Deskpro 386/16	4-8MB	108070-001	$469
Deskpro 386/16	4MB	108072-001	$249
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Compaq SLT/286	1MEG MOD	110235-001	$99
Compaq SLT/286	4MEG MOD	110237-001	$198
Compaq SLT/386	1MEG MOD	118303-001	$89
Compaq SLT/386	2MEG MOD	118304-001	$129
Compaq SLT/386	4MEG MOD	118305-001	$165
Compaq Lte 286	1MEG BRD	117081-001	$69
Compaq Lte 286	2MEG BRD	117081-002	$99
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Grid 1500	4MB	52587	$189
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Packard Bell, Magnavox, Mitsuba	2MB	N/A	$148
Packard Bell, Magnavox, Mitsuba	4MB	N/A	$218
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Samsung Notemaster 386S	2MB	SNM002	$195
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Sharp 4700MZ-200	1MB	CE-471	$198
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256X36 1MEG (72 Pin)		$50		
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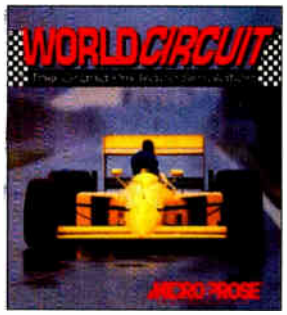

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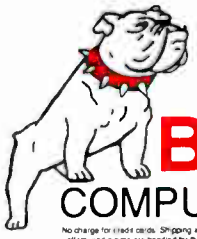

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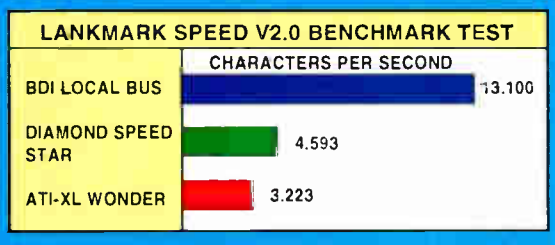

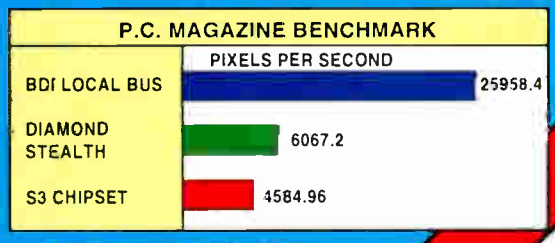

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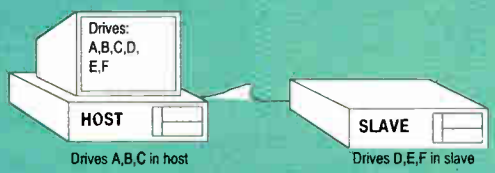

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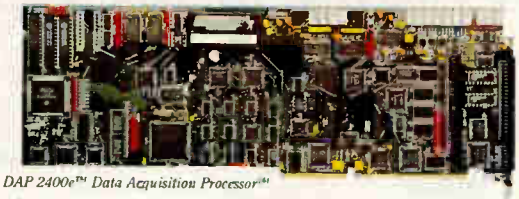

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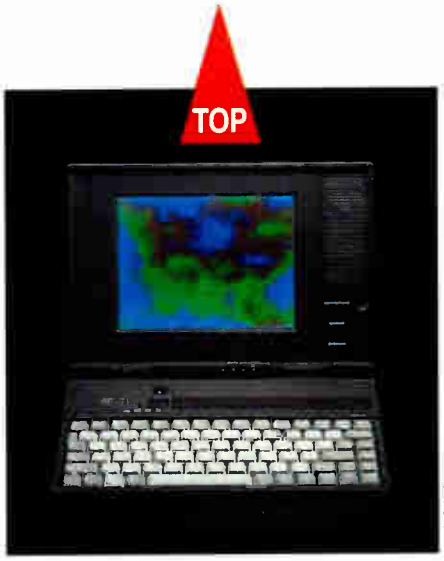

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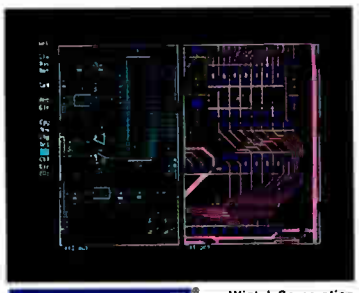

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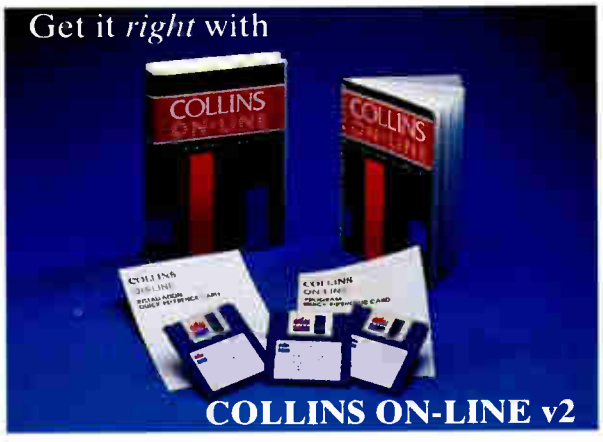

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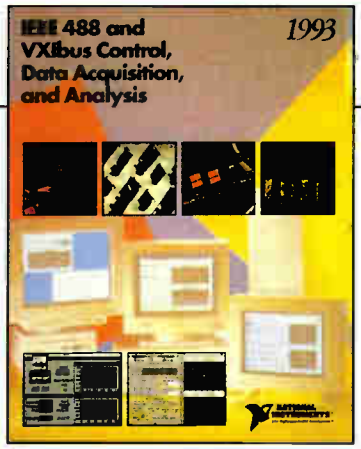

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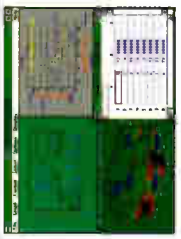

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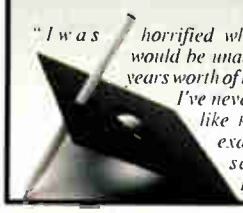

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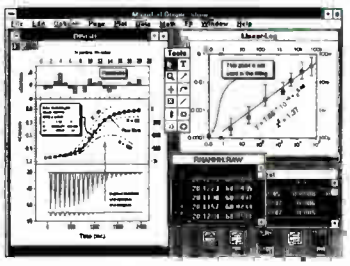

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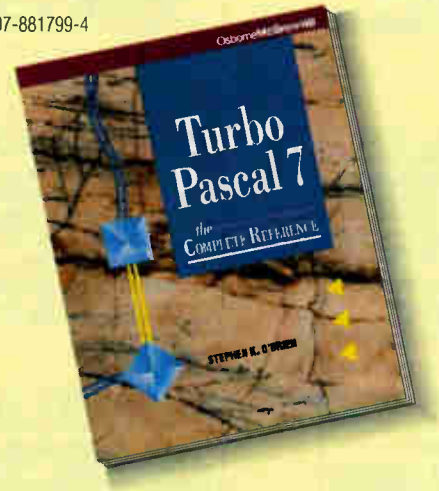

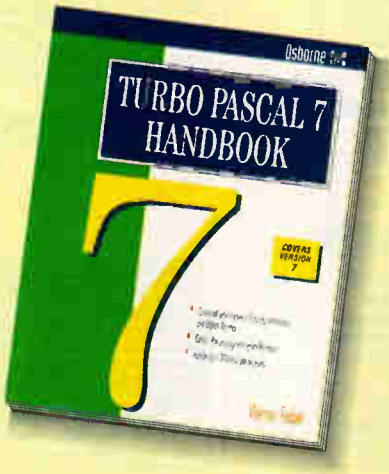

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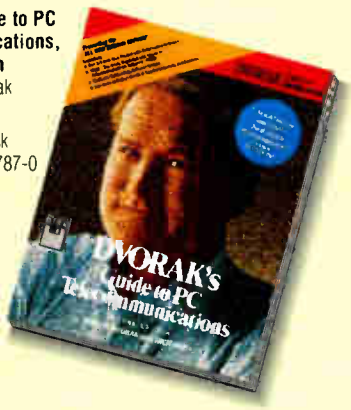

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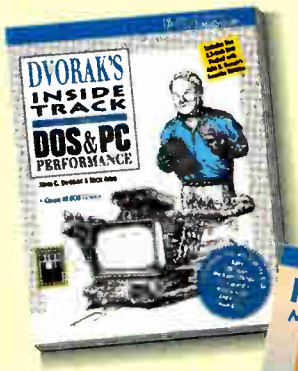

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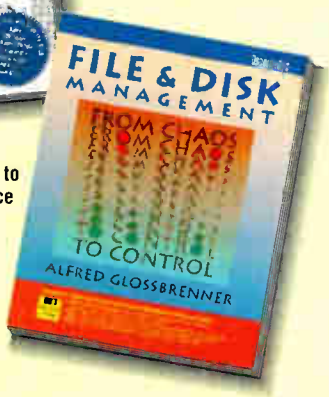

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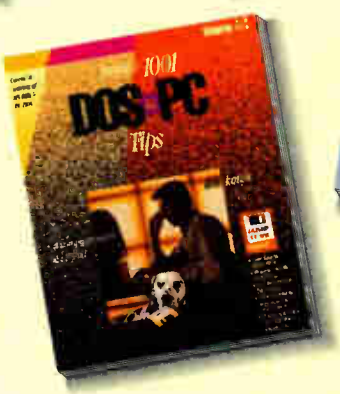

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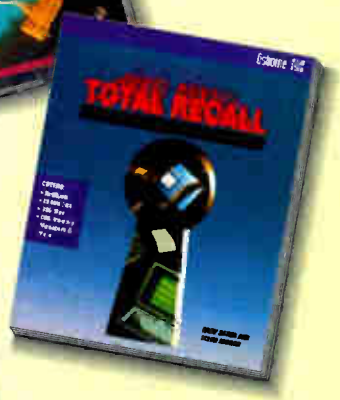

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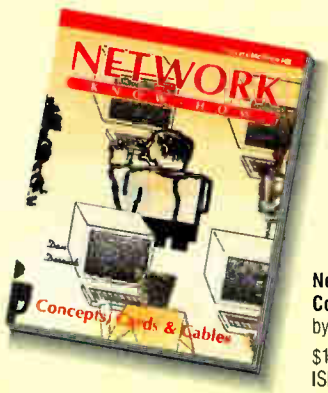

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STOP BIT

ROGER
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CINEMA BY COMPUTER

They included a TV commercial in the Telluride Film Festival this year. It showed a jogger in his name-brand sports shoes jogging on a steel beam at the top of a high-rise skeleton. He ran full tilt toward one of the corners. There was a vertiginous drop beneath him. He pivoted and jogged along another beam. He ducked under a cable and leaped from one beam to another. There wasn't any net.

Computerized special effects have taken over and have taken something away from today's movies

The festival intended this commercial as a harbinger of things to come. The entire spot was created through computer animation—runner, building, shoes, the sky above, the ground below. The eerie thing was, you couldn't tell that it was created on a disk. The visuals looked completely authentic. When we were told the truth, I felt a little like Harrison Ford when he discovers that Rachel Ward is a fabricant.

The day is not far away when entire theatrical films can be created with computers. It's already possible to generate people, rooms, and landscapes out of reality-based visuals, so that the casual eye thinks it's looking at an event in the real world. I'm sure the wizards at Industrial Light and Magic are already far along the road toward fabricating a "live-action" movie out of thin air.

You've probably seen that TV commercial where Humphrey Bogart, the real Bogart, mixes with modern actors. What can be done for 30 seconds can be done for 90 minutes. All the attributes of Bogart—how he looks, how he moves—could be fed into a program that could then costar "Bogart" in a new movie. The other actors would relate to him much as Bob Hoskins related to Jessica Rabbit, or as Arnold Schwarzenegger related to the liquid-metal villain in *Terminator II*. Maybe there wouldn't be any real actors at all; it might be easier to make everything up—all the actors and all the locations.

Is this a good idea? Is there such a thing as special effects becoming too realistic? Steven Spielberg's new *Jurassic Park* will no doubt present us with prehistoric creatures that look completely real. They'll move through three dimensions, fit comfortably into the landscape, and be, to all purposes, real dinosaurs.

But the other night I was looking at the Lumivision laserdisc of a silent classic named *The Lost World*, based on the Conan Doyle novel. Miniatures, models, and stop-action animation are used to create the prehistoric creatures, and the effects are obviously artificial. As a viewer, I was looking at special effects, not living creatures, and I knew it; that was the fun, as it is in a Ray Harryhausen movie when a winged horse takes flight. The entertainment resides in the artifice itself.

Seeing *King Kong* for the first time as a kid, I sensed instinctively that trickery was being used. The big gorilla was real enough to scare me, and yet there was something in the jerkiness of his movements, the way that the camera was obviously choosing to see one thing and not another, that created a special reality having nothing to do with real gorillas.

These days, I'm sure, computers could create a Kong *and* a Fay Wray, make them equally convincing, view them in three dimensions and from any angle with a moving camera, and place them in a real jungle. Would the result be a better movie? I don't know. If the audience is visually convinced that a real woman is being threatened by a real three-story-high monster, does that diminish the movie's dream level? *King Kong* is about fantasies and nightmares, not about things that can really happen. If the movies make them really happen, do they become more compelling—or less?

There is an imperfection in real life that is part of its nature. There are hesitations and subtle clues in human behavior and speech that probably cannot be duplicated by computers, no matter how closely they mimic Bogart's lisp or Kong's roar. There is a chemistry in Cary Grant kissing Ingrid Bergman in *Notorious* that transcends the simple visual representation of the act. And when the lovers part, there is something in their eyes that it would be difficult to program.

If computers take over special effects—replacing models, miniatures, back-projection, optical printers, double exposures, split screens, matte drawings, and all the other tricks of the trade—I have no doubt the effects will look more real. But will I enjoy them more? I'm not sure. Something subtle and wonderful—the willing suspension of disbelief—will have been lost. The director will no longer ask us to pretend. He or she will expect us to believe. But when there is nothing to disbelieve, there is nothing to believe. Simply cold perfection. ■

Roger Ebert is a film critic for the Chicago Sun-Times, *cohost of the* Siskel & Ebert *TV program, and author of the* 1993 Movie Home Companion *(Andrews & McMeel), available in print or electronic formats. His reviews are on-line on CompuServe (GO EBERT), and you can reach him in his section of CIS's ShowBiz Forum.*

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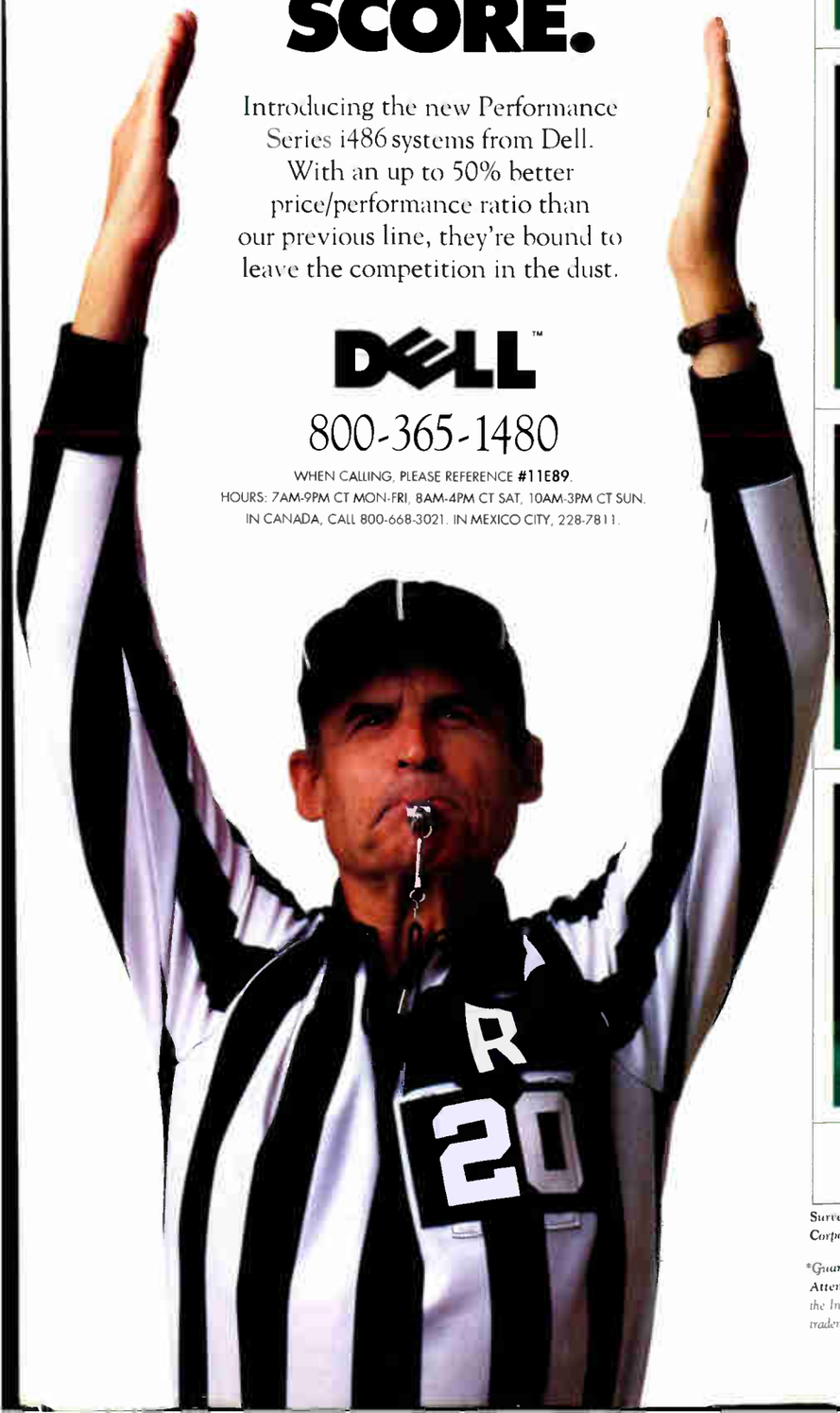

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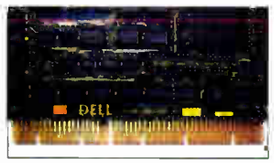

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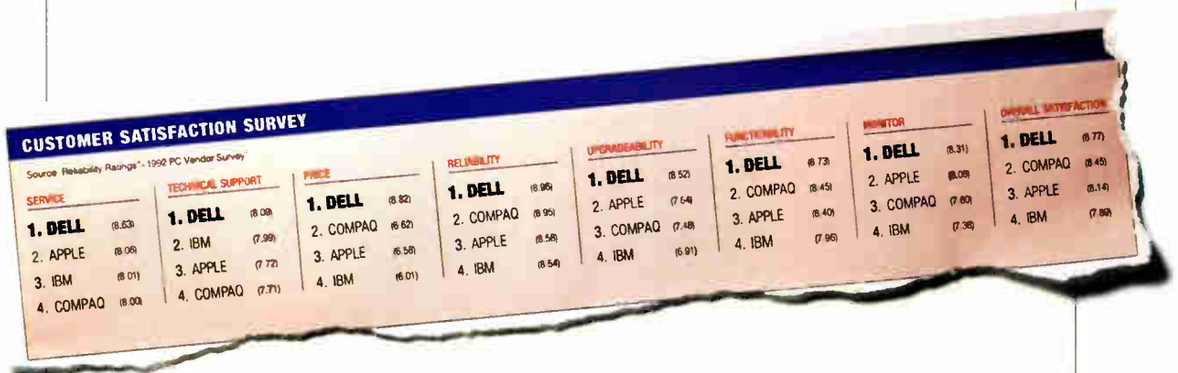

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3. IBM	(8.01)	3. APPLE	(7.72)	3. APPLE	(6.58)	3. APPLE	(8.58)	3. COMPAQ	(7.48)	3. APPLE	(8.40)	3. COMPAQ	(7.80)	3. APPLE	(8.14)
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