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Head to Head

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- Smalltalk for the Nineties
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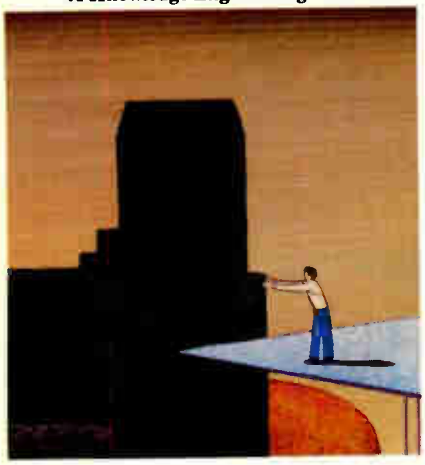

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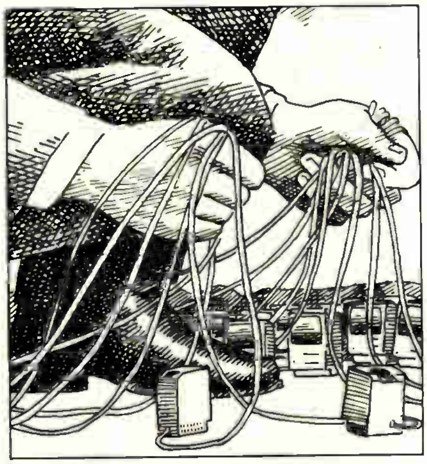

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BYTE (ISSN 0360-5280/90) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. **Postmaster:** Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520.

S P O T L I G H T

ARTIFICIAL INTELLIGENCE LIVES!

Don't look now, but AI is making its way into your applications

BYTE has been following AI since its very first year of publication. Back then, computer scientists and enthusiasts were predicting great things for AI: systems that could replace human thought processes, perform tedious tasks, and extend our ability to manipulate our environment.

Suddenly, every new computer product was touted as incorporating AI technology, much as processed foods began sprouting labels like "all-natural" and "organic"—with about as much meaning. Disillusionment soon followed, to the point where most people now sense their mental "hype-filters" turning on when they hear the phrase "AI."

But let's back up. Granted, AI was overblown, oversold, and underrealized. Meanwhile, however, some very prosaic, mundane AI-based technologies have been making important inroads into business and technology. One of those technologies is knowledge engineering—the art and science of capturing knowledge about very specific subject areas and building that information into expert systems.

MIKE and ES

In this issue, we present two valuable tools. The first is MIKE, a knowledge engineering toolkit for those who want to develop their own expert systems. Developed by researchers at the Open University in England, MIKE (which stands for Micro Interpreter for Knowledge Engineering) is a powerful, flexible tool for programmers who prefer to "roll their own."

Of course, you may not want to write code, but you may still want to develop expert systems of your own. For you, we've got ES, a ready-to-run program that lets you plug in your own rules to develop an expert system. Eric Summers, creator of the public domain ES program, presents a tutorial on his program's use in "ES: A Public Domain Expert System," found on page 289.

MIKE and ES are available for PC compatibles, on disk or by downloading; see page 5 for details. Because MIKE is a larger, more complex program, we'll discuss it in two parts, with part 2 in next month's issue.

In the meantime, we hope these articles and programs stimulate interest in a technology that, as the man said, "don't get no respect." Maybe you'll be challenged to apply the technology to your own area of expertise. Let us know if you do; we'd be interested in hearing about your application.

But please . . . don't call it AI. ■

—Ken Sheldon

New FoxPro

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- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it's able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don't even need a graphics card or special windowing software.

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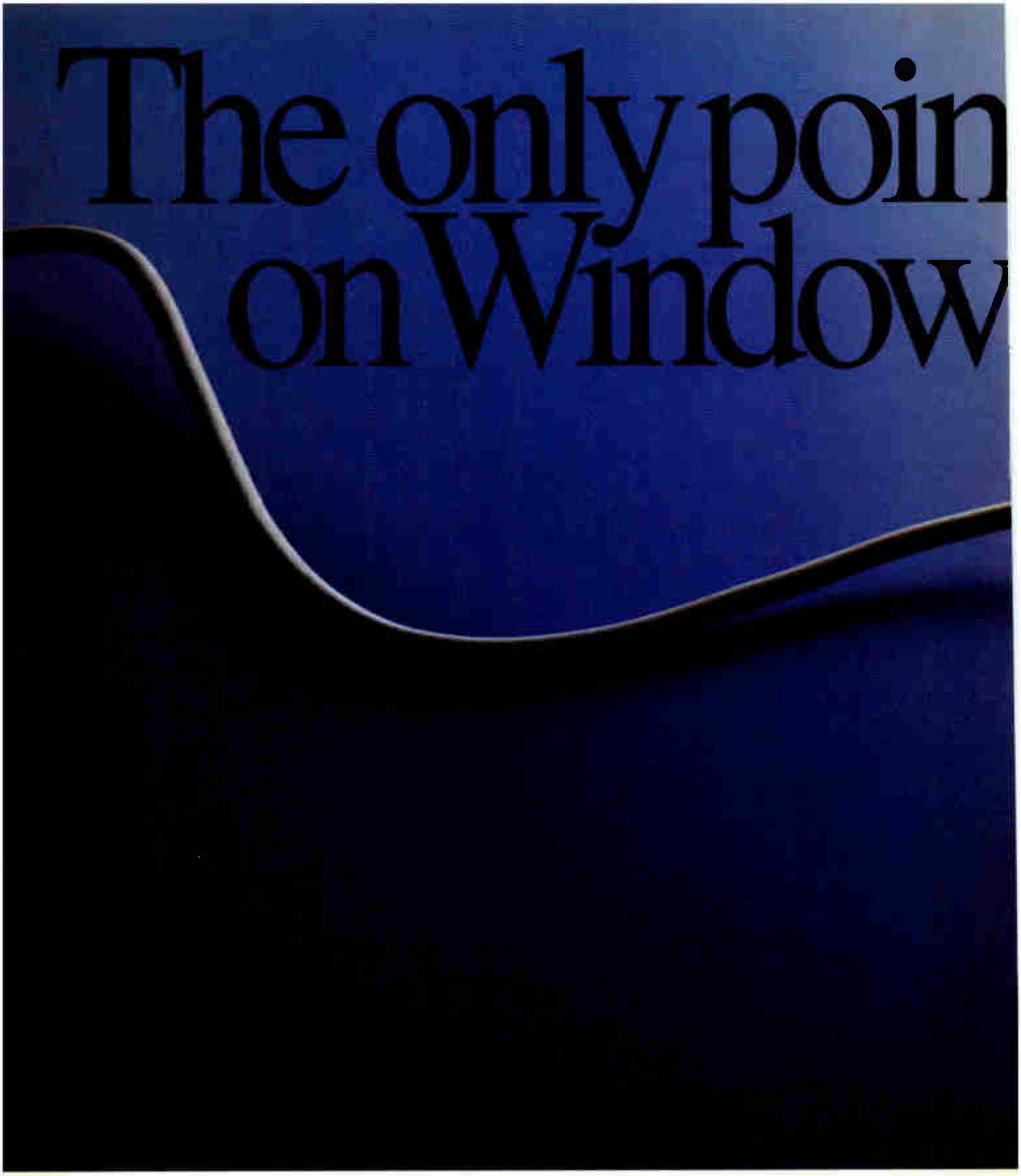

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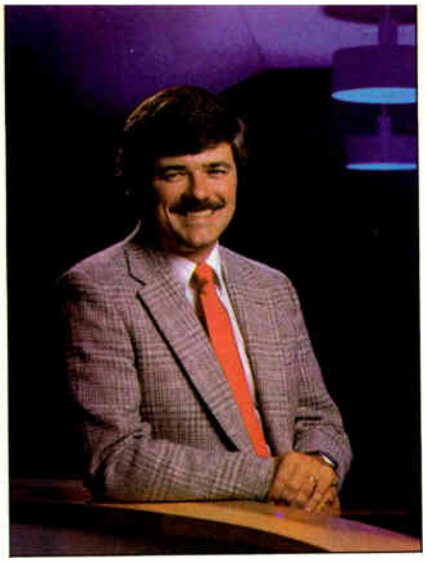

EDITORIAL ■ Fred Langa

TAIWAN, THE SOVIET UNION, AND YOU, PART 2

The future of computing could be Soviet software running on Taiwanese hardware

In early summer, I had the extraordinary pleasure of spending back-to-back weeks in Taipei and Moscow, attending computer trade shows in each city and meeting large numbers of BYTE readers, hardware vendors, software authors, and publishers in both countries. In this space in June, I wrote—before the trip—that "these countries may be a major factor in your computing options for the 1990s."

Well, I was much too conservative. There's no "may" about it: These countries *will* be a major factor—you can count on it. The hows and whys are complex, and they will appear in upcoming feature articles. But for now, here are just a few random highlights.

Taiwan: The New Japan?

Taiwan could well become the "Japan of the Nineties" for the desktop computer world. You may be surprised to learn that Taiwan already makes about 20 percent of the world's PCs. Like Japan 10 or 15 years ago, much of this output is sold as OEM equipment and is relabeled before it reaches consumers, to whom it may not appear to be of Taiwanese origin. I was surprised to see familiar "American" and "European" systems being cranked out of various Taiwanese assembly lines.

The Taiwanese government and industry have placed enormous emphasis on quality-control improvements. The best assembly lines I saw in Taiwan equaled the best in Silicon Valley.

The largest research lab, cosponsored by the government and the computer industry, is aggressively pursuing state-of-the-art designs—including a SPARCstation that will come in at about 18 million instructions per second and yet cost only about $5000 retail, some 3½ times the performance of a 20-MHz 386 for the same price. More conventionally, there are already 100 manufacturers of low-cost 486 motherboards in Taipei alone!

A government/business consortium is attempting to push Taiwan into software R&D. Although Taiwan is now known almost exclusively as a source of hardware, its one big software success to date has been truly major—the ERSO BIOS, which made low-cost Taiwanese PC clones possible and fueled the first mail-order PC business in the U.S. Clearly, when Taiwan puts its mind to software, it can produce.

U.S.S.R.: The Hard and Soft of It

Meanwhile, the U.S.S.R. has little indigenous PC hardware; there's simply no large-scale Soviet high-tech manufacturing ability to speak of. But Soviet programmers have had to overcome the limits of their limited and underpowered hardware with sheer intellectual virtuosity—the Soviet programmers I met are easily the equals of any in the West.

However, lacking valid market feedback and without easy access to Western software, they've wasted lots of effort in reinventing various wheels. For example, many Soviet programmers are busy writing basic applications (e.g., word processors) already available in overabundance in the West. We don't need another way to do block moves.

In contrast to the malaise in the rest of Soviet society, the nascent Soviet computer industry shows colossal pent-up energy and drive. They want to work, and work hard. With the influx of cheap, high-quality hardware (especially from Taiwan) and input from free markets to point them in productive directions, Soviet programmers have the potential to startle the world in every area of software—business, science/engineering, education, personal, and more. By the mid-1990s, the new world standard in computing could consist of Soviet software running on Taiwanese hardware.

Caveats, of Course

Unfortunately, the first Soviet PC entrepreneurs have been burned by unscrupulous Western businesspeople. The Soviets (sadly) have come to see lying and deceit as standard procedure for Western business. Amazingly, this has not deterred them.

Another hurdle for Soviet programmers to overcome is economic. Even "cheap" hardware is still expensive for the average Soviet citizen, who could pay the equivalent of 10 (or more) *years'* wages for a typical AT-class system.

Finally, political instability is a wild card that can always come into play. Many prominent Soviets believe the advent of personal computers—and the relatively free, uncontrollable sharing of information they engender—lies at the heart of the current changes in the country. One Soviet entrepreneur told me, "Stalin only needed to control newspapers, and then radio—and TV is just like radio." But with the free sharing of reusable floppy disks and hard-to-monitor modem communications, uncensored communication could finally take place. "And that was the end of Communism."

Perhaps. But the end of Communism does not necessarily mean the advent of political stability—and this is a factor that will greatly influence the Soviet economy, including its computer/programming industry.

As always, we're keeping our eyes on this and other situations that will affect the way we compute. Now, more than ever, it's important to have a broad view of the computer world—every operating system, on every platform...in every country.

—Fred Langa
Editor in Chief
(BIX name "flanga")

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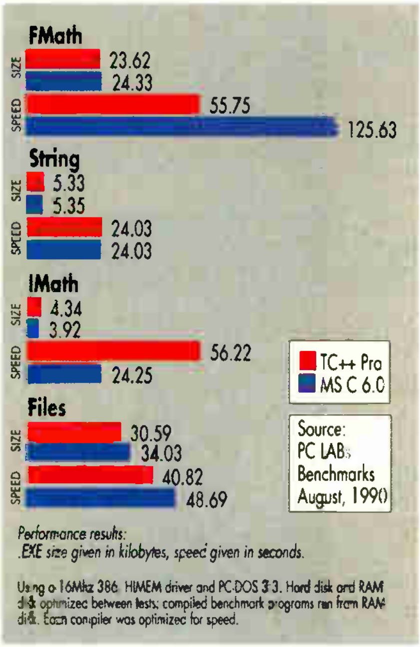

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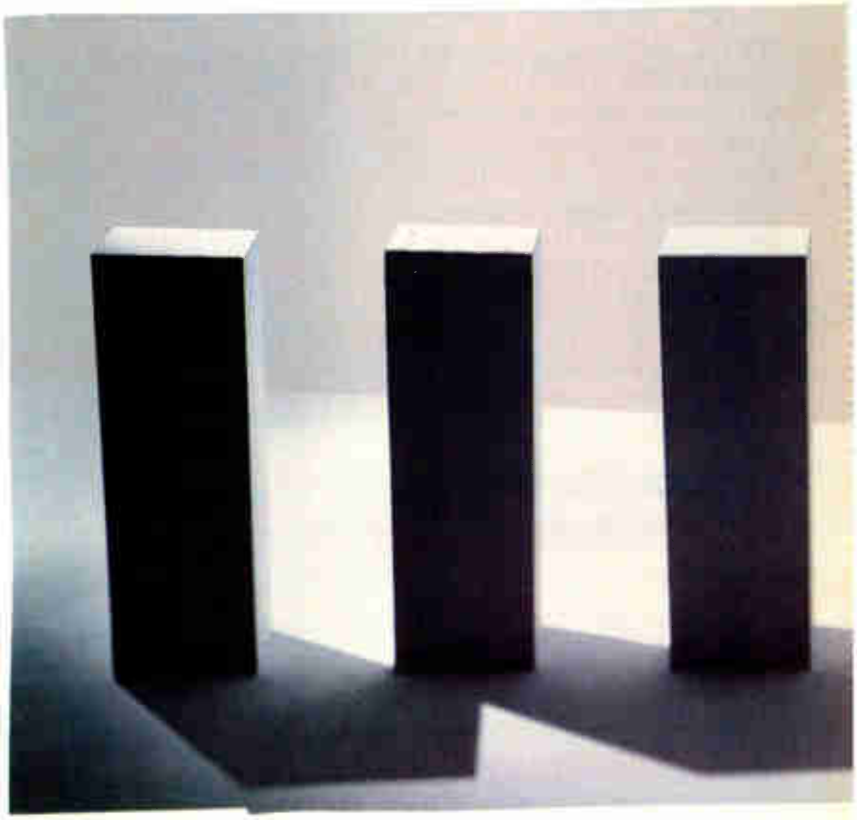

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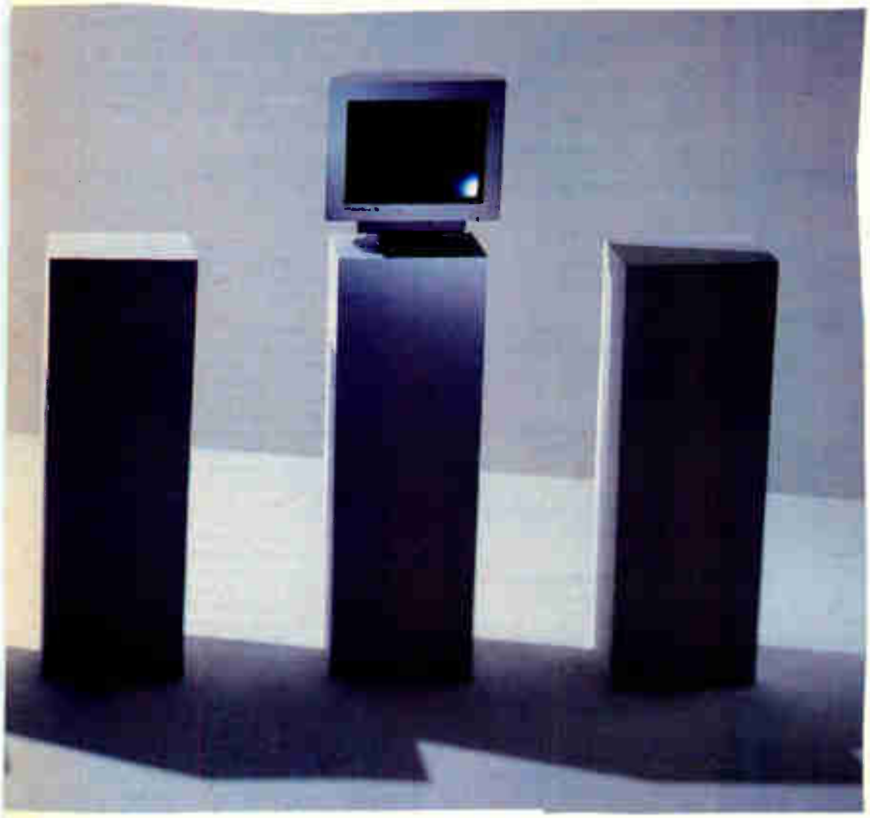

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AMD Gets Closer to Building an AT Motherchip

Signifying the possibility of smaller, less expensive AT-compatible computers, Advanced Micro Devices (Austin, TX) has developed a single chip that contains an AMD 286 processor and all the ancillary chips required to build a basic AT. The new Am286ZX and its low-power sibling, the Am286LX, combine all the functions of the processor and the accompanying components required to turn that processor into an operating computer.

Instead of building crowded motherboards with anywhere from 50 to 150 chips, manufacturers will now be able to use this single chip, plus DRAM chips, a keyboard controller, and a system bus, to make a working computer.

Currently, 286-based systems are made using a 286 and a chip set. This chip set typically includes the necessary DMA controllers, interrupt controllers, counters and timers, a real-time clock, some CMOS static RAM, a clock generator for system timing, a bus controller, a DRAM interface, and a memory management device. Many manufacturers, including AMD, currently produce sets of chips that provide the system builder with all these functions.

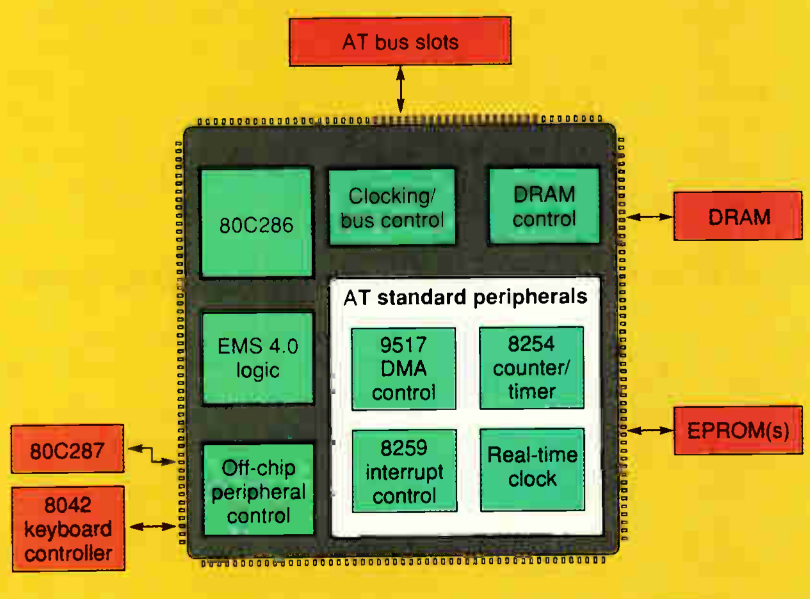
However, these sets can include anywhere from one or two to tens of chips. Several manufacturers, including Western Digital, Texas Instruments, ACC Microelectronics, and Chips & Technologies, are at work on single-chip ATs. But none has yet gone as far as AMD's new chip, which integrates all these functions, as well as the processor itself, onto a single device.

The Am286ZX chip, designed for desktop machines, and the Am286LX, designed for laptop and notebook computers, incorporate the processor core of AMD's 80C286. This core is capable of addressing 16 MB of physical RAM and 1 gigabyte of virtual memory. The processor can operate at 12.5- and 16-MHz clock rates. The chip also adds two DMA controllers with integrated DMA page registers.

A DRAM interface will let manufacturers implement what AMD calls "near zero" wait states with low-cost memory chips. It supports interleaving and page-mode and mixed-mode access. Support

continued

AMD'S 286ZX/LX: A FUNCTIONAL OVERVIEW



NANOBYTES

Personal computers that will break current speed limits, like the 50-MHz 486 machines in the works at some systems houses, will require much faster memory than what's available right now. **Hitachi** (Tokyo) could be the first to market with the top-speed memory chips that systems designers are looking for. The company says it has developed a 256K-bit static RAM with a **6-ns access time**. (The fastest typical memory today clocks in at about 20 to 30 ns.) The devices are built using BiCMOS technology. Hitachi expects commercial versions early next year.

Hitachi has been working on more than speed. The company was recently the first to publicly announce a **64-Mb DRAM chip**. Hitachi engineers said they've been able to reach a 50-ns access time. Power consumption is about one-tenth that of current 16-Mb DRAMs, they said. Skeptics say that despite Hitachi's reported accomplishments, the chips are firmly in the future tense. Commercial delivery isn't expected until 1995.

Deflating the popular pugilistic metaphor of Windows slugging it out with the Macintosh—the One Wins/the Other Loses syndrome—**Microsoft** is "aggressively working on the Mac platform," said vice president Mike Maples at a recent conference. "When System 7.0 ships, we'll have major upgrades" and **two new Mac products**, he said.

The Wollongong Group (Palo Alto, CA) promises a Mac client implementation of Sun's **Network File System**. NFS is a way of accessing files that allows heterogeneous computers to exchange data, even if their internal formats are different. It comes in two parts: a "client" that receives data, and a "server" that holds data. With NFS on the Mac, Mac users will be able to read files stored on Sun workstations and other Unix machines.

NANOBYTES

Despite selling off dBASE Mac, **Ashton-Tate** (Torrance, CA) isn't forsaking the Macintosh market. To the contrary, says spokesperson Linda Duttenhaver, Ashton-Tate will still sell the Full Impact spreadsheet, FullWrite word processor, and FullPaint graphics program. But most important, Ashton-Tate will deliver this year **a Mac version of dBASE IV**, she says. "We have a large corporate customer base that wanted a language-compatible version of dBASE IV for the Mac," Duttenhaver says. Ashton-Tate decided to divest the existing Mac package because the company "wanted to allocate the dollars to dBASE IV for the Mac but not abandon old customers." The package was an anomaly in Ashton-Tate's product line because it did not use the same dBASE language as the PC products and was not fully file-compatible. Details about dBASE IV for the Mac are sketchy, but one person familiar with it said that the application will be "character-based" and will not take particular advantage of the Mac interface, so that PC-based dBASE applications can run unchanged and .DBF files can be accessed without translation.

Meanwhile, the new owner of the dBASE Mac source code, **New Era Software** (Miami), plans to release an upgrade called version 1.2 this month, followed by a major rewrite (to be called NuBASE Mac) next year, and after that, versions for other platforms, including Windows, OS/2 Presentation Manager, SunOS, OSF/Motif, and NeXT. New Era's first priority is to hold onto the current customer base by delivering a quick fix. "We need to acknowledge that dBASE Mac has its limitations," says company CEO Ross Fridman. Version 1.2 will offer better performance, fixes to known bugs and user-interface inconsistencies, and a new search-and-replace feature. The software will be System 7.0–clean, to support Apple's forthcoming operating system for the Mac. The new owner plans to drop the list price of the package from $495 to $99. NuBASE Mac will be both a stand-alone relational database and an object-oriented graphical front end to other databases.

is also included for EMS 4.0 with two sets of 64 EMS registers.

The Am286ZX and Am286LX can directly drive from on-chip the DRAM, 80C287, BIOS, keyboard controller, and two AT bus slots. Computer makers will have to add only the memory chips, slots, and keyboard controller. The ability to drive two slots directly from the chip is a first for AMD, according to Rajesh Tanna, technical marketing manager for integrated processors. This capability is particularly useful for laptop and notebook manufacturers, who may want to have a slot available on a system but are unlikely to want more than two for space reasons.

AMD marketing director Mike Webb said that the Am286ZX is targeted at the low end of the desktop market for business, home, and educational use. This market, according to AMD officials and industry analysts, is rapidly moving from 8088- and 8086-based systems to 286-based machines. The Am286ZX will allow manufacturers to provide smaller, cheaper computers or, alternatively, systems for the same price but with added functionality, such as better video or larger hard disk drives.

Energy-Efficient Laptops

The Am286LX adds some low-power features to improve laptop performance, such as a CPU shut-down mode that turns off the 80C286 section of the chip. A standby mode shuts down all system clocks except those needed for DRAM refreshing. DRAM refreshing itself is staggered to reduce peak current demand, and the system can support the newer DRAM chips.

The Am286LX is the more significant part, AMD officials say. Its power-saving features will let designers of notebook computers implement systems that consume less energy without having to implement their own low-power logic. They will also be able to reduce motherboard sizes by half, leaving room for more peripherals, expansion, or memory. A manufacturer should be able to build a typical notebook computer with a 16-gray-level VGA display, serial and parallel ports, and one or two slots using the AMD chip and only four or five other devices, plus a DRAM chip, on a board.

AMD officials declined to say which manufacturers are planning to use the new chips; according to Webb, "virtually all notable notebook manufacturers are interested in the part."

AMD says that the new chips, which the company planned to announce this month, will be available in sample quantities in the fourth quarter of this year. The company expects volume production to start in the second quarter of 1991. The 12-MHz ZX will cost $69 in 1000-unit quantities; the 16-MHz ZX, $85.50; the 12-MHz LX, $76.50; and the 16-MHz LX, $89.

A few things are missing from the picture as painted so far. Most systems now package serial and parallel ports, some form of display, and floppy disk drive and even hard disk drive controllers directly on the motherboard. A basic system designed with the Am-286ZX/LX would need add-in cards to provide these functions or would require additional chips on the motherboard.

Webb described the Am286ZX/LX as "virtually a motherboard on a chip," a description that is more accurate than not. However, to make a full AT motherboard with floppy disk drives, serial and parallel ports, and built-in video will still require at least four chips plus some DRAM chips. To make a less high-powered system with video on a bus card and minimal I/O might be possible using a single chip, but it's much more likely to be done using two. So although the true single-chip AT is not yet here, it will now be possible to make 286-based systems that are much smaller and consume less power.

— *Owen Linderholm*

Xerox's New Interface: Rooms with a 3-D View

Xerox's Palo Alto Research Center, birthplace of the desktop/windows/icons metaphor, is adding a three-dimensional look and feel, interactive animation, and color to the graphical user interface. PARC's new Information Visualizers (IVs) will go beyond workspaces and windows to what project leader Stuart Card likens to a dining room table metaphor, where data is accessed by context and structure as well as content. "They are a way of managing the clutter of windows," he says.

Unlike 3-D visualizations that involve wearing special goggles and gloves to enter into an artificial world, IVs will use a mouse and point-and-click commands. PARC's aim is to provide a 3-D representation that will be useful to businesses.

continued

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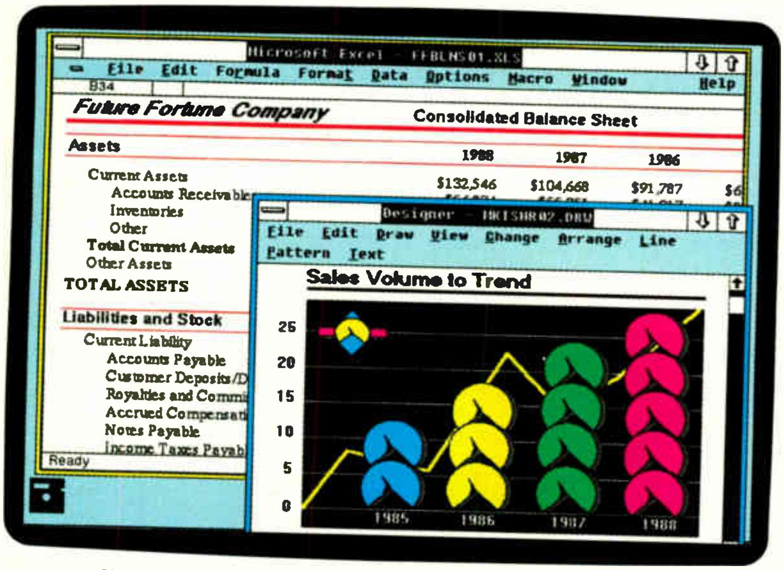

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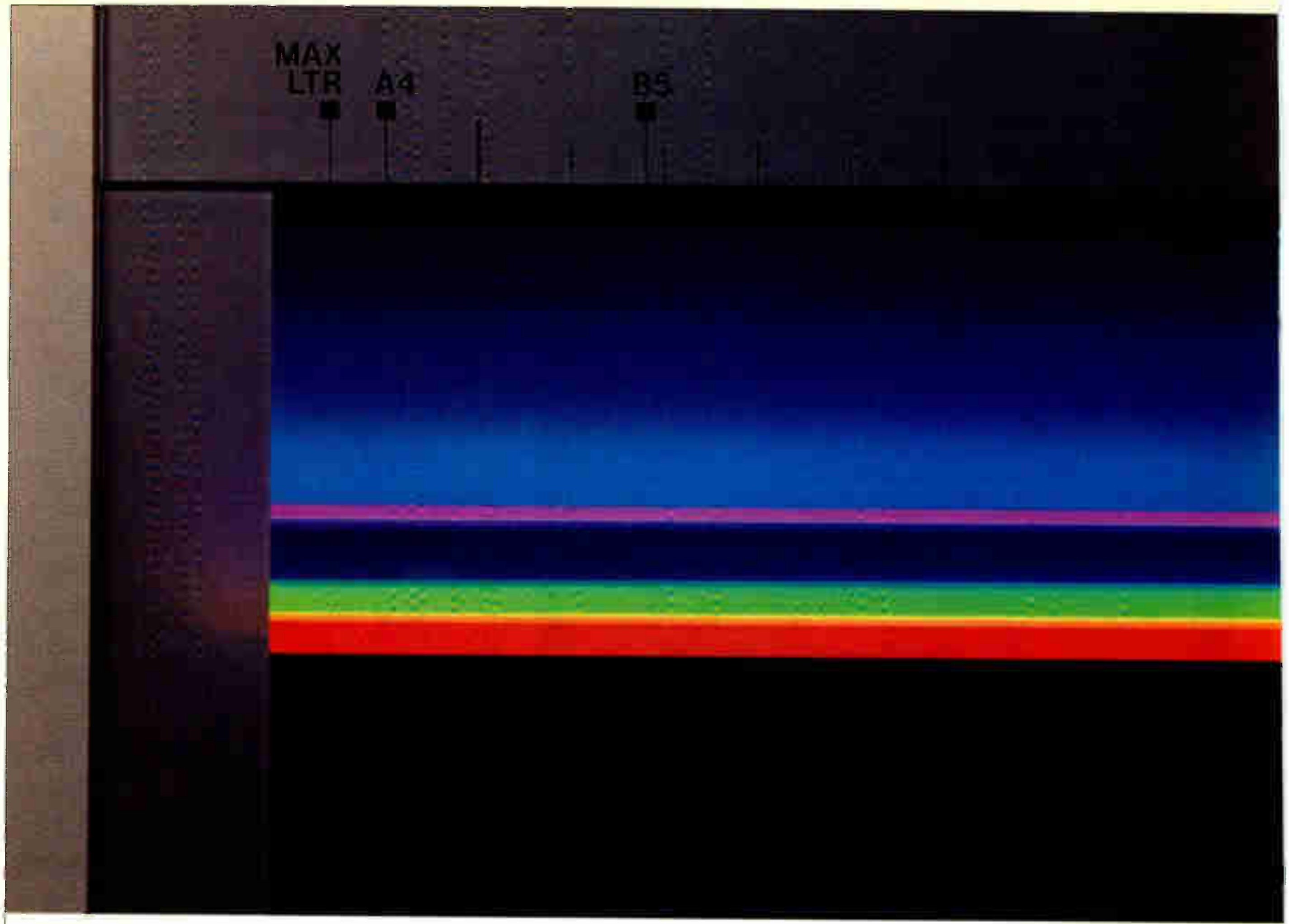

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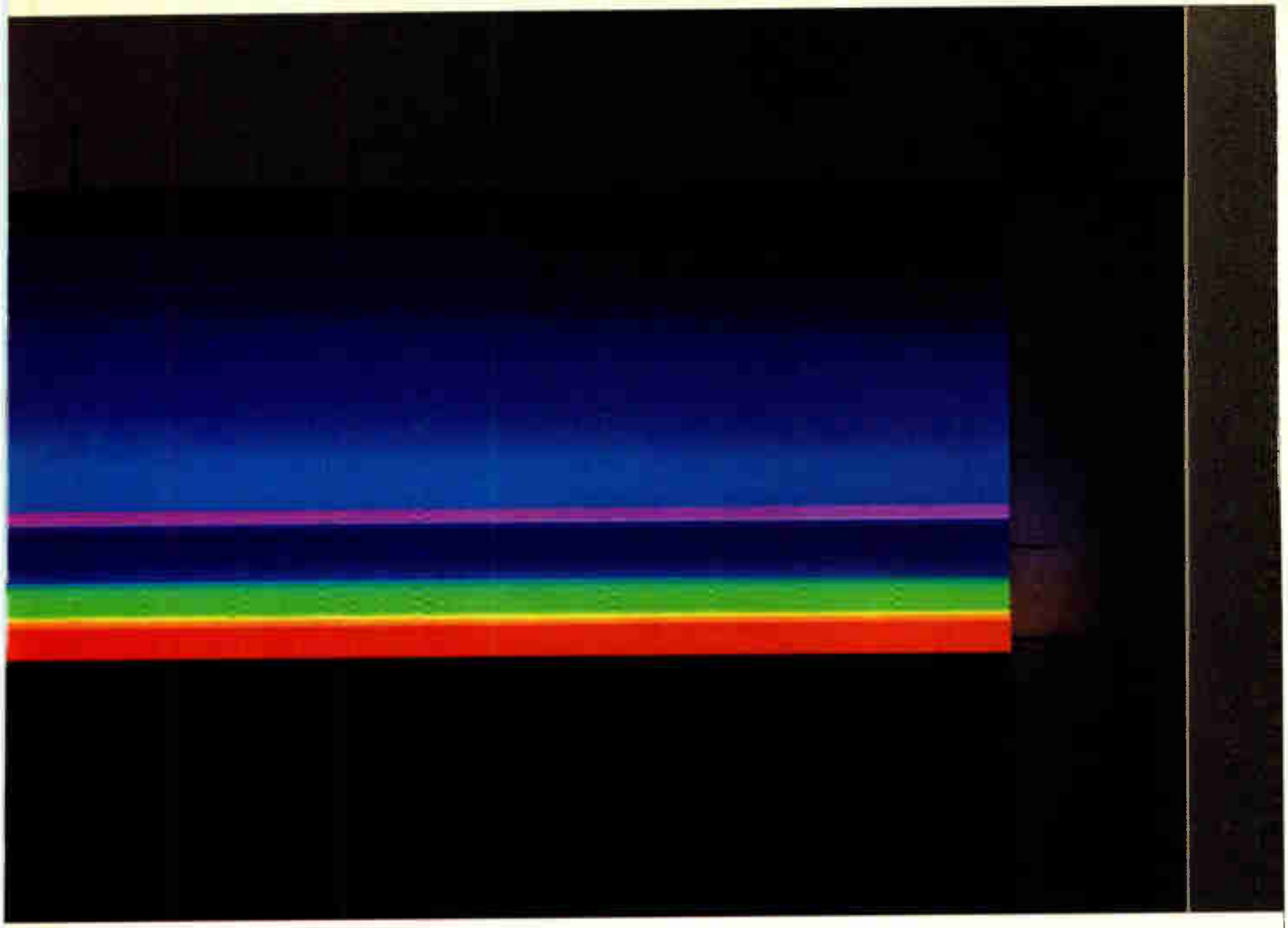

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NANOBYTES

Researchers at the **State University of New York at Buffalo** are working on computer systems with **advanced pattern-recognition skills**—more specifically, systems that will be able to read pieces of mail and sort them at a speed of 12 pieces per second. Working with grants from the U.S. Postal Service, the researchers have so far developed an algorithm that an optical character recognition machine can use to distinguish an address from all the other printing on a piece of mail, but that process currently takes about 1 minute. There are about 1 million data points on each piece of mail, a researcher pointed out. The Buffalo group hopes to someday have a machine that can rapidly zero in on and "understand" any address, even handwritten ones.

Sharp (Osaka, Japan) says it has designed an LCD with a response time that is about triple that of current panels. The black-and-white supertwisted nematic LCD has a response time of about 50 ms, Sharp says, which means that operations like scrolling through a text file and moving a cursor with a mouse are faster than on contemporary portables. The 14-mm panel can display 640 by 480 pixels on a screen measuring 205 mm wide and 155 mm high. Samples should start shipping by year's end, the company says.

With a new business unit to pursue the **multimedia** market, **Autodesk** (Sausalito, CA) is working on a **new 3-D animation program** for IBM-type PCs and anticipates developing other products that will integrate graphics and video. The new program, to be called 3D Studio, is an interactive graphics package that combines tools for creating, manipulating, and animating 3-D images. 3D Studio will run on any 386 or 486 system with 3 MB of RAM, a hard disk drive, and a numerical coprocessor. The expected price is $2995. The program will be able to exchange files with AutoCAD, Animator, TIFF packages, and Pixar's Renderman, Autodesk said. "Multimedia is in a similar stage now to where the CAD market was when Autodesk got started," said company cofounder David Kalish.

An extension of an earlier PARC system called Rooms, IVs construct workspaces that are akin to 3-D rooms, connected to each other by "doors" and filled with interactive objects representing data and resources. Information is arrayed within objects, such as walls and floating trees, that "hang in the air." One IV tree at Xerox represents the top 600 nodes of the company's organizational chart. It's reminiscent of a multitiered Rolodex. In conventional form, that chart is an 80-page document.

Another IV at PARC is the People Browser, which combines employee photos, biographies, and published papers with an interactive floor plan to guide you to the correct office or lab. You can "fly" through a carousel of names or down a directory tree.

Clicking on an object accesses the information embedded in it. When you select an object on the screen, it zooms to the front. Your perceptual system tracks the object's relationship to other objects, aided by visual clues, such as shadows and colors.

The key to the IV, says chief designer George Robertson, is its use of the human perceptual system. "An understanding of human perception led us to design our animated visualizations to shift some of the work of the perceptual system, which frees up people's cognitive functions to work on the problem," Robertson says.

The graphics-intensive IVs currently run on Silicon Graphics Iris workstations, but as hardware and software advances bring 3-D capabilities to less expensive computers, IV-type interfaces like Xerox PARC's might follow onto your desktop.

— Mark Clarkson

Chip Brings More Colorful Graphics to VGA PCs

Remember how the box of 64 Crayolas always looked so much better than the packs of 8 or 24? That's sort of how personal computer users feel when they look at graphically superior workstations. But PC users who covet workstation-style graphics will soon be able to find satisfaction without having to hock the farm. A new chip developed by Edsun Laboratories (Waltham, MA) and Analog Devices (Norwood, MA) can give ordinary VGA systems the ability to display sharper, more colorful images. The new D/A converter chip, which simply replaces the traditional RAM-DAC on a standard VGA board, uses interpolation techniques to smooth jagged lines and blend colors on the screen, resulting in crisper images and a bigger palette of colors and shades. The codevelopers say the device will give standard IBM compatibles the power to generate photorealistic graphics on VGA-type displays.

The chip, equipped with three 8-bit DACs, a color lookup table, and digital signal processing circuitry, uses Edsun's patented Continuous Edge Graphics algorithms to smooth the pixels on the screen and get rid of jagged edges. This aliasing occurs when two different colors meet—the edge of a pink line against a black background, for example. Instead of treating each pixel as a square of one color or the other (pink or black), which creates the dreaded staircase effect, CEG puts the two abutting colors into mixing registers, calculates a real-time weighted average, and then blends the

The CEG chip allows for realistic rendering with a PC. This image was created at the California Institute of Technology.

continued


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What's going to **boost personal computer sales** through the middle of the decade? Small businesses and home offices, says **BIS CAP International** (Norwell, MA). According to the analysts, those two markets are where the most growth in computer sales awaits. Shipments to these two groups are growing 16 percent annually, they say. By 1993, yearly personal computer sales will hit nearly 13 million; according to BIS CAP's projections, about 4 million of them will be to small businesses and home offices.

Hoping to broaden its access to commercial markets, **Sun** (Mountain View, CA) has finally, after many years of selling only direct or through OEMs and VARs, taken the plunge into dealer channels. However, company officials caution that this is not retail in the sense of commodity PCs; nobody is expecting customers to walk in off the street and plunk down bucks for a SPARCstation. Sun's new agreements are with leading resellers: Intelligent Electronics (parent of Entre, Connecting Point, and Today's Computers Business Centers), MicroAge, and NYNEX Business Centers. Sun gains access to small- and medium-size businesses in markets where it lacks direct sales offices. The dealers won't be allowed to sell just boxes; instead, sales will have to be made on a value-added basis, with software supplied for vertical applications and on-site installation and support tossed in.

Neural networks continue to gain credibility and interest, and evidence at the recent American Association for Artificial Intelligence showed that more neural network developers are working with microcomputers. One of the pioneers in this area is **HNC** (San Diego, CA), whose ExploreNet 3000, a $1495 neural network application development package, runs on IBM PC compatibles under **Windows** 3.0. ExploreNet 3000 uses the Windows interface to make it easier to learn how to build neural networks. The package integrates with other Windows programs and supports HNC's Anza Plus coprocessors.

colors to produce a smooth image. As Bill Schweber at Analog Devices explains it, "Because the colors are blended, the eye sees it as a smooth line." The chip is smart enough to mix and "feather" colors the way a painter would.

With its built-in color-mixing engine, the CEG/DAC chip can blend VGA's palette of 256 colors into more than 700,000 shades. It increases apparent pixel resolution to at least 1280 by 1024 pixels and, with some images, to as high as 2048 by 2048, significantly higher than enhanced VGA's 640 by 480. The chip works with standard VGA monitors and requires no equipment adjustments or extra memory, Edsun says.

What the CEG/DAC does require is new drivers. So far, the only two available drivers are for AutoCAD and Lotus 1-2-3. An Edsun spokesperson said others are on the way. Without the drivers, the CEG/DAC operates in VGA mode. Users will be able to toggle between VGA and CEG modes.

Using CEG drivers slightly increases display execution time by about 10 percent, an Analog Devices spokesperson said. But an official at Monolithic Systems, which is using the CEG/DAC on two of its boards, said that he had not "seen or heard of any performance degradation."

Many computer and board manufacturers are evaluating the graphics chip for use in products, Edsun and Analog officials said. Monolithic has plugged it onto its multifunction MicroPAQ card and its MicroFrame 386S AT-compatible motherboard in place of the standard VGA controller. The chip increases the cost of those boards by about $300, a spokesperson said.

The CEG/DAC is compatible with any standard VGA controller and available in versions that are pin-compatible with the most common RAM-DACs, Edsun says, meaning ones from Inmos, Brooktree, and Analog Devices. Volume production is expected to start this month. In quantities of 100,000, the chips will sell for about $15 each; in batches of 1000, they will sell for from $30 to $50 each, depending on model and speed, Schweber said. Although the primary target customer is OEMs, people eager to do some soldering can buy the chip and do the replacement themselves.

— D. Barker

And This Chip Sharpens Portable VGA Displays

VGA on portable computers is also looking better. Cirrus Logic (Milpitas, CA) has developed a new graphics interface controller chip for LCDs that the company says enables small active-matrix displays to produce images in full VGA color.

To generate the required multiple colors and shades, the CL-GD6340 chip drives the display by rapidly turning pixels on and off while the screen is refreshed a single time. Darker pixels are off for longer, and lighter pixels are on for longer. The chip mixes this technique with patterns of pixels to change shades; it uses dithering, stippling, and hatching techniques as well.

The chip is optimized for use with the IBM PC and compatibles, but Cirrus expects that it will work well with other computers; the company says that it has been holding talks with Apple.

The new controller has a RAM-DAC built in, as well as a color lookup table and D/A converter, so it can take the place of a regular RAM-DAC in a display system, thus not increasing the overall chip count. Currently, the CL-GD6340 works with color active-matrix thin-film transistor display panels and passive multiplexed supertwist nematic displays, as well as gas-plasma, electroluminescent, and analog CRTs.

Cirrus officials said that several manufacturers should have prototype systems on display at Comdex next month.

— Owen Linderholm

Developers Tell Apple to Think Business

Mark down those Macintosh prices, stabilize management, and start promoting the Mac as a general business machine. That was the advice for Apple Computer from a group of software developers speaking at the recent Mac Expo in Boston. The software executives all agreed that Apple has to lower its profit margins and sell more computers. That's hardly a novel suggestion, but the call for cheaper Macs is taking on a strident edge these days. Developers are concerned that the market for their software is stagnating—one Microsoft

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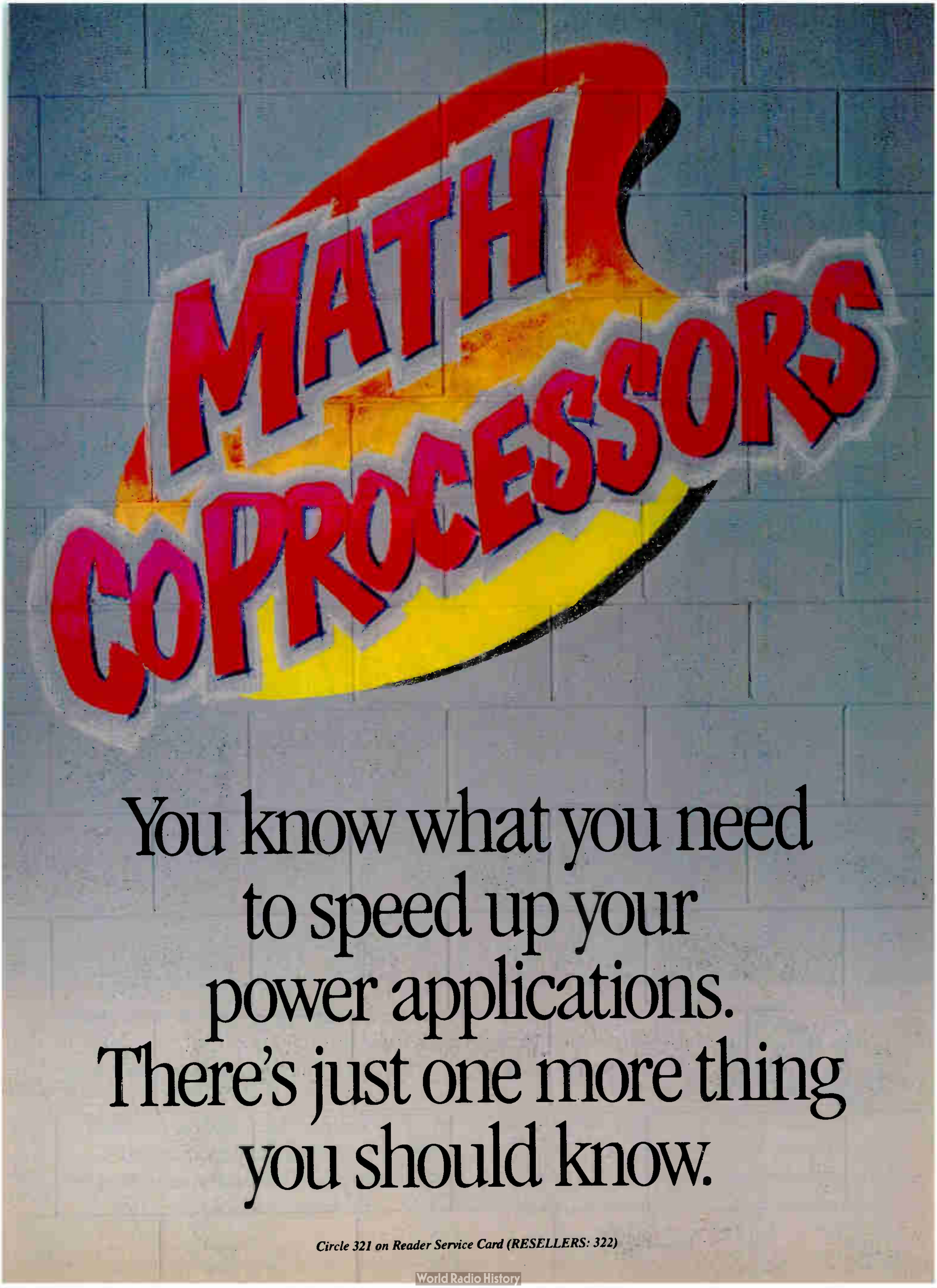
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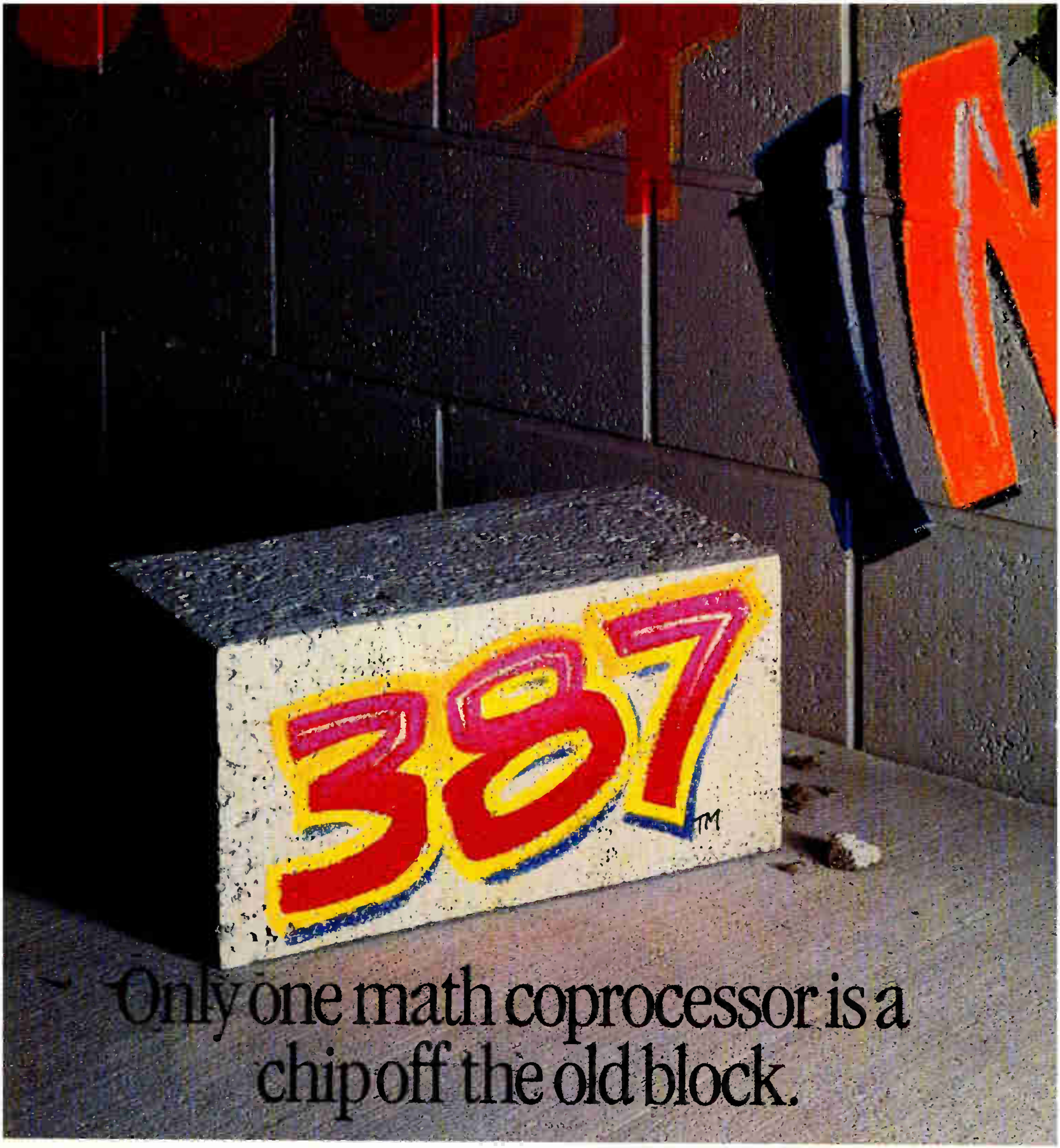

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Cross-platform hypertravel: **Heizer Software** (Pleasant Hill, CA) is selling a hypermedia file-format converter that can translate HyperCard 1.2.5 scripts and stacks into files that work with **Asymetrix**'s Windows-based ToolBook. According to Heizer, about 80 percent of a typical HyperCard application can be directly translated to ToolBook; the rest is flagged, and explanations and suggestions are provided for how to fix it. The $199 utility was developed by the Hypermedia Group.

IBM is terminating four models in its PS/2 line, including the 286-based Models 60-041 and 60-071 and the 386-based Models 80-041 and 80-071. IBM cut prices of the discontinued models from 24 percent to 34 percent. The discontinued Model 60 systems, closing out at $2750 and $3085, are being replaced by the 386SX-based Model 65 SX, introduced in March. The older 16-MHz Model 80s, now going for $4000 and $4500, are being replaced by newer versions with a 25-MHz 386, a SCSI port, and 2 MB of RAM.

After at least a year in the "coming soon" category, the **Macintosh version of Ventura Publisher** will arrive during the fourth quarter of this year, Xerox's **Ventura Software** (San Diego, CA) says. Ventura Publisher is an established desktop publishing program in the IBM PC world, but the Mac version will be going into a market heavily populated with users of Aldus PageMaker and Quark XPress. Ventura officials, however, are promoting their $795 program as the package for industrial-strength page makeup, saying it's better suited for long documents. The Mac edition will be able to import files from the DOS (GEM), Windows, and OS/2 editions of Ventura Publisher.

Bo knows laptops? One of the suggestions made by software developers to **Apple** at the summer Mac Expo involved building a more portable portable. Apple needs not just a range of desktop computers, said Symantec president Gordon Eubanks, "but a laptop other than something only Bo Jackson can carry."

official said that only nine Mac software houses were profitable last year—and that without more Mac users, there will be no growth in demand for Mac programs.

"Market share is a critical issue for Apple," said Bill Campbell, president of Apple's Claris division. "Apple's out of whack on the price/value relationship." Mac developers are facing a drop in unit sales, "while the competition is spending more and more," said Heidi Roizen, president of T-Maker. Apple officials have said that they're willing to take a cut in profit margins, and the new Macs expected this month and in early 1991 might reflect that.

But Apple needs more than just lower prices. The company needs a new attitude, according to Aldus president Paul Brainerd, "a mind-set that looks at all aspects of business use." The company has to develop new markets and move the Mac into new niches, he said. Claris's Campbell even said that Apple should "set aside" multimedia as a market segment. Apple needs to promote the Mac as a business machine, an educational machine, and "a consumer machine," he said.

Symantec president Gordon Eubanks urged Apple to "provide alternate sources for Macintosh technology" by licensing its system software, its "biggest value." Right now, "there's a big risk that Apple will let the second source of Macintosh be Windows."

Microsoft vice president Mike Maples, self-described visitor from "the evil empire," urged Apple to "participate and coexist" with other computer makers. Apple is not going to convince IBM shops to throw out their PCs, he said, but they can figure out how to get Macs into those shops. His biggest suggestion for Apple: "Work toward promoting multiplatform capability." Other developers agreed. In an environment of networked computers, "applications that work across platforms will be critical," Eubanks said.

— D. Barker

OCR Software Will Live Inside Applications

You have a document that you want to pull into your word processor. But first, you have to shut down your editing program, start up your optical character recognition program, scan in the material, and then haul it into the editor. Ocron (Santa Clara, CA) wants to make that whole procedure much simpler. Its new OCR utility program, Recore, is designed to be embedded in application programs or in hardware. Instead of leaving your word processor and entering a stand-alone OCR package to do the character recognition, you'd just select Scan from your current application's list of menu items and then read the text directly from the scanner into your operative program as an ASCII document.

Recore is designed exclusively for embedded applications, says Ocron marketing vice president Larry Kubo. OEMs and systems integrators who want to embed the OCR software in their programs or hardware systems pay Ocron a negotiable licensing fee. Recore is available for 286- and 386-based PCs, PS/2s, Macintoshes, Sun's SPARC systems, and NeXT systems.

Ocron sees Recore as an alternative to stand-alone OCR packages from companies such as Calera, Kurzweil, Caere, and OCR Systems. "OCR ought to be a utility," Kubo says. "It should be subordinate to other applications so that you can input text automatically into your application."

Other applications that could use embedded OCR include document imaging and desktop publishing. Ocron is working on a "ROMable" Recore for hardware devices like fax boards, high-speed scanners, and light pens, Kubo notes.

Recore uses a proprietary engine that stores attributes of a character rather than simply the bit-mapped image, Kubo said. The Recore kernel is about 340K bytes. It's written in C and is compatible with Microsoft Windows' DLL (dynamic link library) protocol.

— Jeffrey Bertolucci

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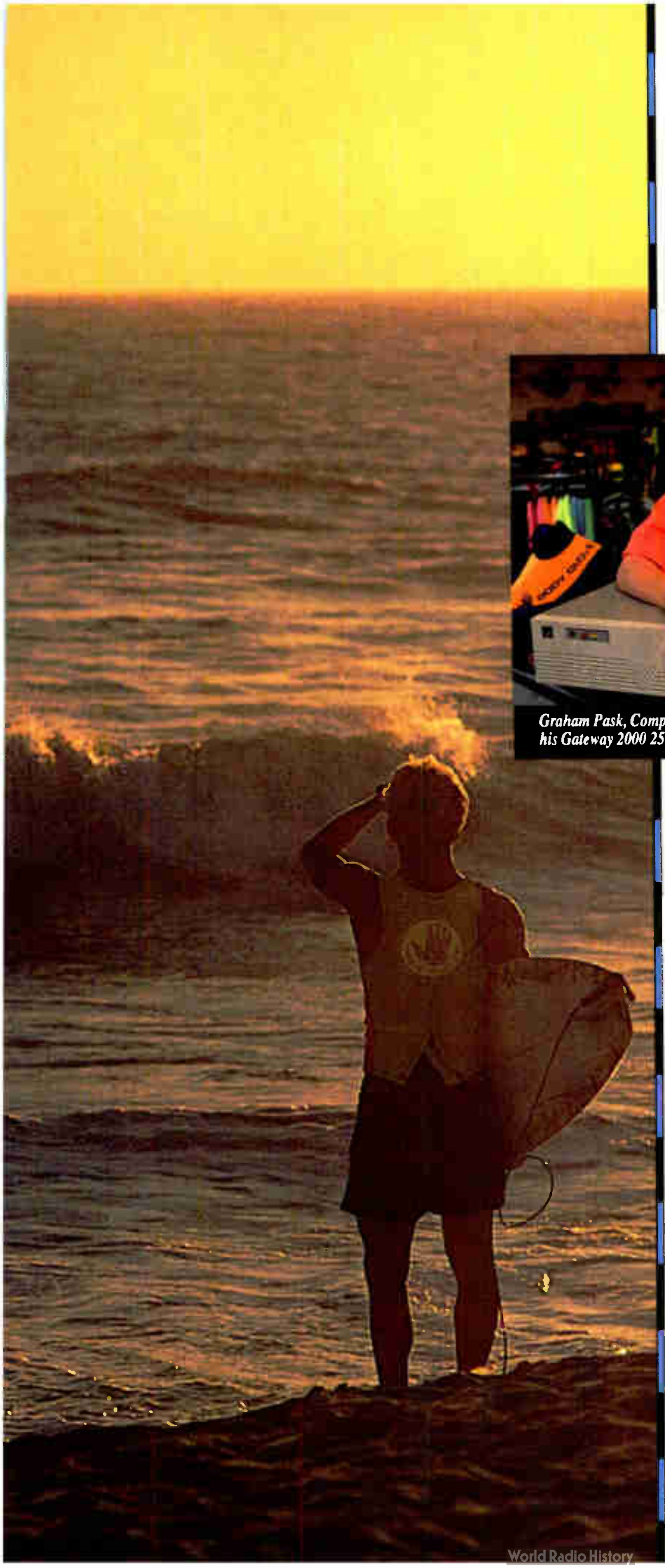


In Redondo Beach, California . . .

You'll find breathtaking ocean views. sensational surfers and Gateway 2000 computers.

Dive 'N Surf, famous for Body Glove® fashions and watersports equipment, is a

Graham Pask, Computer Systems Manager for Dive 'N Surf, and his Gateway 2000 25 MHZ 386 network server.

member of the growing family of Gateway 2000 customers in California. Dive 'N Surf Computer Systems Manager Graham Pask chose a Gateway 25 MHZ 386 machine for his network server. The system runs point-of-sale, inventory control, word processing and desktop publishing software.

"I decided to buy a Gateway 2000 system because they had everything I wanted for a good price," said Graham. "But what really impressed me was the service. I had a problem with my 3 1/2 inch drive so they sent me a new drive the very next day."

Graham said he was so happy with his Gateway system at work that he bought a Gateway 2000 25 MHZ 386 Cache machine for his home.

Until well after sunset, surfers ride the big waves on the Pacific Ocean near Redondo Beach, California.

And In Barrow, Alaska . . .

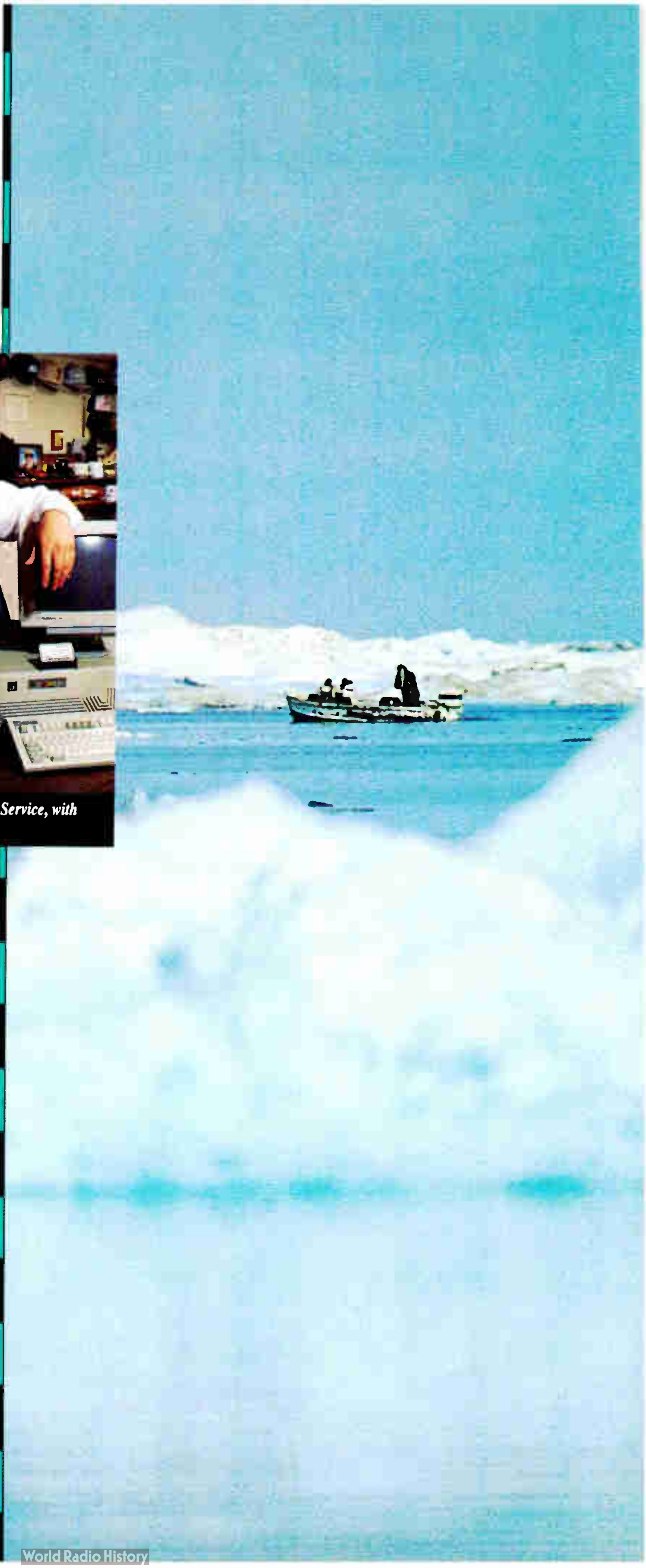
Over 300 miles north of the Arctic Circle, you'll find polar bears, seals, whales, walrus, lemmings, snowy owls and what appear to be the largest mosquitoes in existence. On a summer afternoon you'll also see parka-clad tourists walking among local residents in shorts. And of course you'll find a good Mexican restaurant and Gateway 2000 computers.

Jeff Frier, Cape Smythe Air Service, with his Gateway 2000 386SX.

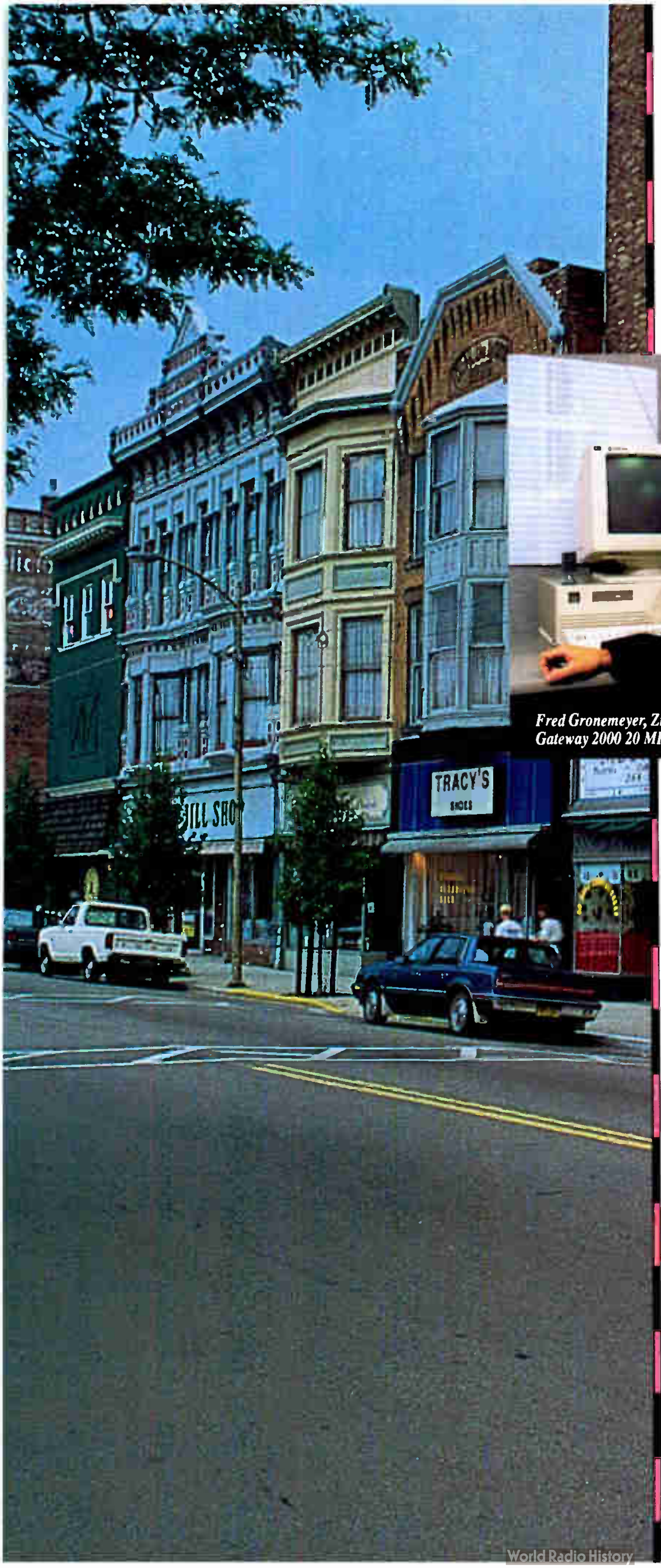
Cape Smythe Air Service, a regional commuter airline serving Barrow, Kotzebue, Nome and remote villages in Alaska, has one of several Gateway 2000 computers operating in Barrow. Jeff Frier, Cape Smythe's accountant, chose a Gateway 2000 386SX to run spreadsheet, data base and accounting applications.

"I was trying to decide between Gateway 2000 and a competitor," Jeff commented, "so I talked to a person who owns the competitor's system. He was disgruntled about the service he received from them. Then I talked to another person in Barrow who has a Gateway and she was happy with the product and service. The choice was pretty obvious -- when you're doing business in a remote area, the most important things a vendor can offer are reliability and good service."

Jeff said he also appreciated Gateway's features and price. "When you have to pay $6 a gallon for milk, it's nice to find a bargain somewhere." Jeff plans to buy another Gateway 2000 computer in a few months.



On a mid-July day in Barrow, Alaska, fishing boats weave in and out of icebergs on the Chukchi Sea



In Bradford, Pennsylvania . . .

You'll find a charming small city nestled in the Allegheny National Forest. The city's most prominent local business is the Zippo Manufacturing Company, where you'll find 18 Gateway 2000 computers in use.

Fred Gronemeyer, Zippo Manufacturing Company, and his Gateway 2000 20 MHZ 386 system.

Zippo is known around the world for its windproof lighter made famous during the second World War, although today the company's product line includes many other specialty advertising items. Fred Gronemeyer, Systems Analyst for Zippo, chose Gateway 2000 as the company's standard PC.

"We needed to set standards for PC's and software to make the most efficient use of these tools," Fred remarked. "We started out with PC's from different manufacturers, but once I tried Gateway I was convinced we could get the highest quality, most reliable machines at the best price from Gateway 2000. I was also impressed by my salesman and the tech support people I've dealt with at Gateway."

Fred said by the end of the year Zippo will be running every system Gateway 2000 makes, from 286's up to a 486 and everything in between.

Main Street, U.S.A., is located in Bradford, Pennsylvania.

And In New York City . . .

You'll find your senses overwhelmed by the countless sights and sounds of this one-of-a-kind city. And of course you'll find thousands of Gateway 2000 computers here.

One New York City Gateway 2000 owner is

Jim Rondinelli, independent record producer and engineer, with his Gateway 2000 386SX.

independent record producer and engineer Jim Rondinelli. Jim uses his Gateway 2000 386SX with a sophisticated player piano sequencer to compose music.

"The software I use is written for the Mac and for IBM compatibles," Jim said, "but it runs much better on IBM compatibles. And it runs best of all on my Gateway. I travel often and I've used my software on a lot of other machines. They don't even compare with my Gateway 2000."

Jim said he bought his Gateway 2000 because it was equipped for the real world with ample hard drive capacity and RAM, both sizes of disk drives and color VGA graphics.

"It's the fastest file transfer computer I've ever used," continued Jim, "plus it ran right out of the box. One afternoon and I was fully functional on a brand new system."

The streets of Manhattan are a constant blur of activity.

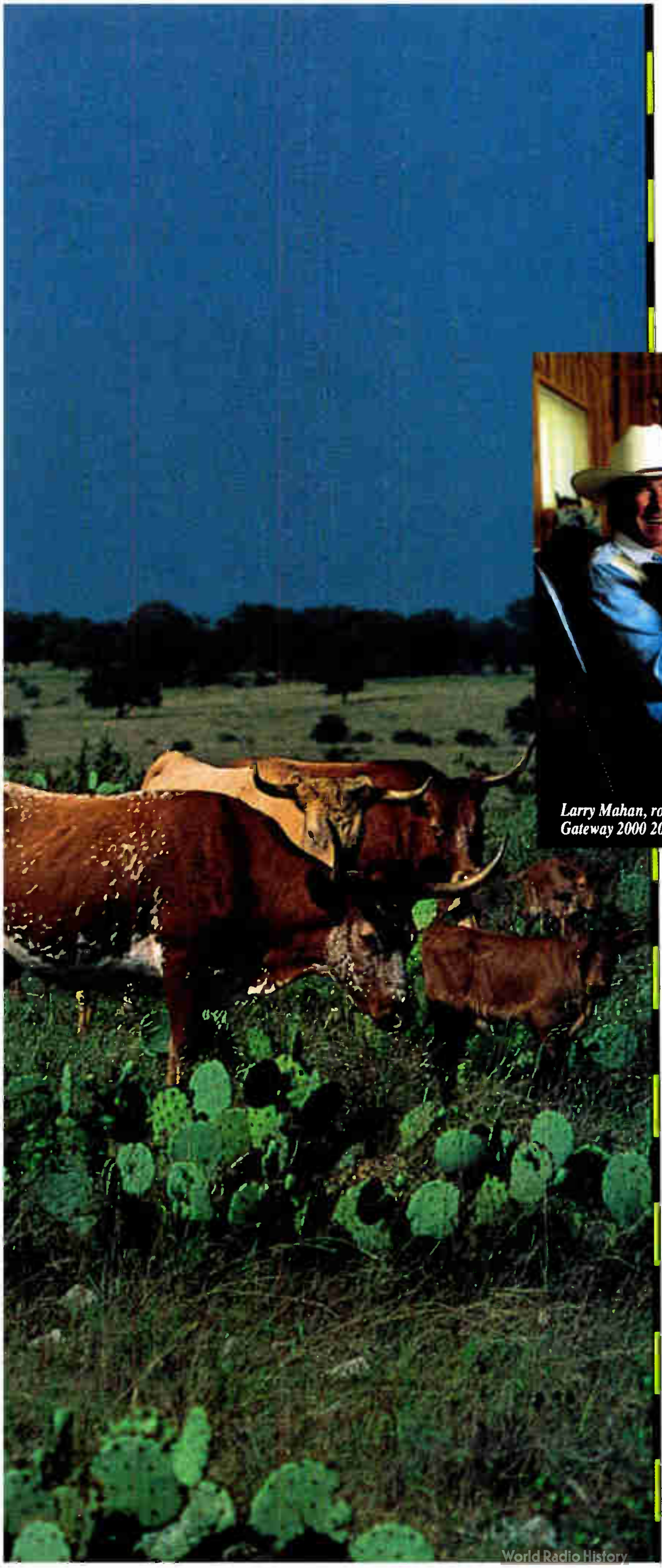
Near Camp Verde, Texas . . .

You'll find the magnificent Hill Country of Texas with rattlesnakes, prickly pear cactus and huge cattle ranches. You'll also find Larry Mahan and his Gateway 2000 computer.

Larry Mahan is to rodeo what Jack Nicklaus is to golf. He is Six Times World Champion All-Around Cowboy and is a member of the Cowboy Hall of Fame. But Larry also runs a cattle and horse ranch and is involved in a western apparel manufacturing company and a new Southwestern foods company. His Gateway 2000 20 MHZ 386 system is an integral part of his business operations. "We run cow and calf software for our Longhorn cattle herd," Larry said. "You can't really manage a livestock business efficiently without it. Plus we do accounting, spreadsheets and word processing on our Gateway 2000 computer."

Larry Mahan, rodeo star, and his Gateway 2000 20 MHZ 386 system.

Asked why he chose Gateway 2000, Larry said, "They had the best features and price – and I thought a computer company that puts pictures of cattle in their ads had to be my kind of people. And I was right. The people I've talked with at Gateway 2000 are honest-to-goodness nice folks. It's a pleasure doing business with them."



Larry Mahan raises registered Texas Longhorn cattle.

ACROSS THE COUNTRY YOU'LL FIND

You'll find so many Gateway 2000 computers in so many places today because people everywhere know a good value when they see one. In all 50 states and in over 70 foreign countries, thousands of people are comparing prices, quality and service – and choosing Gateway 2000.

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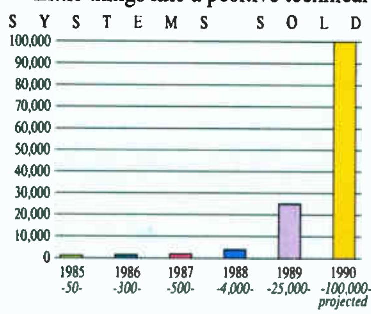
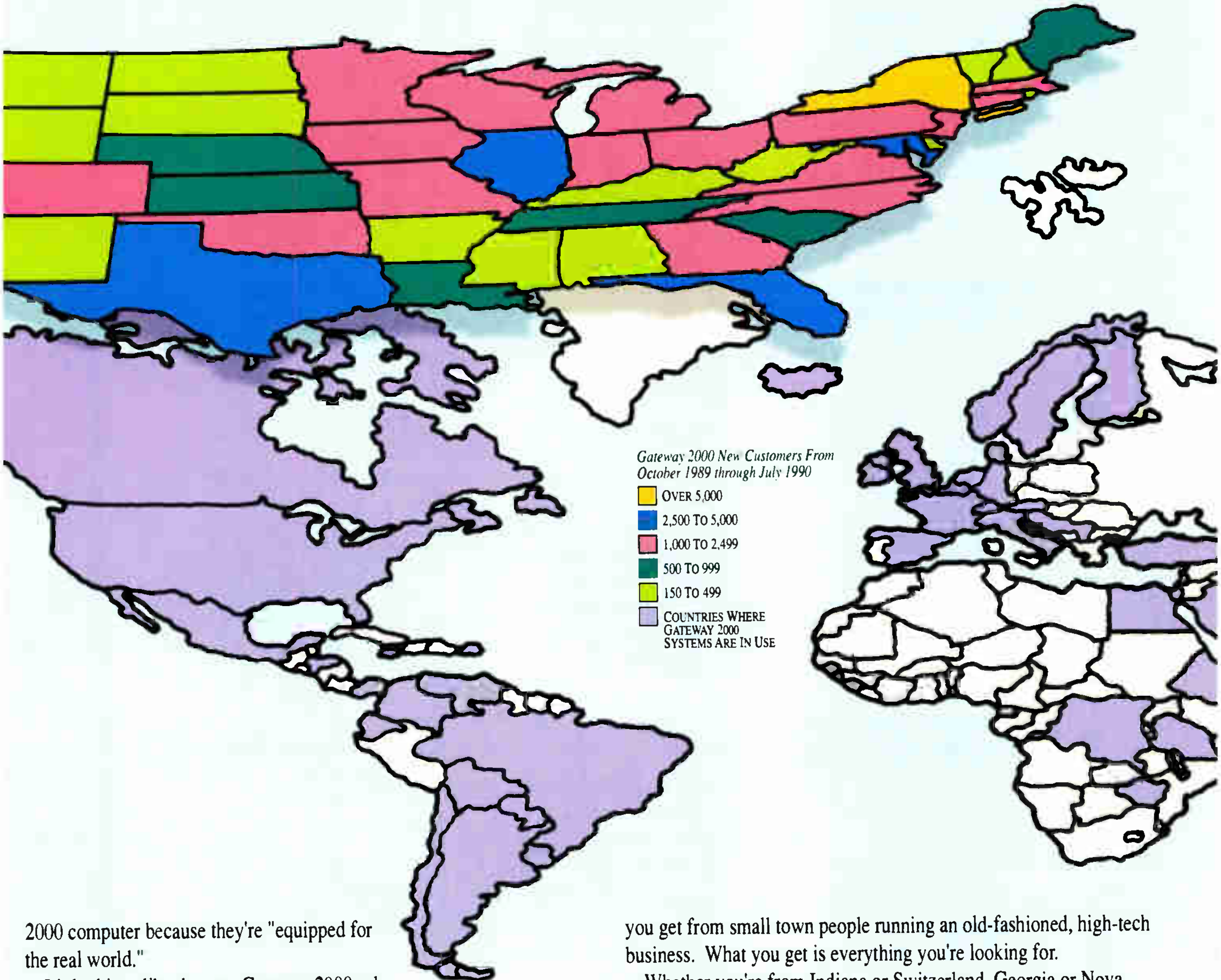


Graham Pask told his Gateway 2000 tech rep that his 3 1/2" drive didn't work, he received a new drive the very next day.

Little things like the way Gateway 2000 systems are fully loaded with all the features you want. Jim Rondinelli bought a Gateway

AND AROUND THE WORLD, GATEWAY 2000!



2000 computer because they're "equipped for the real world."

Little things like the way Gateway 2000 sales people develop excellent business relationships with their customers. Fred Gronemeyer tried his first Gateway because he was impressed by his sales person. Eighteen systems later, Fred is still impressed by his sales person.

And the biggest little thing of all is the feeling you get when you deal with the people at Gateway 2000. As Larry Mahan said, "they're honest-to-goodness nice folks."

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LETTERS

and Ask BYTE

More Worldly Text Displays

"Around the World in Text Displays" by Ben Smith (May) was well written and interesting. I even learned a few things from it—for example, that there are religious issues involving character usage.

However, Smith has succumbed to a very common programmer's problem—namely, "Give me a problem, and I will develop a program to solve it." As much as I like computers and solving problems with them, using a computer is not always the best way to solve some problems.

Several years ago, *Computerworld* ran a letter from a man who was distressed over the fact that because his name contained an apostrophe, it was not always sequenced the same on various lists. For several weeks, the newspaper published letters with various programmers' solutions to this problem. I finally couldn't take it any longer and sent a letter pointing out that the problem was not the collating sequence; it was the man's vanity. If a program has to account for every possible exception, it is doomed to failure, because there will always be one more exception.

I don't think I was unduly harsh in expecting the man to give up his apostrophe. I, too, have occasionally had problems. You will note that my last name consists of two words, and the first letter of each word is normally capitalized. If I know my name is going on a list where it might cause a problem, I make it all one word with only one capital letter.

What does this have to do with the above-mentioned article? It was noted in the article that when it comes to numbers, we have almost universal conformity. Why? Because it is practical. The Japanese are moving in the right direction because they have adopted a simplified character set for newspapers and other uses, and they even use roman characters where necessary. Note also that many foreign computer users buy American computers and use them as delivered. It is no big deal for a German to learn commands like COPY and DIR.

I don't want to step on anyone's culture, but in computers we have a de facto standard character set. Maybe we should expand it to include characters for phonemes not used in English; but, in general, it is no big deal to romanize words from another language. In fact, when anthropologists encounter a language that has no written norm, they don't make up new character sets for it; they use the character sets they know. Let's concentrate our efforts on unification, not on developing yet another program.

Robert L. La Fara
Indianapolis, IN

Although many people have learned to live with roman computing in a non-roman written world, it is no longer necessary for them to do so. Computing and word processing are useful only when they facilitate work. When they throw up barriers to productivity, they should be avoided. —Ben Smith

Thank you for Ben Smith's "Around the World in Text Displays." With the publication of this article, I can finally say that the microcomputer industry may be starting to come of age.

After 15 years, affordable microcomputer hardware is beginning to approach the capabilities required by pan-linguistic text. But, as Smith notes, operating systems and compilers remain bound up in an 8-bit ASCII mentality. When you consider the wholesale rewriting of our entire approach to text processing that will be required, the inertia becomes more understandable, if no less frustrating.

To begin with, any text-coding scheme that allows for 16-bit codes must use 16-bit codes exclusively; otherwise, the text processor will get hopelessly lost, unable to distinguish 16-bit codes from 8-bit codes. Beyond that lies the implicit need for a complete set of universal standards for character fonts, including a standard header format. Aside from the usual information, the header would have to contain an international code that identifies the writing system represented in the font. And there would have to be a standard minimal character set for each recognized writing system.

Then there is the issue of control codes. The best scheme would distinguish them by simply setting the sign bit, so a sizable text-processing subset could be devised.

To input Chinese, voice recognition would be the ultimate solution for creating new text. Optical character recognition would be a real boon in developing databases of established texts, such as a few thousand years' worth of classical literature. Neither would be a trivial undertaking. Meanwhile, I'd like to obtain a copy of the TCA Code (the Taipei Computer Association Recommended Internal Code) specification. If anyone can supply an address for it, I'd very much appreciate it.

Jim Howard
Project City, CA

Your ideas are encouraging. Unfortunately, Chinese has many homonyms. Context and inflection are what determine which word is being used. Voice recognition is difficult enough as it is without this confusion. But with the advances in parallel processing and the reduction in memory costs, what you hope

continued

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Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

for in voice recognition may be affordable within a few years. I, too, have been trying to get an address for more information on the TCA Code, with no success.
—Ben Smith

I have a few small observations about Ben Smith's article on the various alphabets around the world. Classical Sanskrit is now written in Devanagari, as well as in Hindi and many other Indian languages. Before the advent of printing, the script varied from place to place, but today it is pretty well standardized. There are about 50 or so individual letters and over 250 letter combinations, with 12 diacritical vowel markings. This makes the script quite a bit less difficult than Japanese or Chinese. I believe several good implementations of Devanagari are available today. I've seen several advertisements in BYTE for various font editors, such as those from Gamma and MegaChomp.

The Chinese used to send each other telegrams in English or by number. Each number was to represent a specific ideograph. I have also seen secretaries in Japan use their ponderous typewriters, in which each character is lifted out of a board to be pressed against a ribbon onto paper. The characters were also called up by number. Japanese has about 1900 standard characters, of which about 1835 are kanji, and the others katakana and hiragana. This makes for a good memory.

Western languages are written in a linear fashion, while the Chinese languages are written by single ideographs. This is also expressed in the mystical philosophy that Chinese ideographs are closer to reality (whatever that is) in being nonlinear. It appears that nuclear physics and mathematics seem to approach that point of view today as well. But it does make for difficult computerization of communications, until we solve that, too.

Paul A. Elias
Fountain Hills, AZ

Since I wrote the article, I have looked at both of the multilingual word processors for the PC that you mentioned. I found both of them quite usable and very complete in their libraries of writing styles. The products from Gamma Productions are for the professional user and are well documented and appropriately priced. The word processor lets you use up to six different writing methods simultaneously. It is ideal for the academic institution that deals in research. Gamma Productions also distributes the classic texts that are used by the Ibycus system mentioned in the article.

The DuangJan word processor from MegaChomp is less complex and better suited (in terms of both use and price) to the student or less-intense user.

There are others that I have not looked at (see "Word Processing" in The Buyer's Mart at the back of BYTE). For more information, contact Gamma Productions (710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401, (213) 394-8622) and MegaChomp (3438 Cottman Ave., Philadelphia, PA 19149, (215) 331-2748).—Ben Smith

Fax Feedback

I enjoyed Fred Langa's editorial on fax abuse (May). Here's why people use faxing the way they do: It doesn't require an E-mail service, just the existing telephone network with telephone numbers.

So let's invent a new, nongraphical fax format (TFax) for text files, and even include word processing markup codes of some kind (maybe a subset of WordStar). Then we could build machines that send and receive in this format just as easily as an ordinary fax machine can.

Sending would mostly be an option on word processors (software and hardware), rather than a dedicated device, although even the humblest word processors could participate. Receiving devices would be anything from a printer answering the phone (à la present-day fax machines) to a background process answering the phone and capturing data to disk on a personal computer.

Of course, we could immediately have two other things: E-mail to TFax gateways, in *both* directions (E-mail to fax, as on MCI Mail, works only one way); and fax machines that handle both conventional fax and TFax (for yuppies who really don't like computers).

Maybe the TFax format should include a standard header for giving the address, to allow the TFax document to be carried by E-mail services, if anyone along the line cares to put it into one. The simplest TFax address would be an ordinary telephone number (just like fax), but other kinds of addresses could be accommodated via servers.

It's a solution just waiting to happen.

Michael A. Covington
Athens, GA

Fred Langa's May editorial made a lot of sense, but the sad fact is that E-mail will always be a limited system. There are no common standards; X.400 is still not available on PC LANs. Electronic communications in general is complicated by the software—modem `init` strings and all the other details that guarantee that most people will get frustrated. Faxing is perfect because it is a uniform communications standard and nearly foolproof. Put in a sheet of paper, dial the telephone, and it's done! Damn the cost if it is simple.

I would like to make a small editorial suggestion. It might be of interest to readers to look in depth at faxing. For instance, I have noted in my own business that some companies are beginning to adopt the Group 3 and Group 4 fax standards as corporate image-storage standards for large image-storage systems. Some research indicates that home fax penetration is about 4 percent now and exponentially rising.

The truth is, I do use E-mail and BBSes, but I love to fax.

Richard Shockey
St. Charles, MO

HPFS Roots in Unix?

I enjoyed reading Mark J. Minasi's OS/2 Notebook, "Digging into HPFS" (May). I think the 1984 paper "A Fast File System for Unix" (Computer Systems Research Group, University of California–Berkeley) by M. K. McKusick, W. N. Joy, S. J. Leffler, and R. S. Fabry may help decipher more of Microsoft's new High Performance File System. After reading Minasi's column, I wondered exactly how different Microsoft's HPFS is from the standard 4.2 Berkeley standard Unix Fast File System (FFS) in use since at least 1984. The two have a number of major commonalities:

While I cannot speak for all Unix machines, I do know that the DEC VAX typically boots from block 0 of sector 0 on drive 0. Microsoft's HPFS reserves sector 0 for an OS/2 boot block.

Both systems have what are called *superblocks*. McKusick et al.'s description of the FFS superblock seems very similar to that of the superblock for the HPFS. A Unix "file system" is synonymous with HPFS's "data bands." The Unix "free list" is synonymous with HPFS's "free-space bit maps." However, FFS is more versatile and robust. The number of data blocks in a file system can vary in FFS to suit the user's needs.

The FFS inode sounds remarkably similar to Microsoft's fnode, not only in function but also in name.

Finally, Minasi states that dates under HPFS are different than under DOS—that all dates under HPFS are stored as the number of seconds since January 1, 1970. As far as I know, Unix systems have used this same method for representing dates for more than a decade.

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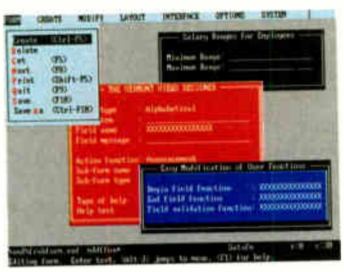

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So, after noting all these commonalities between the two ways of managing a file system, I wonder if Microsoft has "reinvented" a watered-down version of the Unix FFS. Minasi begins the last paragraph of his article with the line, "Microsoft has designed a new system with the future in mind." I beg to differ. I think McKusick, Joy, Leffler, Fabry, and their colleagues designed a new system with the future in mind years ago at the University of California at Berkeley.

Anthony J. Guzzi
Trumbull, CT

Colossal Stop Bit

I enjoyed Rick Grehan's Stop Bit, "Return of the Colossal Code" (May). As a programmer for 15 years, I have become a fossil at the ripe old age of 32. I remember the early days of programming in Hewlett-Packard BASIC on a time-sharing computer while I was in high school. I remember the DEC PDP-15, the PDP-12, and the Datapoint computer with its 8008-type processor. Most of all, I remember when 16K bytes of RAM was common, 64K bytes seemed enormous, and the Altair was the new toy in the laboratory.

The trend of commercial programs crystallized for me when I was reading about OS/2 several years ago, and the article stated that 2 MB of RAM was required and 3 or 4 MB was preferred. In college, we had a Control Data mainframe with 512K bytes of RAM. This machine could support 100 users simultaneously.

I am typing this letter using WordPerfect. I know only about 10 percent of the commands and probably use only 5 percent of them regularly, and that's sufficient to get my work done. I suspect this is true of most of the software I use, and I don't think I am unique in this regard.

Occasionally, I toy with the idea of building a computer with simple, flexible software, just to show people that it can be done. I know that I don't have the time or resources to build such a machine, but it is still an interesting thought. I am glad to have read your article, because now I know that I am not alone in my thinking.

Steve Knox
Seattle, WA

ASK BYTE

A Reader Elucidates

Rick Grehan's response to Joseph A. Bligh's question about a hard disk drive that would not do a warm reboot (Ask BYTE, June) was a good one, as far as it went. But the reply looked only at the defective hardware side of the problem. There is another reason for this type of problem.

Bligh states that he has a Seagate 20-megabyte drive. If his is an inexpensive model that uses a stepper motor to drive the head-positioning mechanism, there may be a simpler way to fix his problem. In such drives, thermal expansion can cause problems. When the disk starts out cold, the platters are at their smallest diameter. As the disk runs, the platters warm up and expand. After a period of time, they stabilize in size. Due to this size fluctuation, any data written to a certain cluster on the disk may not be in the same exact position as information written to this spot later in the session.

This is a cumulative problem that, over time (usually many months), can result in symptoms like those that Bligh describes. It is not a defective part or the result of inferior design. It is inherent in the design of this type of disk.

You can usually solve the problem by backing up the data to other media. (Everyone does backups, right?) Once you have backed up the disk, perform a low-level format to the drive. Next, run MS-DOS's FDISK program, set up the partitioning, and perform a high-level format on the disk with the FORMAT program. Several commercial programs are available to make this process easier. Finally, a book on this subject that I recommend highly is *The Paul Mace Guide to Data Recovery* (New York: Brady Books, 1988). It is available in many bookstores.

Brian D. Catlin
San Marcos, CA

Wells American Not So Well

I have a Wells American 286 with a 40-MB Conner Peripherals hard disk drive. I use the system daily. From the day I purchased the system (over a year ago) to the present, I have endured an intermittent problem with my hard disk drive that my dealer has been unable (or unwilling) to resolve. About two or three times a week, the hard disk drive "hangs" on an I/O operation. The red busy light goes on and remains solidly lit for 2 to 3 seconds. The program that is currently executing waits patiently and without protest for the drive to straighten itself out, which it always does. If you have any clues or remedies to this problem, I would greatly appreciate them.

Dennis C. Kornbluh
Cherry Hill, NJ

The drive light's staying on for 2 or 3 seconds means that your computer is having difficulty reading a sector on the hard disk drive. Intermittent problems like this can have a variety of causes.

First, eliminate the obvious possibilities. Make sure that the hard disk drive controller and cables are making good electrical connections. Jiggle and reseat every connection.

The Conner Peripherals 3½-inch hard disk drives have a good reputation for reliability. However, because of their smaller size and closer mechanical tolerances, they are more susceptible to overheating. Smaller drives have less surface area through which to dissipate heat.

Is your Wells American computer well cooled? Are all the expansion slot openings sealed? When your dealer tests your computer, he or she probably turns it on and immediately runs diagnostic software to check the drive functions. Your computer and hard disk drive never have a chance to warm up. The computer works well when everything is still cool.

When you use your computer, you probably turn it on in the morning and leave it on all day. When your hard disk drive is hot, the read/write heads may not be able to read sectors that were written when the drive was cool. Potential bad sectors can become apparent when the drive reaches normal operating temperature or higher.

To prevent any loss of data, back up your data files and follow the directions in Brian D. Catlin's letter above. You can use FDISK or another hard disk utility program (see "Just What the Hard Disk Doctor Ordered," January).—S. W.

A Super Question

I have watched with great interest the coming of age of the VGA board and its powerful sibling, Super VGA. I am impressed by the Super VGA board. It has the power and capability to boost graphical user interfaces and other graphics applications to spectacular heights and could have been the de facto standard after VGA.

Alas, the competitiveness of the computer field has left us with an array of boards with little (if any) hardware similarity. Instead of being able to write portable applications for a Super VGA standard, programmers find themselves writing applications—and then drivers—for the array of Super VGA boards. Needless to say, this has reduced considerably the number of applications written for Super VGA.

I have a one-person programming

continued

operation, and I find the prospect of writing for the different boards rather daunting, but I think the benefits outweigh the cerebral cost involved. However, finding the technical information for these boards has proved to be a problem in itself. Where do I find all the technical information I need to program these boards?

David Nutbean
Peterfield, Manitoba, Canada

Believe it or not, there may be some good news on the Super VGA front in the very near future. VESA, the Video Electronics Standards Association, is well on its way to establishing a number of vendor-independent video-mode designations and extended-video BIOS calls for modes that go beyond VGA. Adoption of VESA's recommendations seems to be likely, because VESA counts among its members names like Headland, Western Digital, and Chips & Technologies.

VESA has defined graphics modes that range from 640 by 400 pixels by 256 colors to 1280 by 1024 pixels by 256 colors and has recently added support for five extended-text modes. For more information, refer to Bill Nicholls's "Is It Really Super?" (IBM Special Edition, *Fall 1989); you might also contact VESA at 1330 South Bascom Ave., Suite D, San Jose, CA 95128, (408) 971-7525.*

In the meantime, your best bet would be to contact the manufacturer of the chip set built into the board that you intend to program. There are five common chip sets: Those from Renaissance, which you can contact at (206) 454-8086; ATI Technologies, at (416) 756-0718; Paradise, at (415) 960-3353; Video Seven/Headland, at (415) 623-7857; and Tseng Labs, at (215) 968-0502.

The subject of Super VGA programming is new, as you mention, and I can't recommend any books on the subject. Except for information supplied by the chipset vendors, or in the graphics.disp conference on BIX, magazine articles may be the best place to look. "Super VGA Programming," which appeared in the July issue of Dr. Dobb's Journal, *is a good overview of programming Super VGA modes.*—S. A.

Giving Cray His Due

In the First Impression "Sizzling RISC Systems from IBM" (April), Andy Reinhardt and Ben Smith state that "IBM invented RISC in 1975." Hardly; at most, IBM coined the term and applied it to a certain set of concepts.

Seymour Cray developed those concepts and embodied them in hardware more than 10 years earlier, with the CDC 6600, the first machine generally called a supercomputer. If I recall correctly, the 6600 had but 96 instructions, multiple functional units that could operate in parallel, pipelined arithmetic, a relatively large set of registers, and a small instruction cache so tight that loops could run at full speed. Properly optimized code ran at the rate of one instruction per clock cycle. I/O was handled by a *barrel* (the technical term) full of specialized peripheral processors, which were stripped-down mini-CPUs. (A CDC system programmer had to know two assembly languages.)

The CDC Cybers initially were 6000-series CPUs with a different bus and faster peripheral-processing units. When I was a Cyber system programmer, we used to say that 360/370 referred to the size of the IBM instruction set. Over the years, the size of the Cyber instruction set grew to 128; that included floating-point instructions. Later Cybers had larger instruction caches, and the larger ones had a data cache. The microcoded CPUs introduced in the 1980s have, under the microcode, only 64 instructions, although the visible instruction set numbers more than 200 now.

To give credit where it is due, I believe we owe this constellation of architectural innovations primarily to Cray.

Larry J. Van Stone
Stillwater, OK

FORTRAN Hunting

I need your help in choosing a FORTRAN compiler. I use an IBM PS/2 Model 55 SX with a 30-MB hard disk drive and 2 MB of RAM. I would like to use FORTRAN to write civil engineering programs (specifically, to do calculations in elasticity, structural analysis, and dynamics).

Nuno Manuel Barosa Botelho
Lisbon, Portugal

The November 1987 issue of BYTE includes a roundup of FORTRAN compilers; you might check into that for comparative information. Compilers that come to mind include Utah FORTRAN from Ellis Computing (5655 Riggins Court, Suite 10, Reno, NV 89502, (702) 827-3030), as well as the obvious Microsoft Optimizing FORTRAN Compiler (Microsoft, 1 Microsoft Way, Redmond, WA 98052, (206) 882-8080). Lahey Computer Systems (P.O. Box 6091, Incline Village, NV 89450, (702) 831-2500) sells two FORTRAN compilers; one, Personal FORTRAN77, sold for under $100 when I last checked.—R. G.

The Trouble with Cables

I am looking for a small conversion cable. Last year, I bought a Wells American CompuStar 386/25, and it had both 5¼- and 3½-inch floppy disk drives. But the CompuStar is capable of handling up to four floppy disk drives, and the 5¼- and 3½-inch drives were on different cables. This forced me to use device drivers to access the 3½-inch floppy disk drive (which made it drive A) on my system. I'd like to find some kind of adapter to mate the card-edge connector on the second 5¼-inch drive cable to the DIP connector on the 3½-inch drive.

Steve Nelson
Mansfield, TX

Cabling your 3½-inch drive is much easier than finding an adapter. Both the 5¼- and 3½-inch drives are connected to the controller through a 34-pin ribbon cable. Usually, drive A's connector is at the end of the cable, and drive B goes somewhere in the middle. All 5¼-inch drives have a protruding card edge that accepts a recessed card-edge connector, while the 3½-inch drive uses a 34-pin stick header and the mating socket connector. You could find a card edge and mate it to the socket for the stick header, but there's an easier way.

Run out to Radio Shack and get a 34-pin socket connector for the stick header on your 3½-inch drive. The cable on your primary disk drive controller is already cabled for two drives. Install the new connector next to the card-edge connector that's already in the center of the cable; that should let you connect the 3½-inch drive as B.

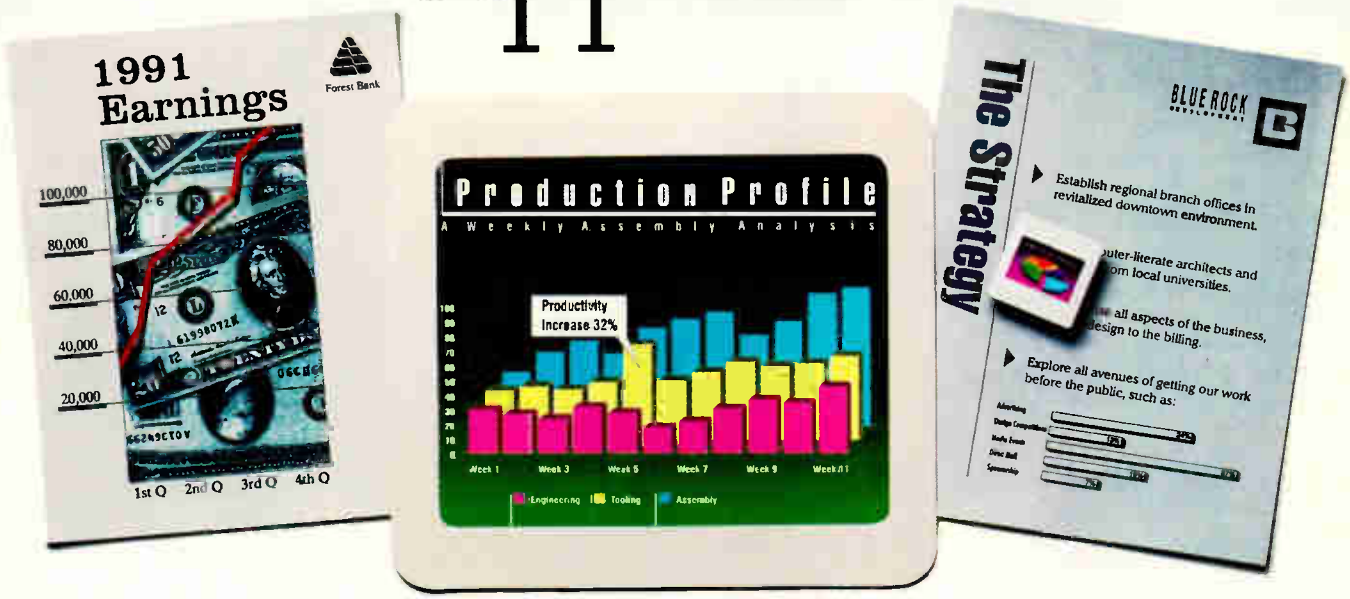
One last gotcha: Floppy disk drives can be set to one of four addresses, depending on how the ribbon cable is made up. Normally, a twist in the cable will fool a primary drive (ID 0) into thinking that it's a secondary drive (ID 1). If your floppy disk drive cable has a twist between drives A and B, your cable hack should work fine. If not, you may have to change the jumpers on the 3½-inch drive. For that, you'll have to contact the store you bought the drive from, consult the manual, or contact the manufacturer.

—H. E.

FIXES

• In the August issue, the "Windows Shopping" resource guide on page 125 listed an incorrect ZIP code for Raima Corp. The correct address is as follows: 3245 146th Place SE, Suite 230, Bellevue, WA 98007. ■

Applause.



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XT Power System:

- 20MB Seagate Hard Drive . . $699.
- 30MB Seagate Hard Drive . . $719.
- 40MB Seagate Hard Drive . . $845.

286 Power System:

- 20MB Seagate Hard Drive . . $925.
- 30MB Seagate Hard Drive . . $950.
- 40MB Seagate Hard Drive . $1,045.
- 80MB Seagate Hard Drive . $1,245.

386 Power System:

- 20MB Seagate Hard Drive . $1,499.
- 30MB Seagate Hard Drive . $1,510.
- 40MB Seagate Hard Drive . $1,649.
- 80MB Seagate Hard Drive . $1,849.

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VGA MONITOR/VGA CARD*
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Circle 145 on Reader Service Card

What's New

HARDWARE • SYSTEMS

It's a PC . . . No, Wait: It's a Unix Terminal

The Genisys 9000 is a 16-MHz 386SX-based "wedge" module that can be configured as a DOS compatible, a graphics or Unix terminal, or an X Window System network node.

A firmware-embedded operating system lets you run up to four DOS sessions concurrently. A 1-MB disk is simulated in nonvolatile RAM, providing the local processing of a LAN node and the data security of a diskless workstation.

The low-profile unit has standard VGA and keyboard ports, as well as one parallel and two serial ports. It comes standard with 1 MB of RAM, expandable to 16 MB.
Price: $2665.
Contact: Zentec Corp., 160 Great Oaks Blvd., San Jose, CA 95119, (408) 365-2900.
Inquiry 1293.

The Genisys 9000 supports local and network DOS processing, terminal access to multiple host databases, X Window System networking, and graphics.

A Finite-Element-Analysis Machine of Your Very Own

Structural Research, known for its finite-element-analysis software, now has a 486 system customized for FEA that's designed to bring to the PC such tasks as nonlinear and fluid-flow analyses.

The 486 Cosmos/M FEA Turnkey system has a 25-MHz CPU supported by a 64K-byte memory cache, 4 MB of RAM, a 100-MB hard disk drive, and a VGA card with a 14-inch color monitor. An FEA program and MS-DOS 4.01 are also included.
Price: $4995.
Contact: Structural Research and Analysis Corp., 1661 Lincoln Blvd., Suite 200, Santa Monica, CA 90404, (213) 452-2158.
Inquiry 1294.

The 486 Cosmos/M FEA Turnkey system is designed to perform tasks on the PC such as nonlinear, fatigue, fluid-flow, and electromagnetic analyses.

Two Low-Priced 486 EISA Machines

SAI Systems' two i486-based EISA machines run at either 25 or 33 MHz.

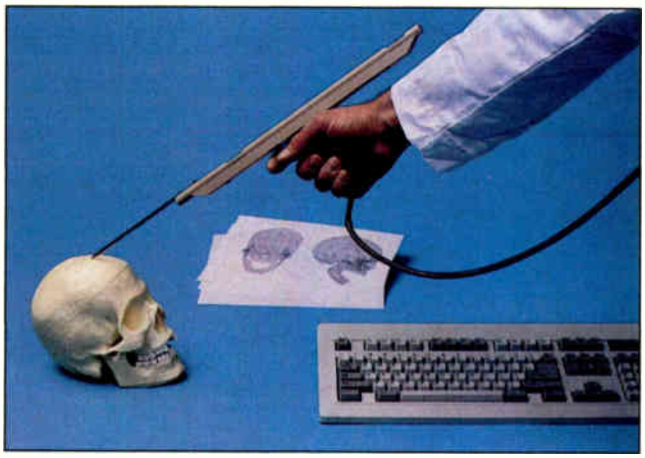
The small-footprint (13½-by 8¾-inch) SAI486ES can hold up to 32 MB of RAM, while the full-size SAI486EC has room for 64 MB. Both systems come with 4 MB of RAM and use a proprietary 32-bit burst memory architecture. The SAI486EC's 128K-byte secondary cache (optional on the ES) can be expanded to 256K bytes. Both have a socket for a Weitek WTL4167 math coprocessor.

Beyond the base configuration, the company also sells full configurations for $1110 to $1300 over the base price. The full configuration includes a 200-MB Conner Peripherals hard disk drive and a VGA monitor controlled by a 512K-byte Super VGA card (the SAI486ES also has the full-size cache).
Price: SAI486ES: 25-MHz, $3995; 33-MHz, $4995; SAI486EC with 128K-byte cache: 25-MHz, $4895; 33-MHz, $5795.
Contact: SAI Systems Laboratories, Inc., 911 Bridgeport Ave., Shelton, CT 06484, (203) 929-0790.
Inquiry 1295.

Zodiac Offers Three 486 Machines

Available in three configurations, the FiveStar 486/25 is a 25-MHz 486 system equipped with a 64K-byte memory cache that is expandable to 256K bytes.

The System 40 comes with 1 MB of RAM, a 40-MB hard disk drive, a Hercules-compatible graphics card, and a 14-inch monochrome monitor. The System 80 has 4 MB of RAM, an 80-MB hard disk drive, a 16-bit VGA card, and a VGA monitor. The System 210 comes with 8 MB of RAM, a 210-MB hard disk drive, and a 16-bit VGA display.
Price: System 40, $5295; System 80, $5995; System 210, $6895; upgrade to 256K-byte cache, $195.
Contact: Zodiac Technologies, 2100 North Greenville Ave., Richardson, TX 75081, (800) 752-5555 or (214) 470-9000.
Inquiry 1296.



With the Series 300 digitizing system, you can capture 3-D coordinates of real-world objects.

3-D Digitizer Captures the World

The Series 300 sonic digitizing system uses high-frequency sound waves to track the position of objects in 3-D space and converts the data to *x,y,z* coordinates on your IBM PC. Robotics, animation, and aerospace design are three applications of the software/hardware package from Pixsys. You can input up to 16 points simultaneously (60 points per second).

The gun-shaped probe bombards the object with sound waves, which then bounce back to a 44-inch-square microphone array. The signals next travel through a multiplexer box and on to the computer's serial or parallel port.

Coordinate-acquisition software is included. A motion-tracking program and 3-D CAD/CAM software are optional.

The Series 300 requires a math coprocessor.

Price: $12,315; motion-tracking software, $1000; 3-D CAD/CAM software, $2950.
Contact: Pixsys, 1727 Conestoga St., Boulder, CO 80301, (303) 447-0248.
Inquiry 1297.

Fora Debuts Flatbed Scanners for PC, Mac

Fora's new three-unit line of flatbed image scanners comes bundled with a variety of image-editing and optical character recognition (OCR) software.

The IMG-311 is a 300-dpi scanner, while the IMG-321 scans at 400 dpi. Both come with a DOS-compatible line-art editing package called MicroArt Image Editor. For $1045 extra, the IMG-311 comes bundled with Caere's OmniPage OCR software and a special high-speed interface (OmniPage requires a 386 or 486 computer).

The top-of-the-line IMG-511 use an 8-bit processor to support 256 gray scales. It comes with your choice of graphics programs: Astral Development's Picture Publish (for the IBM PC) or Letraset's ImageStudio (for the Mac).

Price: IMG-311, $1450; IMG-321, $1695; IMG-511, $2190; optional sheet feeder, $475.
Contact: Fora, Inc., 3081 North First St., San Jose, CA 95134, (800) 367-3672 or (408) 944-0393.
Inquiry 1298.

Pentax Offers Fanfold Laser Printing

Pentax Technologies' Laserfold 240 can print laser-quality text on continuous paper, a feature not normally found in laser printers. The 16-ppm device prints at 240 dpi using a text-only controller that emulates Epson FX-80 text. The tractor feed (adjustable between 4 and 9½ inches) accommodates continuous-form media of different widths. The straight-through paper path is designed to minimize jamming.

With its small footprint (17⁹⁄₁₀ inches wide by 7⅕ inches high by 20⅗ inches deep), the Laserfold 240 fits comfortably on a desktop.

Price: $3995.
Contact: Pentax Technologies Corp., 100 Technology Dr., Broomfield, CO 80021, (303) 460-1600.
Inquiry 1299.

SPREAD THE WORD

Your new product is important to us. Please address information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Better yet, use your modem and mail new product information to the microbytes.hw or microbytes.sw conferences on BIX. Please send the product description, price, ship date, and an address and telephone number where readers can get more information.

Facit's Low-Priced Dot-Matrix Printer

The Facit B1200 is a low-priced dot-matrix printer with print modes and font pitches that are selectable from both hardware and software.

The nine-pin B1200 prints 160 cps in draft mode and 24 cps in near-letter-quality mode. All setup parameters and print modes are selectable from the front panel. IBM Proprinter II and Epson FX command sets are included.

A paper-parking feature lets you insert single sheets without removing the fanfold paper.

Price: $269.
Contact: Facit, Inc., 400 Commercial St., P.O. Box 9540, Manchester, NH 03108, (603) 647-2700.
Inquiry 1300.

A Big Mac Hard Drive in a Little Package

Optima Technology's new SCSI hard disk drive for the Mac IIci and IIcx squeezes 310 MB into a 3½-inch form factor.

The MiniPak 310i is an internal drive that, unlike some high-capacity hard disk drives for the Mac, you can install with no warranty-voiding structural alterations to the computer. According to the company, it has an average seek time of 12.5 ms and a transfer rate of 1.55 MBps. Its bus-transfer rate is 4 MBps.

Price: $4695.
Contact: Optima Technology Corp., 17526 Von Karman Ave., Irvine, CA 92714, (714) 476-0515.
Inquiry 1301.

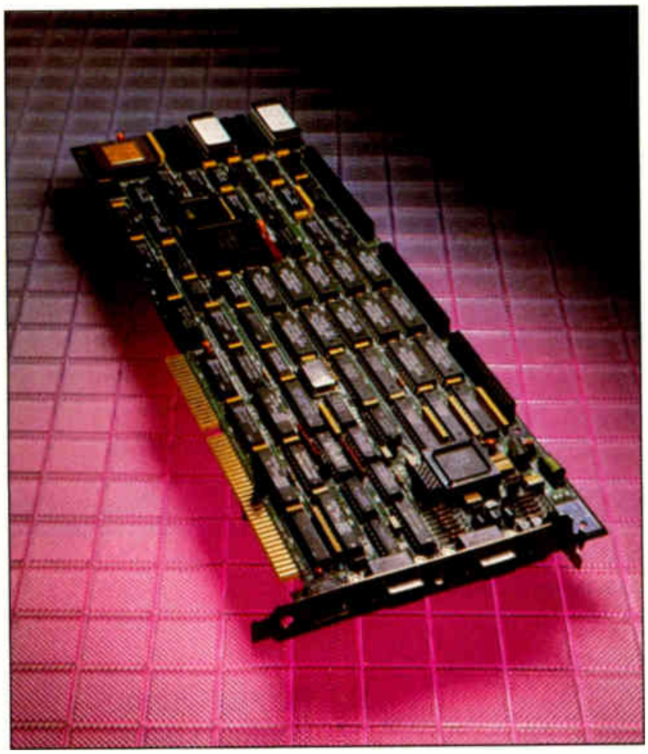
TI Chip Accelerates Fast VGA Board

CalComp's DrawingCard MCA, a high-speed graphics controller for IBM PS/2s and compatibles, uses a Texas Instruments processor to achieve drawing rates in excess of 14 million pixels per second.

The DrawingCard MCA's display-list processing scheme greatly enhances panning and zooming speed in complex drawings, according to the company. The display list resides in extended or expanded memory—not in the card's on-board RAM—which means that image size is less restricted by available memory.

The flicker-free, noninterlaced display is refreshed at 60 Hz and offers a resolution of 1024 by 768 pixels. Two separate models provide 4- or 8-bit display planes for 16 or 256 simultaneous colors chosen from a 16.7-million-color palette.

Price: 16-color Model 3501, $1995; 256-color Model 3502, $2795.
Contact: CalComp, Inc., P.O. Box 3250, Anaheim, CA 92803, (800) 225-2667 or (714) 821-2000.
Inquiry 1302.



The DrawingCard MCA graphics board fits into a single 16-bit slot on your IBM PS/2 or compatible.

ESDI Controllers Power Hard and Floppy Disk Drives

The Lark 330 Series ESDI controllers are 16-bit hard/floppy disk drive controllers for AT and EISA bus computers.

The LRK-330, the hard disk drive–only version of the two boards, operates at a 1-to-1 interleave and at transfer rates of up to 24 Mbps, according to the company. Transfer rates of up to 6 MBps are possible on the host bus.

On-board ROM BIOS setup and diagnostic software calculates the amount of head/cylinder skew, making it easier to match drives with the controller while retaining 1-to-1 interleave.

In addition, the LRK-330 is downward compatible with ESDI drives that support transfer rates as low as 5 Mbps. It works with one or two drives and has a drive-splitting feature that lets you break the 528-MB MS-DOS barrier. Optional read-ahead cache memory is available in 2K-, 8K-, 32K-, or 64K-byte units.

The LRK-331 has the same features as the LRK-330 but includes support for floppy disk drives.

Price: LRK-330, $189; LRK-331, $199.
Contact: Lark Associates Inc., 4046 Clipper Court, Fremont, CA 94538, (415) 657-5275.
Inquiry 1303.

When Is a Disk Not a Disk?

Emulating floppy disks in static RAM (SRAM), a technique typically used in portable computers, is now available as an inexpensive add-in from Hatronics.

The SRAMDrive is an 8-bit board that effectively simulates a floppy disk of up to 512K bytes in capacity, depending on the number of SRAM chips installed. Its battery backup lets the drive retain data for several weeks (batteries are not included).

The SRAMDrive card will fit only in full-size cases. The drive cannot be made bootable.

Price: Assembled 512K-byte board, $395; kits start at $90 in 0K-byte configuration.
Contact: Hatronics, 145 Lincoln St., Montclair, NJ 07042, (201) 783-7264.
Inquiry 1304.

ComputerBoards Offers 16-Channel Analog Input

ComputerBoards' CIO-AD/SSH16 accessory board adds simultaneous sample and hold capability to the company's CIO-AD/16 series of A/D conversion boards.

The CIO-AD/SSH16 is software and connector compatible with MetraByte's DAS-16, as well as MetraByte BASIC, Pascal, FORTRAN, and C software.

Gains of up to 800 are possible on each channel at sample rates of 50 kHz (with the CIO-AD/16) and 100 kHz (with the CIO-AD/16F).

Price: CIO-AD/SSH16, $399; CIO-AD/16, $799; CIO-AD/16F, $859.
Contact: ComputerBoards, Inc., 44 Wood Ave., Mansfield, MA 02048, (508) 261-1123.
Inquiry 1305.

Have Your Video Both Ways

The Cardinal VGA600 graphics board supports both analog and digital video signals, from MDA monochrome to Super VGA.

Based on the Chips & Technologies VGA chip set, the adapter is register- and BIOS-level compatible with the VGA standard, including hidden registers. Its 512K bytes of on-board memory supports Super VGA text resolution of 132 columns by 50 rows, as well as a graphics resolution of 1024 by 768 pixels.

Price: $389.
Contact: Cardinal Technologies, Inc., 1827 Freedom Rd., Lancaster, PA 17601, (800) 233-0187 or (717) 293-3000.
Inquiry 1306.

continued

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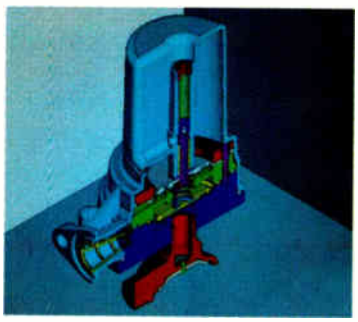


up to four instructions per machine cycle, 42 MIPS and 13 MFLOPS. Suddenly, complex designs don't take eons anymore.

The four RISC System/6000 POWERstations feature a range of graphics processors from grayscale to Supergraphics to satisfy any graphics demand. Great news for Power Seekers working on animation, scientific visualization, medical imaging and engineering solutions like CADAM,™ CAEDS™ and CATIA.™ And for electrical design automation, there's IBM's all new CBDS™ and an arsenal of over 60 EDA appli-

6000™ family.
will seem downright primitive.

cations from more than a dozen vendors.

With every POWERstation, you can get an almost unimaginable palette of 16 million colors, which gives you 3D images so realistic, they fairly leap off the screen, with super sharp resolution of 1,280x1,024 pixels. And when it's time to call in the heavy artillery, the POWERstation 730 draws nearly one million 3D vectors per second. Like all POWERstations, it can come complete with its own graphics processor, freeing the POWER processor to rapidly create and analyze your designs. All at prices that won't sink anybody's budget.

So if you're tired of paddling upstream with yesterday's performance, call your IBM marketing representative or Business Partner to find out more about the RISC System/6000 family. For literature, call 1 800 IBM-6676, ext. 991.

Civilization never looked so good.

For the Power Seeker.

IBM®

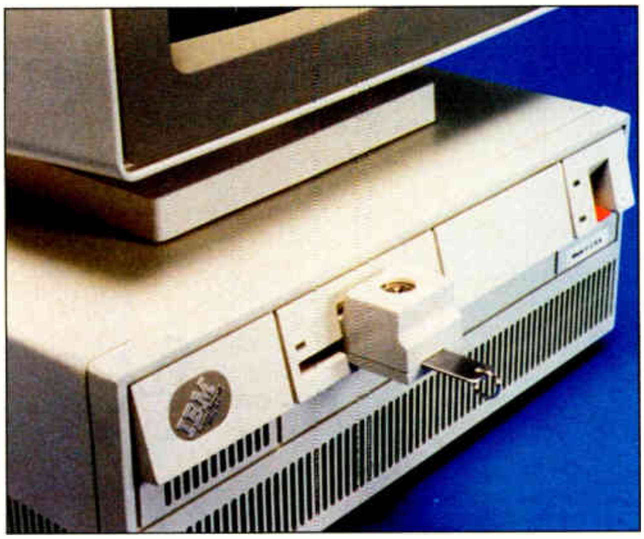
Circle 136 on Reader Service Card

Disk-Drive Lock Keeps Your Data Chaste

Secure-It's Disk-Drive Lock fits into your computer's disk drive slot, making insertion of a disk virtually impossible. The lock is intended to prevent the introduction of a virus or other unwanted data, as well as the removal of information by unauthorized users.

You can remove or insert the Disk-Drive Lock in less than 5 seconds by turning the key, according to the company. There are separate models for IBM compatibles and Macintoshes.

Price: $24.95.
Contact: Secure-It, Inc., 18 Maple Court, East Longmeadow, MA 01028, (800) 451-7592 or (413) 525-7039.
Inquiry 1307.



Secure-It's Disk-Drive Lock keeps your computer safe from unfriendly hands.

Electricity "Sponge" Promises Surge Protection

The ZS900 Surge Eliminator is designed to keep harmful electricity out of network data lines by storing it in special circuitry.

The ZS900 contains no metal-oxide varistors (MOVs), which can catch fire or be permanently damaged by power surges. In a UL-standard test, the device suppressed a 6000-V, 500-amp pulse to 42 V above the normal peak.

Six grounded outlets are mounted at the rear of the 5-pound unit, which comes with a 10-year warranty.

Price: $149.
Contact: Zero Surge, Inc., 103 Claremont Rd., Bernardsville, NJ 07924, (201) 766-4220.
Inquiry 1308.

BEaR-1FB Bundles Computer with Controller

The BEaR-1FB controller from Blue Earth Research combines the programmability of a personal computer with the convenient size of a typical dedicated controller.

The 3- by 2⅝- by ¾-inch box connects to the computer's serial port. It contains 32K bytes of static RAM with battery backup, a real-time clock/calendar, an eight-channel, 8-bit A/D converter, and dual RS-232C channels. Controlling everything is an Intel N83C51FB processor.

Resident firmware contains a floating-point BASIC interpreter and Debug Monitor for assembly language programming. You can also use the controller as a development tool and prototyping platform for the 87C51FC microcontroller recently announced by Intel.

The company also offers hardware/software bundles that add macro assemblers and other programming tools.

Price: Controller only, $199; with manuals, power supply, and cable, $299; with macro assembler and other utilities, $379.
Contact: Blue Earth Research, 310 Belle Ave., Mankato, MN 56001, (507) 387-4001.
Inquiry 1309.

10 Minutes Till Doomsday

Taesung is offering two low-priced uninterruptible power supplies that it claims can keep stand-alone XT and AT compatibles running for at least 10 minutes after disruption of regular power.

The UPS-3000 (for XTs) and UPS-4000 (for ATs) have a 1-ms switchover time that is among the fastest available, according to Taesung. The fast switchover time is accomplished via a proprietary switching circuit and by synchronizing the UPS with the phase of the incoming AC power. Each UPS also guards against line noise, as well as brownouts below 100 V and surges above 135 V.

Each unit has LED status lights and a dual-tone warning system that you can quiet with a mute switch. Battery recharge time is 3 to 4 hours.

The box contains four AC outlets, two RJ-11 jacks for phone line protection, and a light indicating proper operation.

Price: UPS-3000, $299; UPS-4000, $349.
Contact: Taesung Industries, Inc., 2001 Westside Pkwy., Suite 240, Alpharetta, GA 30201, (404) 664-8944.
Inquiry 1310.

continued

Record and Play Sound in Perfect Sync with Animator

ImageTel's sound-coupling system lets you record sound tracks, store them digitally on a disk, and play them back in perfect synchronization with an animation created with Autodesk Animator. Called AA Sound, the card includes two on-board 6582 sound synthesizer chips that can generate sound effects and music backgrounds. The card can sample at rates of from 4 to 41 kHz, and it includes two output connectors and one input connector.

AA Sound includes a library of 60 copyright-free sound effects and software for modifying your recorded music. The software, which requires 80K bytes of RAM, lets you achieve such special effects as increasing the speed of the sound track, adding echo for a cavernous-sounding voice, and adding ping-pong sound effects, where music oscillates between the left and right speaker to give you a rotating speaker effect.

Price: $799.
Contact: ImageTel International, Inc., 900-B South Federal Hwy., Hollywood, FL 33020, (305) 926-7450.
Inquiry 1311.

INSTANT WORKSTATION. JUST ADD OPEN DESKTOP.

Take a look at the vast majority of graphical workstations developed over the past decade and you'll see something they all have in common:

An integrated UNIX® System environment.

Now take a look at the vast majority of businesses that have put computing power directly onto their office desktops over the past decade, and you'll see something they all have in common:

Industry-standard personal computers.

It doesn't take a computer to forecast the platform that's going to put graphical workstations on the vast majority of business and engineering desktops in the next decade:

An integrated UNIX System environment for industry-standard personal computers.

And that's what Open Desktop™ is all about.

Open Desktop is the complete graphical operating system that's built on the most popular UNIX System platform of all time—SCO™. And it lets you create your own networked, icon-driven workstation environment using the industry-standard 386 or 486 computers and peripherals of your choice.

In a single, easy-to-use, fully supported—and completely integrated—package, Open Desktop delivers:

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- compliance with POSIX™ and X/Open® standards
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- distributed SQL database management services
- compatibility with existing DOS, XENIX®, and UNIX System applications and data files
- NFS™, TCP/IP, and LAN Manager networking facilities

And all at an unbelievably affordable price.

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SCO™
THE SANTA CRUZ OPERATION

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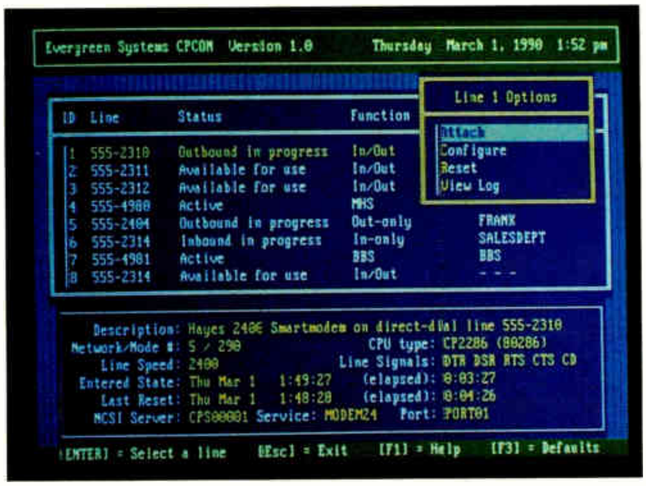
(800) SCO-UNIX (726-8649) (408) 425-7222 FAX: (408) 458-4227 E-MAIL: . . . !uunet!sco!info info@sco.COM

Circle 266 on Reader Service Card

FlexCom Lets You Dial Out, Too



FlexCom supports dial-in and dial-out access using the same modem and phone line.

Evergreen Systems' FlexCom product line provides asynchronous communication for Novell NetWare–compatible LANs. The software and component hardware system includes three basic FlexComServer models (available in tower or rack-mountable versions), FlexCom Communications Processor (FlexCom/CP) Kits, and FlexCom software.

The FlexComServers share features such as dial-in, dial-out, and special-purpose lines using dedicated communications processor cards; an ARCnet, Ethernet, or Token Ring network card and driver; a 3½-inch 1.44-MB floppy disk drive; and connections for a monochrome monitor and keyboard. The servers attach to any Novell-based network as a 286 external bridge, so you need only one network connection per FlexComServer. You can also attach multiple FlexComServers to a single network for support of up to 50 dial-in/dial-out lines per group.

The FlexCom/CP Kits include a communications processor card, 6-foot external modem cables for each line, FlexCom/CPX software with dial-in support for each line, and DOS 3.3 for each processor. Each kit can handle two or four dial-in communication lines and is available with or without a bidirectional option that gives each line dial-out as well as dial-in capabilities.

The FlexCom software consists of three packages: FlexCom/Manager, FlexCom/CPX, and FlexCom/CPS. FlexCom/Manager is the supervisory and control software for the FlexCom system. The FlexCom/CPX package manages the communications processor and serves as the interface between the FlexCom/Manager software and the CP. FlexCom/CPS includes the software you need to support one dial-out line on a CP.

Evergreen Systems offers nine base units, six communications processor kits, and three software packages.
Price: FlexComServer base units, $1295 to $3695; systems, $2990 to $27,655, depending on the server and the number of dial-in lines.
Contact: Evergreen Systems, Inc., 1510 Grant Ave., Suite 102, Novato, CA 94945, (415) 897-8888.
Inquiry 1312.

LANVista Analyzer Spots Looming Crises

If you've been looking for a LAN troubleshooter and protocol analyzer that doesn't cost an arm and a leg, then you should check out LANVista 100 from Digilog. The combination hardware and software package can capture frames to speed troubleshooting, generate traffic to test network stress, test the cable for fault isolation, and decode all seven layers of most popular protocol stacks to spot problems.

After LANVista 100 captures and decodes frames, you can view them in summary mode, hexadecimal or ASCII mode, or full decode mode. The Microsoft Windows–compatible system also lets you slice frames into parts or capture their entire contents, with the capture buffer configurable up to 8 MB.

You can filter captured frames based on criteria such as destination addressing, frame length, protocol type, good or bad frames, specified length, or data content. To speed up troubleshooting, you can have four display filters active simultaneously.

The package also helps you gather statistics in user-specified intervals on percent utilization of the LAN, number of good frames, and number and types of bad frames. You can use the information to identify adverse trends that might bring down the LAN and to set alarm thresholds that monitor network operations.

LANVista 100 is available as a kit containing a full-size board and software or as a complete package already installed in a portable 386 PC.
Price: $3495.
Contact: Digilog, Inc., 1370 Welsh Rd., Montgomeryville, PA 18936, (215) 628-4530.
Inquiry 1313.

New 5250 and 3270 Converters Aid Printer Sharing

Two new intelligent printer controllers, called the AX-3 and AX-7 Cobras, allow hosts and PCs to share serial and parallel printers in twin-axial and coaxial environments. Both converters automatically shift to a neutral setting once a host or PC printout is completed, so they are ready for new transactions from either the host or the PC.

The AX-3 Cobra is for IBM 5250 users who want to connect their dot-matrix or laser printers to the IBM S/34, S/36, S/38, or AS/400. The AX-7 Cobra, for IBM 3270 users, supports a wider range of hosts, including the IBM 30xx, 43xx, and 370. You can connect the AX-3 Cobra to your IBM 3196/97 or the AX-7 Cobra to your 3270 terminal, and the converters will guide you step by step through the setup routines. Alternatively, you can use your host to command and define the unit status.

Both units offer over 30 dot-matrix and laser printer emulations, including IBM Graphics, IBM Proprinter, Epson FX, Diablo 630, Hewlett-Packard LaserJet, Canon, and Xerox. You connect both devices to the parallel printer interface. The controllers have internal programmable settings with up to 80 accessible control strings for specific applications and optimal use of printer features.
Price: Without intelligent PC host sharing, $1145; with intelligent sharing, $1195.
Contact: Axis Communications, Inc., 130 Centre St., Danvers, MA 01923, (508) 777-7957.
Inquiry 1314.

continued

CONNECTIVITY

Pocket Fax/Modem from Best Data

Best Data Products offers the Smart One Traveler, a 2400-bps battery-operated pocket modem that lets you send faxes to Group 3-compatible fax machines or PC fax cards.

When in fax mode, Smart One Traveler can transmit faxes by converting ASCII text, PCX, TIFF, or IMG files into bit-mapped format. It works in background mode and can send multiple faxes to several destinations. The device also incorporates fax/mail-merge features for form letters and fax broadcasting applications, and Time Scheduled Transmission that lets you program Smart One Traveler to send faxes and data when telephone rates are at their lowest.

Smart One Traveler can transfer data at rates of 2400, 1200, and 300 bps and transfer faxes at a rate of 4800 bps. It is compatible with Bell 103 and 212A and CCITT V.21, V.22, and V.22bis, as well as CCITT Group 3 and Group 2 standards. The unit is Hayes compatible and also provides features like redialing of busy numbers, a comprehensive log file, and cover sheets.

Two versions are available, one for the IBM XT and AT and one for the Macintosh. The device has an RS-232C connector that attaches directly to laptop or desktop computers. External dimensions are 2¾ by 5 by 1¼ inches, and weight is 8 ounces.
Price: $299.
Contact: Best Data Products, Inc., 9304 Deering Ave., Chatsworth, CA 91311, (800) 632-2378 or (818) 773-9600.
Inquiry 1315.

The Smart One Traveler package includes communication and fax software, a 9-V battery and external power supply, LED lights, a speaker, and a power-down feature.

Share Your LaserJet with Friends

With ServerJet, up to 10 users can share one or two Hewlett-Packard LaserJet II, IID, or III printers at a data transfer rate of 115,200 bps. The user-installable board plugs into the optional I/O slot on the back of the printer. It can accept and spool data at any time, even when the printer is printing another document.

Four models are available. The ST621 connects six serial-output computers to one printer; the ST622 connects one parallel-output and six serial-output computers to two printers; the ST721 connects one parallel-output and six serial-output computers to one printer; and the ST1021 connects 10 serial-output computers to one printer.

Each model comes with 256K bytes of internal memory that is expandable with 256K bytes, 512K bytes, or 768K bytes of additional memory up to 1 MB.
Price: ST621, $495; ST622, $695; ST721, $645; ST1021, $795.
Contact: ASP Computer Products, Inc., 1026 West Maude Ave., Suite 305, Sunnyvale, CA 94086, (800) 445-6190 or (408) 746-2965.
Inquiry 1316.

No Waiting for ARCnet

The new PcARC 8-bit ARCnet adapters from Network Interface use the NCR 90C126 chip to achieve faster arbitration speed and zero-wait-state operation.

The half-size cards employ buffer chaining and circular buffering to increase throughput and use only 16K bytes of memory space to reduce configuration problems on fully configured CPUs. They also have diagnostic LEDs, internal connectors that interface with the company's Active Hub cards, and easy access to all switches once you have the boards installed in your PC.

The PcARC series is available for coaxial-star, coaxial-bus/high-impedance, twisted-pair, and fiber-optic cabling topologies.
Price: Coaxial version, $250; twisted-pair version, $295.
Contact: Network Interface Corp., 15019 West 95th St., Lenexa, KS 66215, (913) 894-2277.
Inquiry 1317.

Radio Transmitters Expand LAN Size

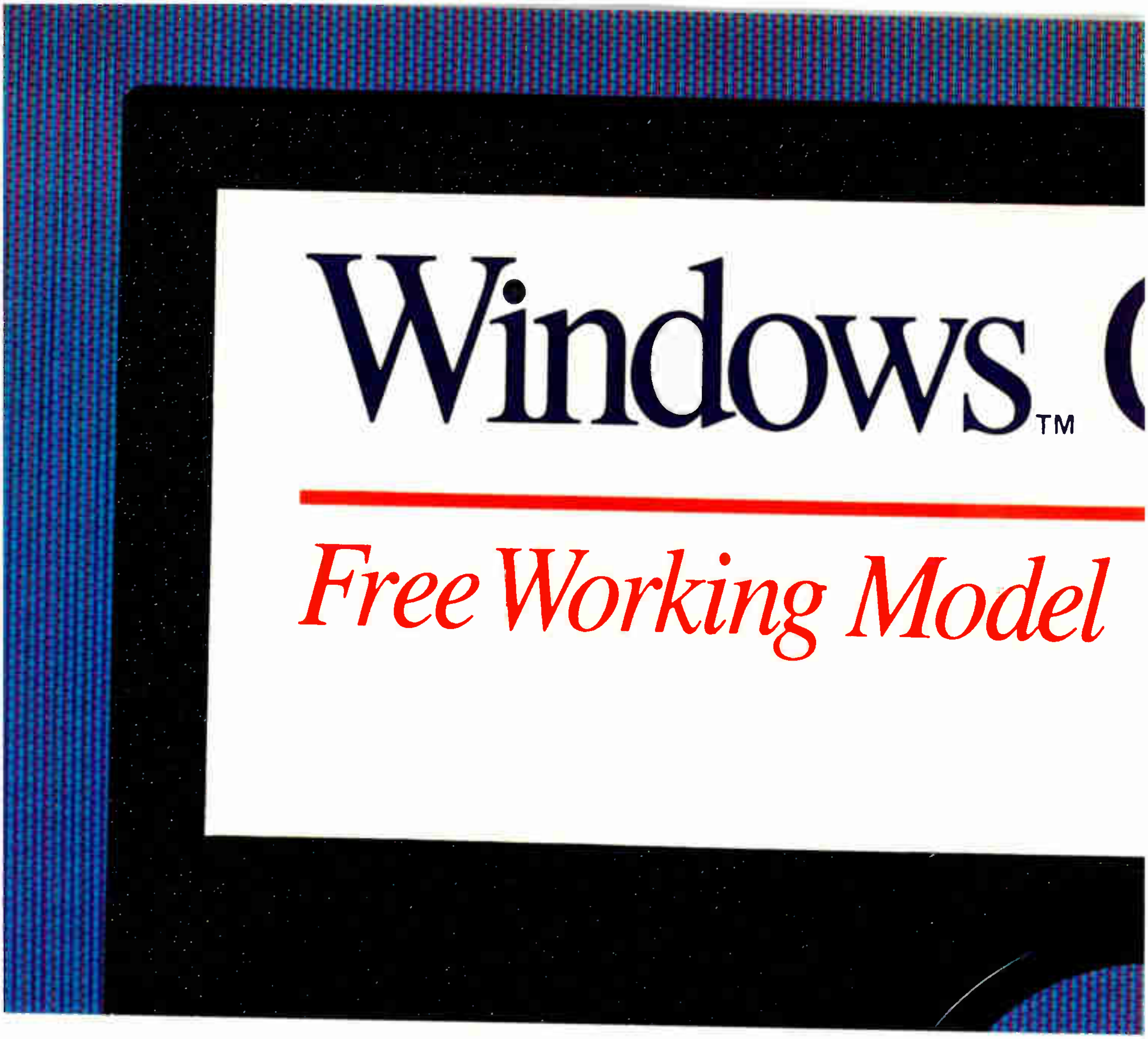
With Distance Extenders, you can locate a parallel network printer up to 4000 feet from the server and still maintain the maximum printing speed of 4000 to 5000 cps.

The system is a radio transmitter/receiver combination. You install a Distance Extender transmitter in the parallel port of the server, and a receiver in the parallel port of the printer. Both devices work with either DB-25 or Centronics parallel connectors.

Distance Extenders are LAN independent, and they also work with Digital Products' PrintDirector and NetCommander sub-LANs. Using the Distance Extenders with either of the sub-LANs, you can raise the maximum distance between the printer and the PC to 8000 feet. You can purchase Distance Extenders in sets to support PC/LAN Server-to-printer and sub-LAN-to-printer applications.
Price: $190 per set.
Contact: Digital Products, Inc., 108 Water St., Watertown, MA 02172, (800) 243-2333 or (617) 924-1680.
Inquiry 1318.

continued

After everything you've heard about Windows Computing, there are only two things you should believe.



Your

See for yourself. With Windows™ Computing, using your PC becomes easier, faster, and more productive than you ever imagined possible. But you don't have to take our word for it. Because, right now, we're making fully functional Working Models of Microsoft® Windows version 3.0, Microsoft Excel, Project, Word and PowerPoint® presentation graphics program as easy to get a hold of as they are to use.

Windows Computing is the Windows version 3.0 environment combined with any of the hundreds of Windows applications already available.

Just pick up the phone and call (800) 323-3577, Dept. M68, and we'll

*The first Working Model you select is free during our Windows Computing Promotion, September 15 through December 31, 1990. One free Working Model per person. Each additional Working Model is $9.95, applicable sales tax not included. Offer good whil

eyes.

send you a free copy of the Working Model* you're most interested in.

Or, if you would prefer, just ask for the date, time and location of a Windows Computing seminar being held near you. Either way, the experience is sure to impress you.

The truth is, we believe there could be only one reason why people might not see just how much Windows Computing means to the future of the personal computer.

They haven't looked.

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Map-Oriented Applications with MapAccess

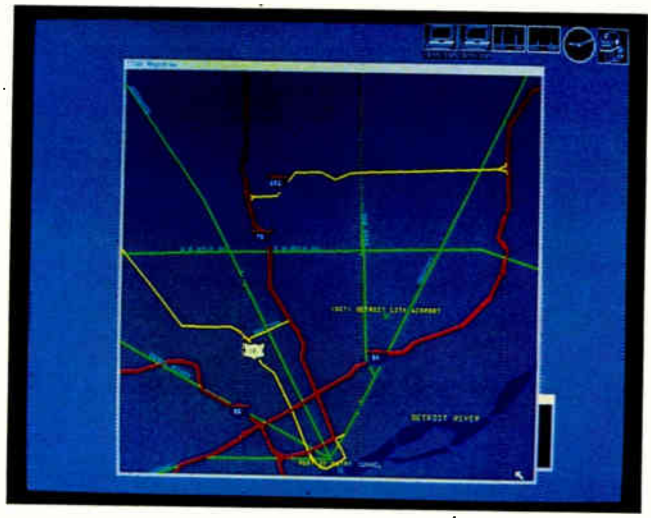
Etak's MapAccess toolkit lets you incorporate the company's digital road maps in your DOS and Xenix applications for delivery information, emergency dispatching, and geographic information systems. MapAccess tools consist of a C library with modules for retrieving and displaying maps and for locating a specified street address on a map.

Etak plans to release versions of the toolkit for AIX and OS/2 later this year, along with a pin-map library for locating specific types of landmarks and zooming in on them for greater detail.

Price: $2000 per module; prices of specific digital road maps vary.

Contact: Etak, Inc., 1430 O'Brien Dr., Menlo Park, CA 94025, (415) 328-3825.

Inquiry 1271.



The MapAccess toolkit lets you incorporate Etak's digital road maps in your applications. The MapDraw library of the toolkit displays this map of the Detroit area.

Toolbox Reduces Windows 3.0 Programming Curve

Drover Technologies has designed the Drover ToolBox, a dynamic link library (DLL) for developing in C under Windows, so that function-naming conventions, structures, and parameters appear as an extension to the Windows Software Development Kit. Drover says that this results in Windows 3.0 code that's easy to read and maintain. To help you get started, the ToolBox includes a sample application and hints for Windows programming.

The ToolBox supports data-input field masking—floating-point, integer, date, and time fields restrict and format data input as the end user types it. You can set ranges for in-line validation of data, and the ToolBox includes a set of far pointer string-handling functions, including versions of `sprintf` and `sscanf` to help develop DLLs.

A pattern editor contains functions for creating and displaying black-and-white and color bit maps and device-independent vector patterns. Other functions include date and time, a temperature-gauge class for task progress, and utility functions.

Price: $295.

Contact: Drover Technologies, Inc., 660 White Plains Rd., Tarrytown, NY 10591, (914) 631-4942.

Inquiry 1272.

Make Prolog Work in Harmony with C

To facilitate integration of reasoning and meta programming into commercial applications, Quintus has created a development system that lets you embed Prolog code in applications written in C.

Quintus Prolog 3.0 lets you tap the traditional strengths of Prolog—reasoning, data manipulation, database development, and prototyping—and marry them with the more commercially accepted C.

Quintus Prolog 3.0 has a user interface based on the X Window System standard that lets you run, edit, and debug Prolog programs as you view them in a set of windows, with each window providing menus for additional operations. The interface has a Prolog source-level debugger, allowing you to debug compiled code.

The run-time module of Prolog that runs within C requires about 800K bytes, which makes it suitable for workstations only. The initial version supports the Sun-3 and Sun-4 workstations, with ports for DECstations, IBM RISC machines, and the Intergraph 6000 series scheduled to come out by the end of the year, the company says.

Price: $10,000.

Contact: Quintus Computer Systems, Inc., 1310 Villa St., Mountain View, CA 94041, (800) 542-1283 or (415) 965-7700.

Inquiry 1275.

Add Graphics with Device-Independent Library

Due to its device independence, Geocomp's Geograf Level One graphics library lets you add graphics to your application without having to develop graphics device drivers for each device you want to support. The library uses the same structure for Microsoft and Borland compilers, allowing you to use similar graphics calls with different languages and compilers, Geocomp says.

Plots from an application can be imported into any program that supports HPGL-formatted files.

Price: $149.

Contact: Geocomp Corp., 66 Commonwealth Ave., Concord, MA 01742, (800) 822-2669 or (508) 369-8304.

Inquiry 1273.

32-bit Compiler Breaks the 640K-byte Barrier

Lahey's new 32-bit FORTRAN compiler, called F77L-EM/32, works with the company's Ergo OS/386 DOS Extender to let you exceed the 640K-byte barrier of DOS and use extended memory. It also supports Desqview and offers unlimited run-time licensing. F77L-EM/32 lets you compile, link, and make programs from within its editor. It runs on 386 machines with 1 MB of memory, a math coprocessor, and DOS 3.0.

Price: $895; Ergo OS/386 DOS Extender (required), $395.

Contact: Lahey Computer Systems, Inc., P.O. Box 6091, Incline Village, NV 89450, (800) 548-4778 or (702) 831-2500.

Inquiry 1274.

continued

How To Find The Perfect Mouse In Your Future.

No matter what forces shape your destiny, there's a Series 9 mouse in your future. It's the world's most sophisticated mouse. And now it comes with the world's hottest graphical interface—Windows 3.0. With adjustable resolution, the Series 9 mouse lets you tune its performance to fit your application. So when you're working on Windows 3.0, you can really enjoy the view. The sleek, ergonomic, Series 9 mouse is Microsoft compatible and works with any application on an IBM® PC (or compatible). Suggested retail price: $215 Bundle, $119 Mouse. Includes Logitech's lifetime hardware warranty.

For more information call Logitech's Customer Sales Center: (800) 231-7717, ext.349. In California: (800) 552-8885. In Canada: (800) 283-7717. In Europe: ++41-21-869-9656.

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Tools That Power The Desktop.

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Link Census Maps and Databases to Track Demographics

Atlas*GIS (Geographic Information System) integrates a database, drawing and editing tools, and map presentation abilities to let you track demographics, analyze geographic relationships, and target market penetration on the IBM PC. The network-compatible program supports the U.S. Census Bureau's 1990 computerized street maps and other digital street maps with latitude/longitude coordinates.

Atlas*GIS matches addresses with the coordinates and lets you attach data to those points on the map. After you attach the data to street addresses, you can use the Atlas*GIS database and the program's mapping capabilities to create thematic maps. You can view changes in data instantly in a map.

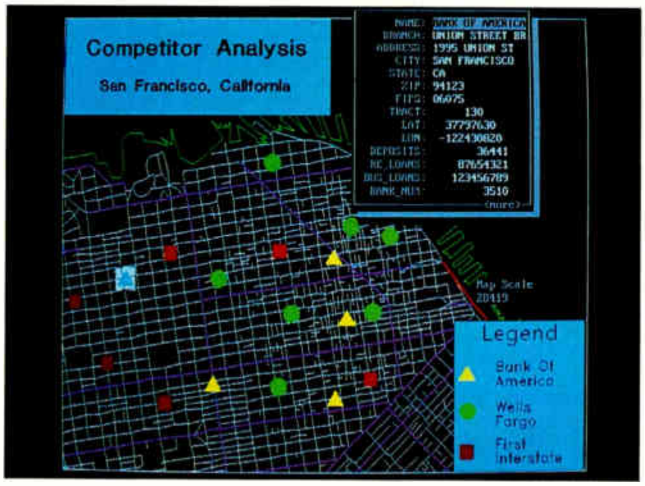
Atlas*GIS includes boundary files of all U.S. counties, ZIP code areas, and other catalogs. Maps can display such detailed geographic relationships as concentrations of customers per block, the buying power of a neighborhood, and other business data. The dBASE-compatible Atlas*GIS database lets you work with any database that has ZIP code, address, or similar fields.

Atlas*GIS supports thematic, dot-density, street-based, and pin maps. You can zoom into maps for detailed representations in up to 250 layers.

Price: $2495.

Contact: Strategic Mapping, Inc., 4030 Moorpark Ave., Suite 250, San Jose, CA 95117, (408) 985-7400.

Inquiry 1276.



*Atlas*GIS maps can display detailed geographic relationships such as concentrations of customers per block, the buying power of certain neighborhoods, and other business data.*

Three Programs to Test Employee Proficiency

Kee Systems has teamed up with the Educational Testing Service (administrator of the SAT) to develop Aequitas, a program for determining the software skill levels of current and prospective employees.

Program modules test employee proficiency in WordPerfect, DisplayWrite, and Microsoft Word.

Aequitas runs on the IBM PC with 512K bytes of RAM.

Price: $795 per year for the base configuration (includes one module); $395 per year for each additional module.

Contact: Kee Systems, 6460 Dobbin Rd., Columbia, MD 21045, (301) 740-0110.

Inquiry 1277.

The Job Qualifications Comparison System (JQCS) for the IBM PC lets you store information such as work history, education, demographic data, and pre-employment test scores to help you identify the most qualified applicants.

The JQCS base program supports up to 100 individuals. You can increase the system's capability to handle up to 5100 applicant entries.

Price: $250; 100 additional entries, $125; 5000 additional entries, $2250.

Contact: E. F. Wonderlic Personnel Test, Inc., 820 Frontage Rd., Northfield, IL 60093, (708) 446-8900.

Inquiry 1278.

Certify! presents a screen that's identical to the application that's actually used in your office and runs an employee through that application's typical procedures.

Certify! modules can test proficiency in Lotus 1-2-3, dBASE, Microsoft Word, WordPerfect, MultiMate, and other applications, plus DOS.

The program runs on the IBM PC with 512K bytes of RAM.

Price: $149.95 per application.

Contact: American Training International, 12638 Beatrice St., Los Angeles, CA 90066, (800) 955-5284 or (213) 823-1129.

Inquiry 1279.

Micrografx Offers All-in-One Business Graphing Program

Micrografx says that its new software package, called Charisma, will satisfy most of the needs of business graphics users. It combines charting, drawing, freehand illustration, clip art, and computer-based slide shows.

In addition to using the Windows Clipboard and Dynamic Data Exchange, the software can read data and graph files from Lotus 1-2-3 and Excel, Harvard Graphics, and several other formats. Export options include PostScript and HPGL.

Charisma runs under Windows 2.11 or 3.0 on a 286 or higher system with 1 MB of RAM.

Price: $495.

Contact: Micrografx, Inc., 1303 Arapaho, Richardson, TX 75081, (800) 733-3729 or (214) 234-1769.

Inquiry 1280.

Forms Publishing with Windows

Form Publisher for Windows provides a desktop publishing system for creating blank forms under Windows 3.0. The program's Forms-On-Demand library provides more than 500 standard forms for business, government, and industry.

The program offers a building-block approach to forms design by using a library of form elements, such as address labels, checklists, and grids. You can import scanned images in several standard graphics formats, such as TIFF, PCX, and MSP, and place them anywhere on the form.

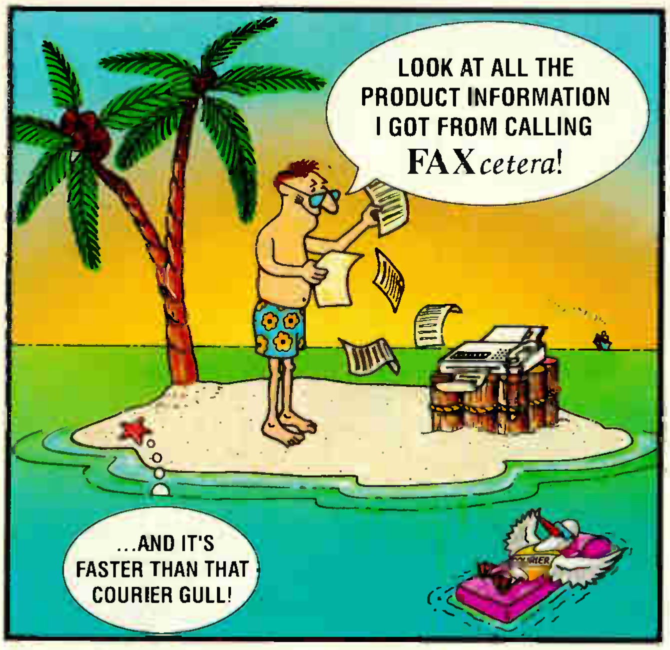
Price: $249.

Contact: FormWorx Corp., Reservoir Place, 1601 Trapelo Rd., Waltham, MA 02154, (617) 890-4499.

Inquiry 1281.

continued

Programmer's Paradise®...



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386 CONTROL PROGRAMS

	LIST	OURS
DESQview 386 w/ QEMM	220	169
Microsoft Windows 3.0	150	99
VM/386	245	209
VM/386 MultiUser	895	839
VM/386 MultiUser Starter	395	339

386 DEVELOPMENT TOOLS

	LIST	OURS
386 ASM/LinkLoc	1295	1145
Lahey F77L-EM/32 (w/ OS/386)	1290	1035
MetaWare High C 386	895	849
Novell C Network Compiler/386	995	799
Paradox/386	895	629
PC-lint 386	239	179
Phar Lap 386 ASM/LINK	495	435
WATCOM C 8.0/386 Prof.	1295	1099
w/ Phar Lap 386 ASM/LINK	1790	1399
WATCOM C 8.0/386 Standard	895	719

ASSEMBLY LANGUAGE

	LIST	OURS
Advantage Disassembler	295	279
ASMFlow	99	89
Dis Doc Professional	250	225
MS Macro Assembler	150	105
OPTASM	150	129
Re:Source	150	129
Sourcer w/ Pre-Processor	170	149
SpontaneousAssembly	395	CALL
Turbo Debugger & Tools	150	99
Visible Computer: 80286	100	89

BASIC COMPILERS

	LIST	OURS
MS BASIC Prof. Devel. System	495	349
Power Basic	129	89
QuickBASIC	99	69
True BASIC	100	69

BASIC LIBS/UTILITIES

	LIST	OURS
db/LIB	139	125
DiaLogic	95	85
GraphPak Professional	149	129
P.D.Q.	129	115
ProBas	159	149
ProBas Toolkit	99	94
ProMath	99	94
QBase and Quickscreen	149	125
QuickComm	149	119
QuickPak Professional	169	149
QuickPak Scientific	79	70
QuickScreen	99	90
QuickWindows Advanced	149	119

C COMPILERS

	LIST	OURS
Lattice C 6.0	250	155
Lattice C 286 (w/ extension)	495	395
Microsoft C 6.0	495	339
MS QuickC 2.5	99	69
MS QuickC w/ QuickAssembler	199	139
Novell C Network Compiler	695	559
Top Speed C Standard	199	155
Extended Edition	395	315
OS/2 Professional	495	445
Turbo C 2.0	99	69
WATCOM C 8.0 Professional	495	419
WATCOM C 8.0 Standard	395	335

C++

	LIST	OURS
C++/Views	495	419
NDP C++	495	479
Rogue Wave Math.h++	150	129
Turbo C++	200	135
Turbo C++ Professional	300	205
Zinc Library	200	179
Zortech C++ Debugger	150	129
Zortech C++	200	165
Developer's Edition	450	399
Zortech C++ Tools	150	129
Zortech C++ Video Course	500	449

C-COMMUNICATIONS

	LIST	OURS
Breakout II	249	189
C Asynch Manager 3.0	189	139
Essential Communications	329	259
Greenleaf CommLib	359	287
Greenleaf ViewComm	399	319
SilverComm C Asynch Library	249	209
View-232	189	149

C-FILE MANAGEMENT

	LIST	OURS
AccSys for dBASE or Paradox	395	349
Btrieve Devel. System	595	449
C-ISAM	225	209
Codebase IV	295	219
CQL w/ PASS	395	349
c-tree	395	315
dBC III	250	229
dBC III Plus	500	439
db_FILE Bundle	295	249
Essential B-Tree w/ source	198	149
FairCom Toolbox - Prof. Edition	1095	789
FairCom Toolbox - Special	695	509
Informix Products	CALL	CALL
Paradox Engine	495	349

C-GENERAL LIBRARIES

	LIST	OURS
Blackstar C Function Library	99	79
C TOOLS PLUS/6.0	149	109
C Utility Library	249	199
Greenleaf Functions	229	179
Greenleaf SuperFunctions	299	239
Turbo C TOOLS/2.0	149	109

C SCREENS

	LIST	OURS
Greenleaf DataWindows	395	315
Hi-Screen XL	149	129
Panel Plus	495	395
QuickWindows Advanced (C)	169	149
Vermont Views	495	CALL
Vitamin C	225	165
VC Screen	149	125

C-UTILITIES/OTHER

	LIST	OURS
Clear +	200	169
C Shroud	198	149
C-Terp	300	219
Code Runner	149	135
Heap Expander	80	70
MKS LEX & YACC	249	197
PC-lint	139	105
PCYACC Professional	495	459
TimeSlicer	295	279

CASE TOOLS

	LIST	OURS
EasyCASE Plus	295	265
Professional Pack	395	355
Personal CASE	199	179

COBOL LANGUAGE

	LIST	OURS
Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
Personal COBOL	149	129
MS COBOL	900	629
Realia COBOL	995	849
SCREENIO	400	375

CODE GENERATORS

	LIST	OURS
Logic Gem	99	69
Matrix Layout 2.0	200	159
PRO-C	399	339

DATABASE DEVELOPMENT

	LIST	OURS
Clarion 2.1	CALL	CALL
Clipper 5.0	795	519
Data Junction Advanced	299	269
dBASE IV	795	489
dBFast/PLUS	345	295
dGE	295	249
FlashTools!	89	79
Flipper	195	169
Force 2.1	695	589
FoxPro	795	489
FUNCKy Library	195	179
Magic PC	499	429
R&R Report Writer	150	129
R&R Code Generator	150	129
Say What?!	50	39
SilverComm Library 2.0	249	209
Tom Rettig's Library	100	80
UI2 Version Two	595	479

DEBUGGERS (DOS)

	LIST	OURS
MultiScope	179	135
OPTDEBUG	150	129
Periscope I/512K	595	475
Periscope II	175	125
Periscope IV/16, 25 MHz	CALL	CALL
Turbo Debugger & Tools	150	99

DOCUMENTING/FLOWCHARTING

	LIST	OURS
allCLEAR	300	229
Clear+	195	169
C-Clearly	130	115
Flow Charting III	250	199
Interactive Easyflow	150	125
Paginate	100	79
Source Print	99	74
The Documentor	295	245
Tree Diagrammer	99	74

EDITORS

	LIST	OURS
BRIEF 3.0	199	CALL
Edix	195	155
EDT+	295	269
EMACS	325	265
Epsilon	195	159
KEDIT 4.0	150	125
MKS Vi	149	129
Multi-Edit Professional	179	159
PI Editor	195	175
Sage Professional Editor	295	249
w/ Mouse	395	319
SLICK Editor	195	154
SPF/PC	245	199
VEDIT PLUS	185	CALL

EMBEDDED SYSTEMS

	LIST	OURS
Link & Locate ++	395	349
Link & Locate ++ Extended	479	395
Paradigm Locate	295	265

FORTRAN LANGUAGE

	LIST	OURS
Grafmatic	135	119
Lahey F77L	595	535
Lahey Personal FORTRAN 77	99	89
MS FORTRAN	450	299
Plotmatic	135	119
RM/FORTRAN	595	499
WATCOM FORTRAN 77/386	1095	CALL

GRAPHICS LIBRARIES

	LIST	OURS
Baby Driver	250	199
Essential Graphics	399	319
Font-Tools	150	119
Graf/Drive Plus Developer's	299	269
GraphiC 5.0	395	319
Graphics-MENU	179	159
Data Entry	99	89
Data Entry w/ source	224	199
GSS Graphics Devel. Toolkit	595	509
HALO	395	279
HALO Professional	595	419
HALO Window Toolkit	595	419
Icon-Tools/Plus	150	119
Menuet	325	279
MetaWindow	250	209
MetaWindow Plus	325	289
PCX Effects	99	89
PCX Programmer's Toolkit	195	175
PCX Text	149	135
Slate w/ graphics	448	415
Turbo Geometry Library	200	179

LINKERS/LIBRARIANS

	LIST	OURS
Plink86+	395	335
Plink/LTO	495	419
PolyLibrarian	249	209
.RTLink	295	265
.RTLink/Plus	495	409

OS/2 TOOLS

	LIST	OURS
Brief	199	CALL
CASE:PM for C	1495	1420
Epsilon	195	159
MKS LEX & YACC	349	279
MS OS/2 Pres. Manager Toolkit	500	349
MultiScope for OS/2	449	345
PCYACC	695	625
PI Editor	249	225
Repository Explorer	995	895
Smalltalk/V PM	495	369
TopSpeed Modula-2 (OS/2)	495	449
Vitamin C (OS/2)	345	279
Zortech OS/2 Compiler Upgrade	150	129

PASCAL LANGUAGE

	LIST	OURS
Asynch PLUS	149	115
B-tree Filer	125	109
MS QuickPASCAL	99	69
Object Professional	150	109
Power Tools PLUS/5.0	149	109
Topaz	99	89
Topaz Multi-user	149	135
Turbo Analyst	99	89
TurboMAGIC	199	179
Turbo Pascal 5.5	150	105
Turbo Pascal 5.5 Professional	250	175
Turbo-Plus 5.5	199	159
Turbo Professional 5.0	125	109

SMALLTALK

	LIST	OURS
Smalltalk-80 (386)	595	535
Smalltalk/V	100	85
Smalltalk/V 286	200	169

SOURCE MAINTENANCE

	LIST	OURS
Code Check	495	469
MKS Make	149	119
MKS RCS	189	149
MKS Software Mgmt. Team	299	239
PolyMake	179	149
PVCS Professional	495	419
SMS	495	399
TLIB	139	109
5 Station LAN	419	339

WINDOWS (MS) TOOLS

	LIST	OURS
Actor 3.0	695	559
Asymetrix Toolbook	395	CALL
Bridge Toolkit	695	659
Case:W	795	759
C-Talk/Views	450	375
dBFast/Windows	395	335
DialogCoder	499	435
MS Windows Development Kit	500	349
MultiScope for Windows	379	289
Object Graphics	395	319
ProtoView	695	625
Whitewater Resource Toolkit	195	169
WindowsMAKER	595	535
WinTrieve	395	339
WNDX GUI Toolbox	499	449

NEW RELEASES

HALO Professional
by Media Cybernetics
Provides graphics application developers access to protected mode. Support for popular DOS extenders allows for creation of sophisticated graphics programs without concern for the 640K memory constraint imposed by DOS.
List: $595 **Ours: $419**

allCLEAR by CLEAR Software
Automatically creates presentation quality flowcharts, treecharts, procedure diagrams, decision trees and org charts from plain English descriptions. Multi-page diagrams, user-definable symbols, text centering and more. Import files from any word processor or Lotus worksheets.
List: $300 **Ours: $229**

Turbo EMS 5.0
by Merrill and Bryan Enterprises
Expanded memory manager for 286/386. Includes SHUTTLE! utility that relocates TSRs, Device Drivers and Network Shells. Provides automatic spillover between any combination of memory media. Includes VCPI support. Network compatible.
List: $100 **Ours: $89**

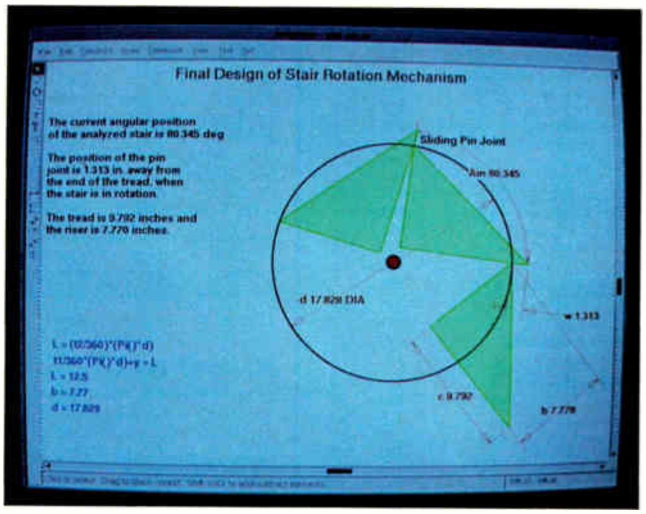
World Radio History

See How It Runs, Not Just How It Looks

Premise says that the new version of DesignView, a prototyping program for visualizing and optimizing mechanical parts and systems designs, can now import your established CAD drawings for redesign and analysis. You can use DesignView's IGES and DXF drivers to import AutoCAD, VersaCAD, CADkey, and other CAD drawings.

With DesignView 2.0, you can analyze your designs in the early phase of the design cycle when the cost of changes is lowest, Premise says. Like the previous version, the core technology of DesignView 2.0 unifies variational geometry with mathematics, which means that when you change the value of a dimension or add a new constraint, a constraint solver modifies the entire geometric model.

DesignView runs on the IBM AT with Windows 3.0; the Sun SPARCstation; and DEC's DECstation using OSF/Motif under the X Window System.
Price: $895 and up.
Contact: Premise, Inc., Three Cambridge Center, Cambridge, MA 02142, (617) 225-0422.
Inquiry 1288.

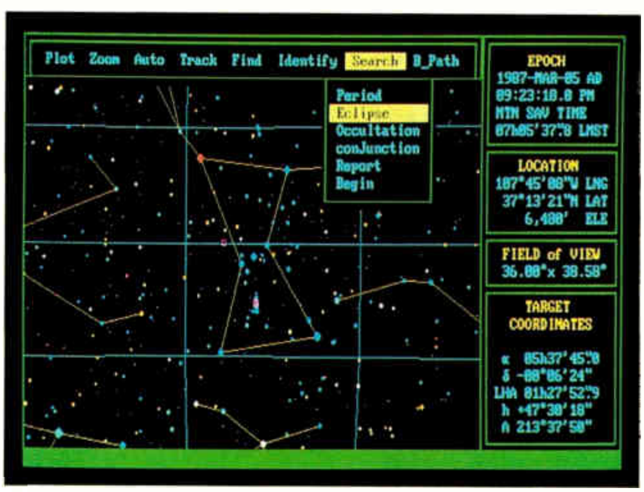


Premise says that an exercise machine manufacturer used DesignView to redesign a prototype of a stair climber. At lower left, you can see the equation solver.

Look Up into the Sky from Your Desktop

LodeStar Plus provides variable-size views of the sky for any year from 9999 B.C. to 9999 A.D. When you enter the location, date, and time on your IBM PC, you can view the sky as it would actually appear, including over 9000 stars, 8000 galaxies and nebulas, the sun and moon, and all planets. The program also lets you view solar and lunar eclipses.

Databases included with the program give you the Flamsteed, Henry Draper, and Smithsonian Astrophysical Observatory numbers for stars, and the New General Catalogue numbers for nonstellar objects. Databases also provide right ascension and declination, brightness, and other information.
Price: $149.95.
Contact: Zephyr Services, 1900 Murray Ave., Pittsburgh, PA 15217, (800) 533-6666 or (412) 422-6600.
Inquiry 1289.



LodeStar Plus provides a view of the sky, plus information about that view at right.

Designed for amateur and professional astronomers, SuperStar can accurately display the sky as it would appear from any place on Earth at any time within 5000 years of the present. The program includes an interface to the Hubble Space Telescope Guide Star Catalogue that lets you graphically display the information on-screen.

The program includes all 259,000 stars of the *Smithsonian Astrophysical Observatory Star Catalogue* and over 8000 deep-sky objects. SuperStar also comes with a database of over 21,000 variable stars, stars that have detectable changes in intensity that are accompanied by physical changes. An additional database provides 21,000 more variable stars.

The program runs on the IBM PC, but an AT or higher system with a hard disk drive and a math coprocessor is recommended.
Price: $149.95; SuperStar Professional, $249.95; variable-star database, $25.
Contact: PicoScience, 41512 Chadbourne Dr., Fremont, CA 94539, (415) 498-1095.
Inquiry 1290.

With over 500 images taken from Voyager I and II, Voyage to the Planets puts on a CD-ROM more than 350 MB of pictures of Jupiter, Saturn, Uranus, and their moons.
Price: $99.
Contact: Astronomical Research Network, 206 Bellwood Ave., Maplewood, MN 55117, (612) 488-5178.
Inquiry 1291.

Prime Focus Imaging has optimized its Tycho imaging software for astronomy, allowing you to take advantage of the Electrim digital camera's ability to extend exposure time to 8 minutes.

With the camera's extended exposure ability, you can optimize detection of low-light-level observations, the company says. Acquired images can be saved in the Flexible Image Transport System format.

Tycho runs on the IBM PC with a VGA card. The program is also available for PCs with EGA graphics.
Price: Tyco, $150; with camera, $550.
Contact: Prime Focus Imaging, 128 Elpis Rd., Camden, NY 13316, (315) 245-3596.
Inquiry 1292.

continued

Create Giant Posters on the Mac

A new version of PosterWorks, the program for making posters up to 100 square feet in size, lets you assemble layouts comprising scalable type, clip art, illustrations, and other graphical elements. Once you've completed the design, you can print the poster on any PostScript device.

During layout, you can arrange image, text, and graphical objects by scaling, moving, stretching, and cropping individual objects.

As with the first version of PosterWorks, version 2.0 includes color calibration tools. It runs on the Mac Plus or higher with at least a 20-MB hard disk drive and 2 MB of RAM.

Price: $295.

Contact: S. H. Pierce & Co., Suite 323, Building 600, One Kendall Sq., Cambridge, MA 02139, (617) 395-8350.

Inquiry 1282.

DesignCAD Releases Mac-Based CAD Program

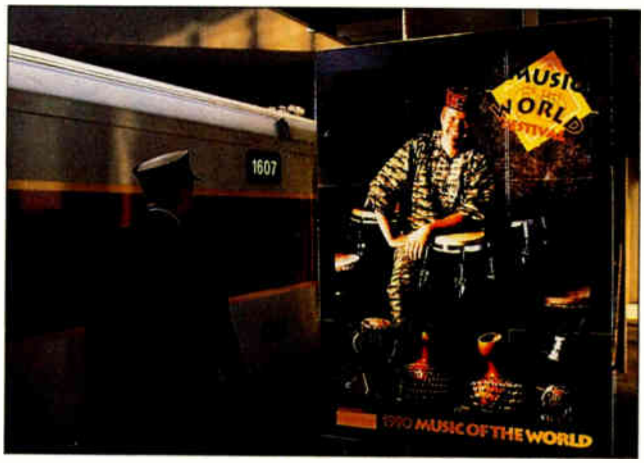
DesignCAD Macintosh is A/UX compatible and provides 2-D and 3-D CAD, including 32-bit floating-point accuracy, extensive geometric construction features, cubic spline and bi-cubic surface geometry, and dimension/annotation capabilities.

The program requires a math coprocessor and a Mac Plus or higher.

Price: $699.

Contact: DesignCAD, Inc., 327 South Mill, Pryor, OK 74361, (918) 825-4848.

Inquiry 1283.



PosterWorks 2.0 lets you work in an electronic pasteboard with grids that delineate boundaries of individual printouts that make up the entire poster.

Video Titling and Special Effects Without Jaggies

Data Translation's VideoQuill, a video titling and special effects program for the Mac, is an alternative to the expensive dedicated character generators used in professional broadcast studios.

VideoQuill lets you put special effects and titling onto video images and resize, rotate, distort, and fill type with color images. Antialiasing removes jagged edges from characters, resulting in improved resolution and high-quality video output, the company says.

The program runs on the Mac II with 4 MB of RAM recommended and a color display. It ships with nine vector-based fonts. Another 47 fonts are available.

Price: $495; additional font library, $495.

Contact: Data Translation, Inc., 100 Locke Dr., Marlborough, MA 01752, (508) 481-3700.

Inquiry 1284.

With Showmaker and the Amiga, the Beat Goes On

Showmaker, a program for creating presentations that use video titling, animation, MIDI music, and other media, takes advantage of the Amiga's multitasking capability to prepare lengthy presentations limited only by your hard disk drive's available storage space. Through continuous caching, Showmaker can preload a presentation's next segment while running the current segment.

Showmaker lets the Amiga control any external device, including laser disk players, MIDI keyboards, audiotape recorders, and VCRs. Showmaker also lets your animations move to the beat: You can define an animation to move according to the beat of a MIDI drum instead of just frames per second.

With built-in support for video titling and voice-over, the program lets you create a video without having to hire an outside firm to do your production.

Showmaker runs on the Amiga 1000 or higher with 1 MB of RAM (2 MB is recommended).

Price: $395.

Contact: Gold Disk, 2535 West 237th St., Suite 106, Torrance, CA 90505, (213) 530-8111.

Inquiry 1285.

IsiCAD's Distributed CAD for Networks

IsiCAD's CADvance for Workgroups, designed for PC networks, combines a form of distributed processing with information and peripheral sharing and built-in security and control.

CADvance for Workgroups lets you off-load CPU-intensive applications from a client workstation to the server, providing a multitasking environment for even single-tasking DOS, the company says.

Price: $3495; single-user version, $3295.

Contact: IsiCAD, Inc., 1920 West Corporate Way, P.O. Box 61022, Anaheim, CA 92803, (714) 533-8910.

Inquiry 1286.

Get the Big Picture in AutoCAD

Panacea's Deluxe versions of its display list drivers for AutoCAD release 10 and AutoCAD 386 include a new interface feature to aid in editing large AutoCAD drawings. The Big Picture, a window that shows a miniversion of your drawing, highlights the current editing area so you always know your location as you pan and zoom. The Deluxe drivers increase the speed of pans, redraws, and zooms to up to 20 times faster than with standard drivers.

Price: $169 to $299.

Contact: Panacea, Inc., Londonderry Sq., Suite 305, 50 Nashua Rd., Londonderry, NH 03053, (800) 729-7420 or (603) 437-5022.

Inquiry 1287.

FINALLY. A COMPUTER COMPANY WITHOUT THE PUSHY SALESPEOPLE.

Dell's new free catalog has everything you need to buy a computer, except pushy salespeople. It tells you about our new computers, prices, services, and reasons we've won eight out of eight *PC Week* Polls of Customer Satisfaction for personal computers.

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Company: ______________ If Applicable
Address: ______________
City: ______________ State: ______ Zip: ______
Type of Business: ______________
Approx. # of Employees in Company: ______________
Home Phone: (______) ______________
Business Phone: (______) ______________
Fax #: (______) ______________

1. Which products are you most interested in?
☐ 286-based systems ☐ UNIX®-based systems
☐ 386-based systems ☐ Laptops
☐ 386SX-based systems ☐ Other: ______
☐ 486-based systems

2. Are you interested in computer products for:
☐ Home ☐ Business ☐ Resale

3. How many PCs does your company plan to purchase in the next twelve months?

Quantity	Timeframe	Quantity	Timeframe
______	Less than 1 month	______	6-12 months
______	1-3 months	______	More than 12 months
______	3-6 months		

4. What do you plan to use computer products for?
____
____
____

5. How many PCs do you have installed now at your company?
____

6. Are you interested in leasing? ☐ Yes ☐ No

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Company: ______________ If Applicable
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City: ______________ State: ______ Zip: ______
Type of Business: ______________
Approx. # of Employees in Company: ______________
Home Phone: (______) ______________
Business Phone: (______) ______________
Fax #: (______) ______________

1. Which products are you most interested in?
☐ 286-based systems ☐ UNIX®-based systems
☐ 386-based systems ☐ Laptops
☐ 386SX-based systems ☐ Other: ______
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______	1-3 months	______	More than 12 months
______	3-6 months		

4. What do you plan to use computer products for?
____
____
____

5. How many PCs do you have installed now at your company?
____

6. Are you interested in leasing? ☐ Yes ☐ No

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We can't. Workgroups are too critical to leave in the hands of amateurs.

So Dell has gone overboard in servicing servers. In fact, we just won the *PC Week* Poll for Corporate Satisfaction for servers, where our reliability and service were rated far above our competitors.

Which brings us back to our question:

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We have two new 486™ EISA servers. Dell gives you a choice of the 25 MHz Dell™ 425TE and the 33 MHz Dell 433TE.

The 25 MHz Dell System® 425TE has up to 64 MB of RAM capacity, 11 storage bays, and a whisper-quiet 300 watt power supply. We've also built-in features such as password protection, a software controlled reset switch, and an efficient cooling system to protect component life.

What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

For even more performance, the 33 MHz Dell System 433TE is everything our 425TE is, with 32% more speed. The Dell exclusive memory design with a 128 KB external cache gives it maximum throughput.

THE NEW DELL SYSTEM 433TE 33 MHz EISA i486™ AND THE NEW DELL SYSTEM 425TE 25 MHz EISA i486.

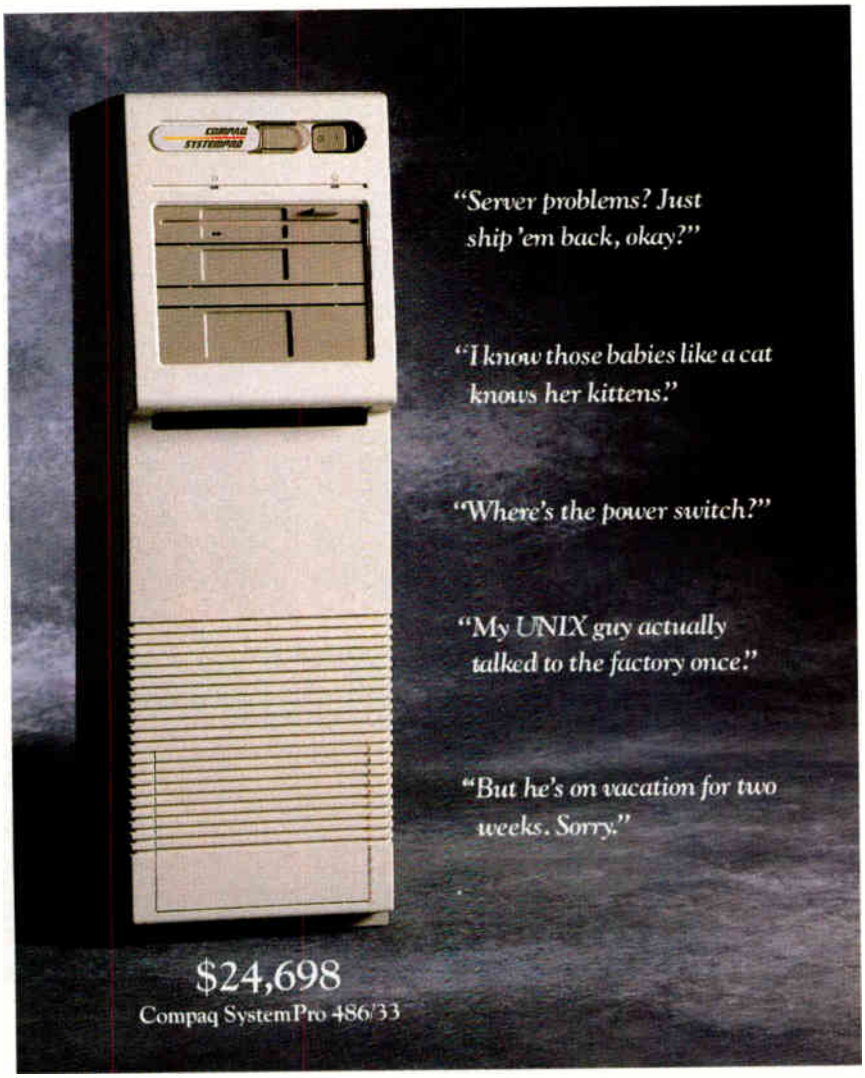
- Intel® 80486 microprocessor running at 33 MHz (433TE) or 25 MHz (425TE) with 8 KB internal cache.
- 128 KB external cache (433TE).
- Standard 4 MB of RAM,* expandable to 64 MB (eight internal SIMM sockets each accepting a 1 MB, 2 MB, 4 MB, or 8 MB SIMM, installable in matched pairs).
- Socket for WEITEK 4167 math coprocessor.
- 11 internal half-height drive bays.
- Eight 32-bit EISA expansion slots (six EISA master slots and two EISA slave slots).
- High-performance IDE (80 MB, 100 MB, 190 MB) and ESDI (330 MB, 650 MB) hard disk drives.

△Xerox Extended Service Plan pricing starts at $1,180 (433TE) or $960 (425TE).
Commercial Lease Plan. Lease for as low as $423/month (433TE) or $359/month (425TE).

	433TE	425TE
650 MB VGA Color Plus System 8 MB	$11,799	$9,599

AD CODE 11E24

UNBELIEVABLE.



■ ***From this foundation, create a powerful PC network or UNIX workgroup.*** Dell's new systems have more than enough performance to function as a LAN Server and WAN or internetworking gateway. So they're capable of supporting the most demanding server use—a multi-function network. Of course, they're completely compatible with all major network operating systems, including Novell, 3COM and Banyan.

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Servicing servers is beyond most Compaq dealers. If a server happens to go down, your whole company can go down with it.

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That's why we have a special advanced systems hotline for you to call. It's manned by specialists with the UNIX source code licensed from AT&T.

On those rare occasions we can't fix it over the phone, we'll call the Dell trained Xerox technicians. They'll come to your office with the solution or part in hand.△

There's a lot more to know before you buy a server. When you call Dell, our experts will give you the help you need to buy a server.

Then we'll send it off with a 30-day no questions asked money back guarantee, and a one year limited warranty.

Call us.

We'd like to make believers out of you.

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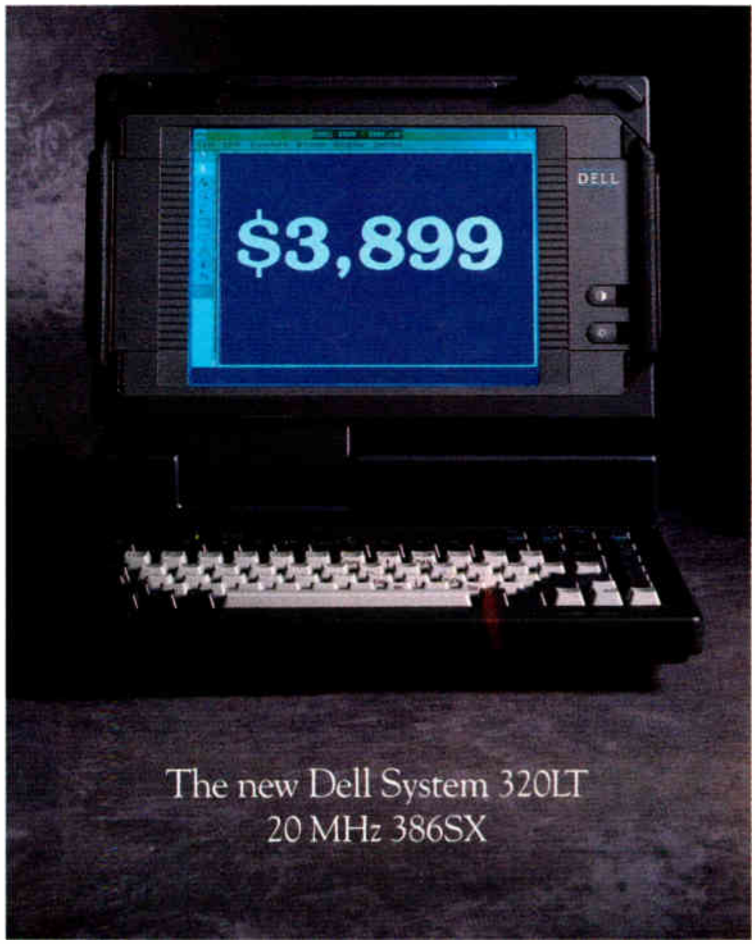

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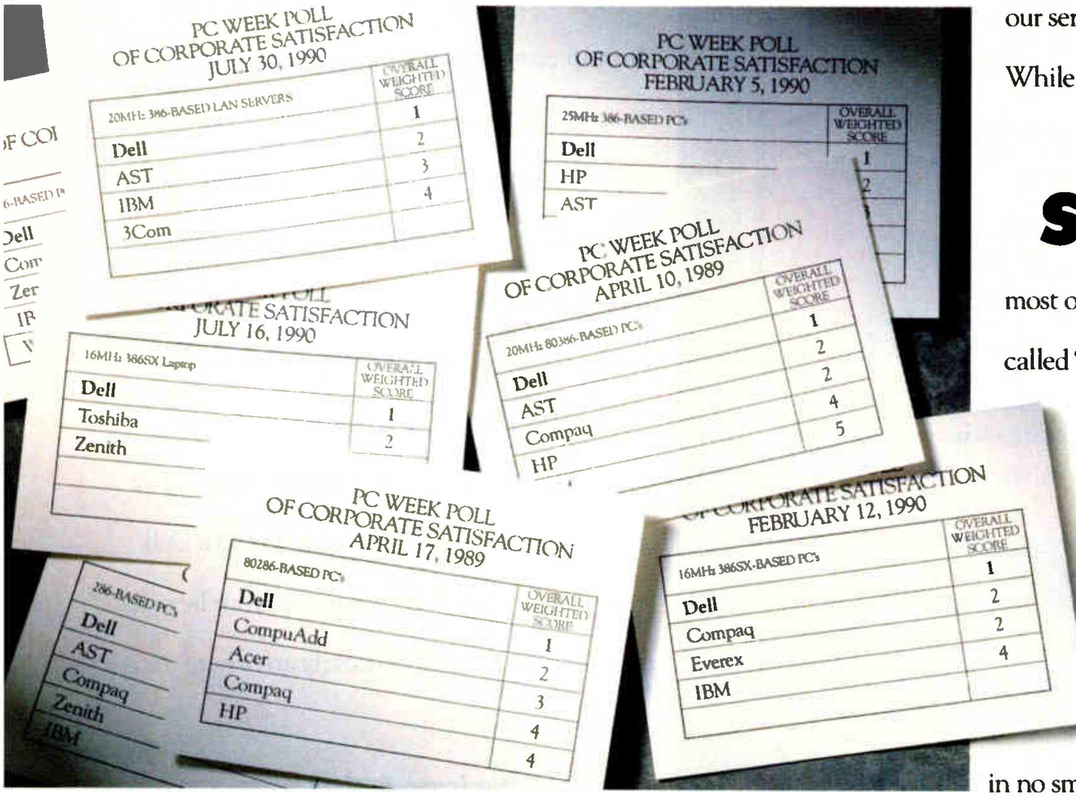

most of our competition is often called "non-existent."

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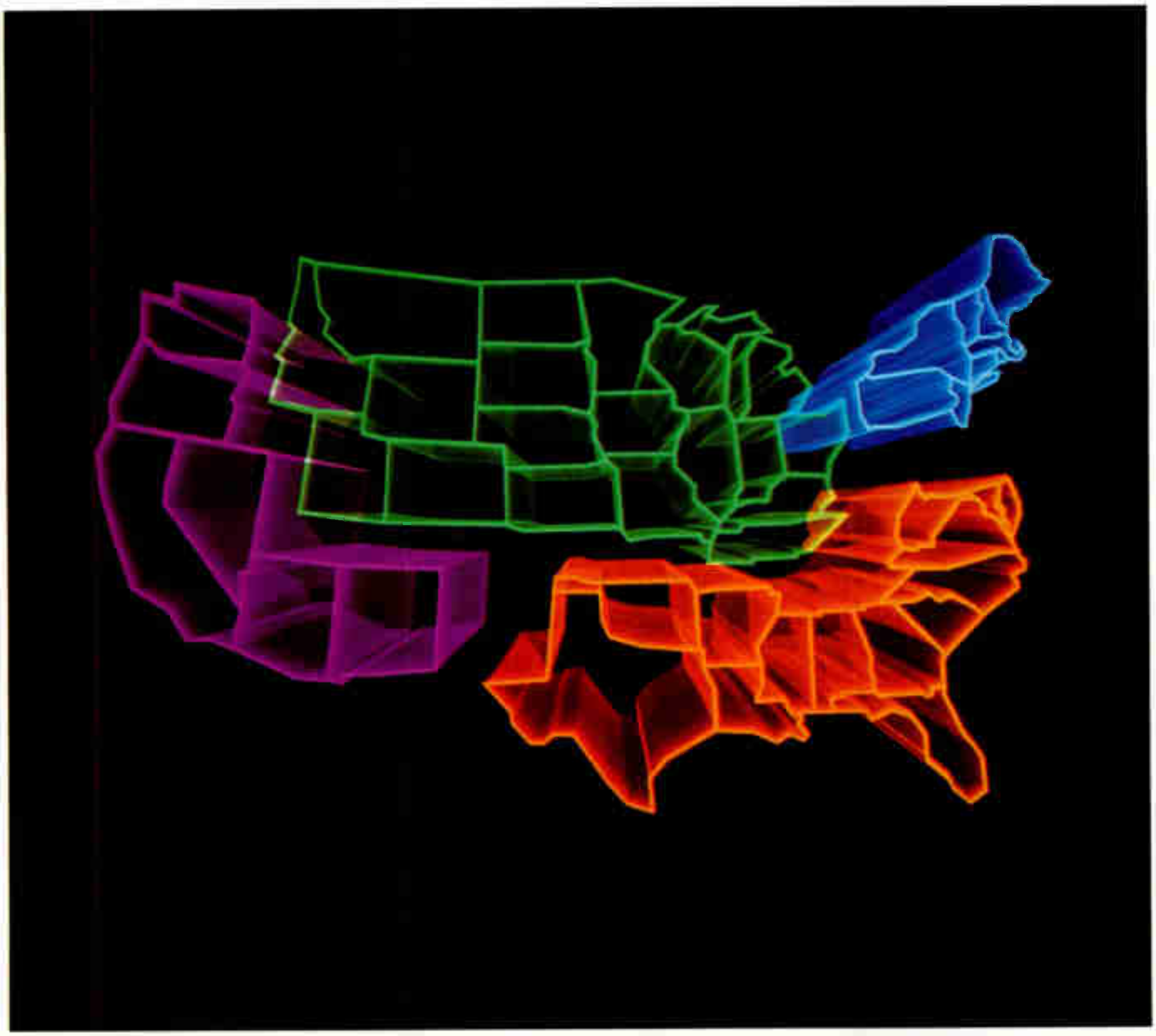

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Computer Users Group Newsletters Are Honored

Newsletters from 10 computer users groups received awards at the Third Intergalactic User Group Officers Conference held in New York City last summer. The awards were sponsored by the BYTE Information Exchange (BIX), and judging was done by working magazine editors from New York City.

Winners from the northeast region include Best Coverage of Special-Interest Groups and Group Events (under 16 pages)—*PBCUG Communicator*, published by the Pemi-Baker Computer Users Group, Cindy Downing, editor; Best Features (between 16 and 32 pages)—*Westchester PC News*, published by the Westchester PC Users Group, Lang Murphy, editor. Contact: Pemi-Baker Computer Users Group, RFD 2, Box 399, Plymouth, NH 03264, (603) 536-3880. Westchester PC Users Group, P.O. Box 349, White Plains, NY 10602, (212) 326-4439.

Users Group Material Popular in the U.S.S.R.

Soviet personal computer users may be used to standing in line for a lot of things, but when representatives of U.S. computer users groups and computer industry leaders visited there earlier this year, there was a mad rush for information.

"We thought the Soviets would be orderly and would stand in line to get copies of the users group publications we brought to the conference in Moscow," Jerry Schneider, executive secretary of the Association of PC Users Groups (APCUG), told attendees at the Third Intergalactic User Group Officers Conference. "But when we put 200 copies of the publications on the table for the Soviet delegates to pick up, we were literally pinned against the wall as the Soviets charged the table to grab what they could."

Schneider was later told by one of his Soviet hosts that when you discover after standing in line for a long time that there is often nothing waiting for you at the end, you learn to get what you can, when you can.

Schneider said he was amazed at the vast desire for information about computers in the Soviet Union and that the Soviets had difficulty in understanding the concept of users groups.

"There was one booth with the words 'Users Group' on it, and when we approached them about getting involved with APCUG, they tried to sell us software," Schneider said. "Their concept of users group was a company. We had to explain that a users group in the U.S. was more like a university, and that people came together to learn and to share knowledge. They had difficulty understanding."

Even more difficult for the Soviets, Schneider indicated, is obtaining paper to print

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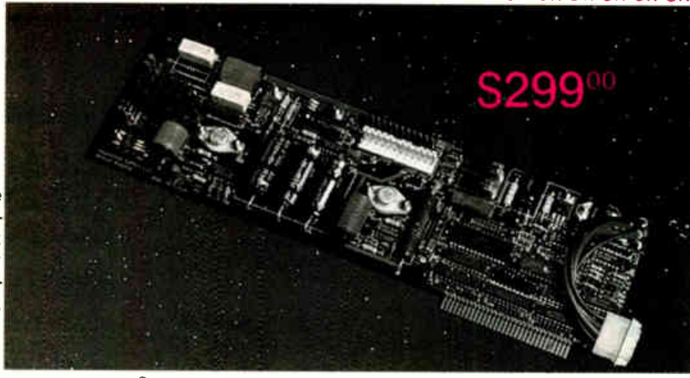

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journals about computing. Most of the publications about computers in the Soviet Union are published in Finland or West Germany.

Schneider and Jim Moody, Borland's users group coordinator, said it wasn't only paper products for publishing that were lacking in the Soviet Union. The common paper products they found in hotels were of less-than-desirable quality.

If the concept of users exchanging information in users group meetings was foreign to the Soviets, the very idea that users could use a common telephone line to call and exchange information with other users was even more amazing.

"They almost couldn't comprehend that we were connected with just a telephone line to a computer in the U.S. when we projected on a large screen the APCUG bulletin board," Moody said. "Anyone who has used the Soviet telephone system could understand why they were amazed. We worked for hours to get the hookup and only got on-line just a couple of minutes before our session was scheduled to begin, which was a bit too close for my comfort."

—David Reed

Users Groups Getting Involved in Community Service

Computer users groups are doing more than just sitting around and talking about the latest microprocessor. For many, community service is a standard activity.

Several groups spoke of their efforts to bring their computer skills to public service at the Third Intergalactic User Group Officers Conference.

Non-Profit Computing, a group affiliated with the New York PC Users Group, attempts to help put nonprofit community organizations in touch with local computerists willing to volunteer their time.

Non-Profit Computing also solicits donations of used computer equipment from companies wanting tax write-downs for their donations and finds nonprofit organizations in need of such equipment.

"Many groups will come and say they need new computers like 386s and 486s," explained Joanne Malbin, volunteer coordinator for the group. "But that's not going to happen. We try to match people up with existing donated equipment." For example, Non-Profit Computing recently received a donation of 250 DisplayWriters from a law firm that was updating its equipment.

Over the last six years, Non-Profit Computing has worked with more than 1000 nonprofit organizations through donations of equipment, monthly hands-on problem-solving meetings, and workshops on using equipment.

Other users groups also conduct public service work. The Boston Computer Society, for example, has a volunteer clearinghouse.

—David Reed

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LC-890XL 300 dpi PostScript	3699.00
Colormate PS PostScript color printer	6999.00

NewGen (Hi-Res PostScript Laser)

TurboPS/480 800 x 400 dpi	$5695.00

QMS Laser Connection

QMS-810 300 dpi PS Laser	$2995.00
QMS-810 Turbo - blazing fast	3995.00
QMS PS-410 300 dpi, 3 active ports, autoswitch between PCL & PostScript	CALL

Desktop Publishing Monitors & Video Controller Cards

Elite Business Systems — 2-page DTP monitor
Comes with 19" 1280 x 1024 pixel hi-res monitor, cable, controller card, software drivers, manual, Windows 3.0 compatible, 3-year warranty.

DesignView/19E	$1595.00

Hercules — 1024 x 768 resolution, 24-bit color

Hercules Graphics Station	699.00

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MONITERM — 2-Page DTP monitors
Moniterm monitors come complete with cables, controller card, and software drivers.

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NEC Color Monitors

Multisync 2A 14" (800 x 600 res)	$479.00
Multisync 3D 14" (1024 x 768 res)	659.00
Multisync 4D 16" (1024 x 768 res)	1269.00
Multisync 5D 20" (1280 x 1024 res)	2399.00
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Circle 596 on Reader Service Card (RESELLERS: 597)

A Trackball for Every Environment

A new version of the Mouse-Trak trackball input device specially designed for use in harsh environments is now available from ITAC Systems.

The Mouse-Trak Model M5-IND is made of 5 percent glass-filled Lexan 500, the same material used in bulletproof glass. A Mylar ring around the ball opening guards against dust and debris. In addition, the circuit board electronics have a water-resistant coating.

Like its desktop counterpart, the Model M5-IND has user-definable input keys and speed controls. It interfaces by a single connection to a wide range of systems, including those from Apple, IBM, DEC, Sun, and Apollo.

Price: $295.
Contact: ITAC Systems, Inc., 3121 Benton St., Garland, TX 75042, (214) 494-3073.
Inquiry 1169.

The Mouse-Trak Model M5-IND's electronics have a conformal coating to protect it when used in high-moisture areas.

Compare and Check AutoCAD Drawings

AutoSight Compare provides several ways of comparing different CAD drawings and different versions of the same drawing.

The program displays changes using composite, net difference, overlay, and split-screen methods.

The composite method provides you with a color-coded display of the different and common elements of drawings. With the net difference method, all common elements are erased, showing changes only. The split-screen method displays drawings side by side, while the overlay method stacks multiple drawings on top of each other. You can also turn layers on and off.

AutoSight Compare supports DWG and DXF CAD file formats on the IBM PC or higher.

Price: $399.
Contact: AutoSight, Inc., P.O. Box 362086, Melbourne, FL 32936, (407) 242-5865.
Inquiry 1170.

New Version of Disk Duplicating Software

EZX Publishing says that its EZ-Copy Plus disk duplication program offers an alternative to expensive dedicated systems. Version 1.3 of the program supports serialization and label printing during duplication, according to the company.

EZ-Copy Plus supports 3½- and 5¼-inch formats, including 720K-byte, 1.2-megabyte, and 1.44-MB disks. In addition to printing serialized labels as it embeds serial numbers into disks, EZ-Copy Plus can print serial numbers off-line. The program includes routines for rejecting marginal disks, the company says.

EZX recommends either a hard disk drive, extended memory, or expanded memory for your IBM PC or higher.

Price: $495 for up to 10 machines.
Contact: EZX Corp., P.O. Box 58177, Webster, TX 77598, (800) 359-9539 or (713) 280-9900.
Inquiry 1171.

Expert Help Alternative to Norton Guides

The Expert Help Hypertext Search Engine and KnowledgeBase Composer, which SofSolutions offers as an alternative to the Norton Guides collection of pop-up TSR manuals for programmers, runs in less than 1K byte of main memory. The company reports that the engine is compatible with Norton Guides, while offering global search with automatic lookup, text cutting and pasting, and support for electronic notes. The program supports EMS and can pop up over graphics, according to the company.

With the program's composer, you can transform text files into KnowledgeBase or Norton Guides format and transform KnowledgeBases back into their original files. This lets you create and edit both Guides and KnowledgeBases.

In addition to the engine, the company offers a developer's kit for distributing KnowledgeBases that you create without royalty.

Price: Expert Help, $79; Expert Help Developers Kit, $199.
Contact: SofSolutions, 440 Quentin Dr., San Antonio, TX 78201, (800) 325-6820, ext. 7 or (512) 735-0746, ext. 7.
Inquiry 1172.

180 Maps and Landmarks for the Mac and IBM PC

Marketing Graphics' latest library of PicturePak clip art includes state maps (with and without county distinction), maps of 10 metropolitan areas, and landmarks that represent each state. The library is available in dual CGM/PCX file format for the IBM PC and in MacPaint and MacDraw II format for the Mac.

The company also has clip-art libraries for executive and management, finance and administration, and sales and marketing. The company's USA Series includes images for federal, state, and local government.

Price: $145.
Contact: Marketing Graphics, Inc., 4401 Dominion Blvd., Suite 210, Glen Allen, VA 23060, (804) 747-6991.
Inquiry 1173.


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5200SX	386-16	2x16 Bit	VGA GAS plasma	3.5/1.44	40MB IDE	YES	8MB	$2999
5200NV	286-16	2x16 Bit	VGA GAS plasma	3.5 1.44	40MB IDE	YES	8MB	$2399

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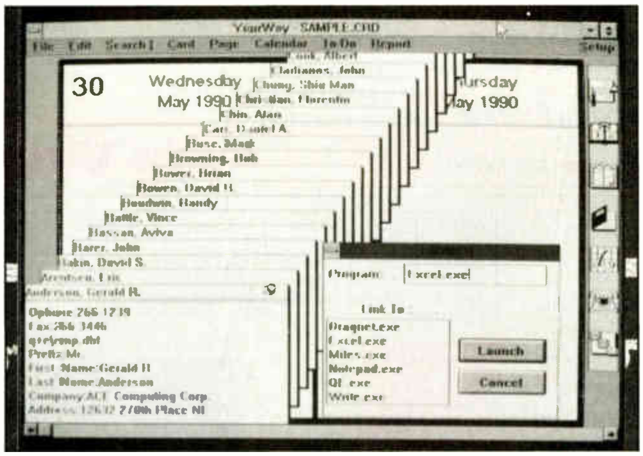
Have It Your Way

Prisma Software says that YourWay lets you organize a personal productivity workstation under Windows with a program launcher, exchanging data through the Clipboard via Dynamic Data Exchange.

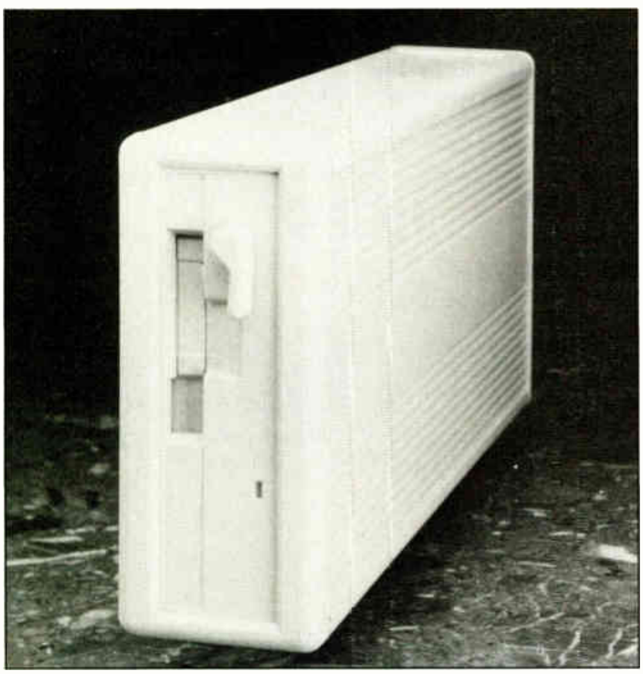
With YourWay, you organize sales contacts in a 3-D card file. The company says that it designed the YourWay word processor to support easy form-letter generation. Other features of the program include a calendar, customizable dictionary, to-do clipboard, report generator, and automatic dial. The application launcher supports Windows- and character-based applications.
Price: $289.
Contact: Prisma Software Corp., 2301 Clay St., Cedar Falls, IA 50613, (800) 373-0241 or (319) 266-7141.
Inquiry 1174.



With YourWay, you manage information with desktop objects that resemble card files, pages, calendars, a to-do list, and columnar reports.

High-Precision Backup for the Mac

Braemar says that the SX150 external tape backup subsystem for the Mac can back up 155 MB of data in less than 25 minutes. You can choose between file-by-file and mirror-image backup.



Braemar says that its SX150 can back up 155 MB of data in less than 25 minutes when used with a reliable low-cost cassette.

The SX150 uses three methods to ensure the integrity and readability of backed-up data. Read-while-write reads data as it is written, and micropositioning of the read head aids the success of retries. Special motors and tape guides are intended to keep the tape tensed and on track.

The menu-driven software provides a progress indicator and a cataloging feature for searching through previous backup sessions. A calendar helps you program unattended archiving.

In addition, the SX150 lets you select SCSI addresses via a rear-mounted push button.
Price: $749.
Contact: Braemar Corp., 11400 Rupp Dr., Burnsville, MN 55337, (612) 890-5135.
Inquiry 1176.

Check Candidates' Environmental Voting Records

If you want to consider a candidate's record on environmental issues before you vote in the fall congressional elections, Save the Planet can help by letting you compare records of all members of Congress for the 1989 legislative session.

In addition to providing a database on politicians' voting records, the program includes information on ozone-destroying chemicals, atmospheric chemistry, and climate-change modeling. A global-warming model illustrates the ecological trade-offs associated with the timing of greenhouse-effect policy decisions.

Save the Planet is available for the Mac and IBM PC.
Price: $15.
Contact: Save the Planet Shareware, P.O. Box 45, Pitkin, CO 81241, (303) 641-5035.
Inquiry 1177.

Calculator for Scientists, Engineers

You can use the Q.E.D. calculator for mathematical, scientific, statistical, and financial operations, according to DigiCorp. All operations are performed in double precision for accuracy, and the calculator supports a math coprocessor if one is present in your IBM PC.

Q.E.D. retains your last 180 lines of operations. With Q.E.D., you can save data in ASCII format for transferring to spreadsheets and word processors. Other features include a 15-register memory and a line editor for labeling.

You can program Q.E.D. in BASIC, BASICA, or GWBASIC. Q.E.D. requires 256K bytes of RAM; 365K bytes is recommended.
Price: $59.95.
Contact: DigiCorp, 6925 Union Park Center, Suite 145, Midvale, UT 84047, (800) 825-9085 or (801) 562-2625.
Inquiry 1175.

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- Landmark = 16.0 MHz - Norton SI = 15.4x
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Hard Drives: MB/Ms	20/40	42/28	65/28	80/18	105/18
No Video	$749	$849	$949	$1,149	$1,249
Mono	$874	$974	$1,074	$1,274	$1,374
VGA-Mono	$1,049	$1,149	$1,249	$1,449	$1,549
SVGA	$1,299	$1,399	$1,499	$1,699	$1,799
Hires	$1,399	$1,499	$1,599	$1,799	$1,899

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Standard System Features plus:

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386SX/16 System Features, Hard Drive, Monitor & Video Card

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No Video	$1,049	$1,149	$1,349	$1,449	$1,799
Mono	$1,174	$1,274	$1,474	$1,574	$1,924
VGA-Mono	$1,349	$1,449	$1,649	$1,749	$2,099
SVGA	$1,599	$1,699	$1,899	$1,999	$2,349
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for 64 KB Cache, add $300

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Mono	$1,674	$1,774	$1,974	$2,074	$2,424
VGA-Mono	$1,849	$1,949	$2,149	$2,249	$2,599
SVGA	$2,099	$2,199	$2,399	$2,499	$2,849
Hires	$2,199	$2,299	$2,499	$2,599	$2,949

386/25 Super VGA System *$2,199*

- 386/25 Standard System
- 42 MB Hard Disk w/Quick 28 ms Access Time
- Second 5.25" 1.2 MB or 3.5" 1.44 MB Diskette Drive
- High Performance 16-bit 512K VGA Graphics Card w/1024 x 768 Capability
- 14" Color Super VGA Monitor with 800 x 600 Resolution and 0.31 dot pitch
- DOS 3.30 or 4.01 Included

386/33C Standard System *$1,699*

Standard System Features plus:

- Intel 80386DX Processor running at 33 MHz
- 1 MB RAM Standard (Expandable to 8 MB RAM)
- 64 KB Static RAM Cache for Increased Performance
- 7 Million Instructions Per Second (MIPS) Operation
- Landmark = 56.0 MHz - Norton SI = 45.9x
- AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

MICROCOM 386/33C

386/33C System Features, Hard Drive, Monitor & Video Card

Hard Drives: MB/Ms	42/28	65/28	80/18	105/18	205/18
No Video	$2,049	$2,149	$2,349	$2,449	[illegible]
Mono	$2,174	$2,274	$2,474	$2,574	$2,924
VGA-Mono	$2,349	$2,449	$2,649	$2,749	$3,099
SVGA	$2,599	$2,699	$2,899	$2,999	$3,349
Hires	$2,699	$2,799	$2,999	$3,099	$3,449

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- Landmark = 117.0 MHz
- AMI BIOS with MS-DOS, OS/2, XENIX, UNIX, Novell, Windows & 386-Specific Software Support

MICROCOM 486/25C

486/25C, System Features, Hard Drive, Monitor & Video Card

Hard Drives: MB/Ms	80/18	105/18	205/18	340/18	650/16
No Video	$4,949	$5,049	$5,399	$6,099	$7,099
Mono	$5,074	$5,174	$5,524	$6,224	$7,224
VGA-Mono	$5,249	$5,349	$5,699	$6,399	$7,399
SVGA	$5,499	$5,599	$5,949	$6,649	$7,649
Hires	$5,599	$5,699	$6,049	$6,749	$7,749

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- 1MB Memory on Board (To 8MB)
- VGA Graphic Card (256K, 800x600 Res.) (512K, 1024x768 Res. + $50) External Monitor Adaptor
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- Carrying Bag. Weight 27 Lbs.
- Dimensions: 17.5(W) x 14.1(D) x 6.8(H)
- 7 expansion Slots Model Optional

$3,579 (Special)

HDD	286-12	386SX	386/25	386/33	486/25
40MB	2209	2469	2839	3189	4759
100MB	2599	2859	3229	3579	5149
150MB	2889	3149	3519	3869	5439
200MB	2969	3229	3599	3949	5519
345MB	3809	4069	4439	4789	6359

VGA AMBER CRT PORTABLE 100MB AT

- Built-in 9" Amber VGA Monitor
- Speed Digital Display. 3 Drive Bays
- 205W P/S 110/220V. 4 Exp. Slots
- 86 Keyboard, Detachable Keyboard + $30
- AT 12 MHz System, 1MB Memory (To 4MB)
- VGA Graphic Card (256K, 800x600 Res.)
- Run 48 Grey Scales VGA Internally Run Color VGA Externally
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- Carrying Bag. Weight 26 Lbs
- Dimensions: 17.5 (W) x 14.1 (D) x 6.8 (H)

$1,869

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1479	1739	2109	2459	4029
65MB	1589	1849	2219	2569	4139
100MB	1869	2129	2499	2849	4419
150MB	2159	2419	2789	3139	4709
200MB	2239	2499	2869	3219	4789
345MB	3079	3339	3709	4059	5629

AMBER CRT PORTABLE 100MB AT

- Built-in 9" Amber Monitor
- Speed Digital Display. 3 Drive Bays
- 205W P/S 110/220V. 4 Exp. Slots
- 86 Keyboard, Detachable Keyboard + $30
- AT 12 MHz System, 1MB Memory (To 4MB)
- Mono or Color Graphic Card
- Amber EGA Display (option) + $100
- 1.2 MB or 1.44 MB Floppy Drive
- 100MB 25ms Hard Drive
- Carrying Bag Weight 26 lbs.
- Dimensions 17.5(W) x 14.1(D) x 6.8(H)

$1,599

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1209	1469	1839	2189	3759
65MB	1319	1579	1949	2299	3869
100MB	1599	1859	2229	2579	4149
150MB	1889	2149	2519	2869	4439
200MB	1969	2229	2599	2949	4519
345MB	2809	3069	3439	3789	5359

COLOR EGA CRT Portable Available

386-33 100MB VGA PLASMA PORTABLE

- 640x480 VGA Plasma Display
- Detachable 101-key Keyboard
- 200W P/S, 110/220V. 3 Drive Bays
- 386-33 MHz CPU, w/64K Cache Memory
- 1MB Memory on Board (To 8MB)
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial and Parallel Ports
- External Monitor Adaptor
- Carrying Bag. Weight: 26 Lbs.
- Dimensions: 16"(W) x 9.75"(H) x 8.5"(D)

$3,349

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1979	2239	2609	2959	4529
65MB	2119	2379	2749	3099	4669
100MB	2369	2629	2999	3349	4919
150MB	2609	2869	3239	3589	5159
200MB	2699	2959	3329	3679	5249
345MB	3499	3759	4129	4479	6049

CGA PLASMA PORTABLE 100MB AT

- 640X400 CGA Plasma Display
- Detachable 86-Key Keyboard
- External RGB Monitor Adaptor

$1,829

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1439	1699	2069	2419	3989
65MB	1579	1839	2209	2559	4129
100MB	1829	2089	2459	2809	4379
150MB	2069	2329	2699	3049	4619
200MB	2159	2419	2789	3139	4709
345MB	2959	3219	3589	3939	5509

CGA LCD PORTABLE 100MB AT

- 640X200 Res. Backlit LCD CGA Display
- 640x400 Res. CGA Display + $110
- 200W 110/220V P/S. 6 Exp. Slots
- Detachable 86-Key Keyboard
- AT 12MHz System, 1MB Memory (To 4MB)
- 1.2MB or 1.44MB FDD
- 100MB 25ms HDD (To 500MB)
- Serial/Parallel/Game Ports
- External Monitor Adaptor
- 16"(W) x 9.5"(H) x 7.5"(D), 23Lbs

$1,519

HDD	286-12	386SX	386/25	386/33	486/25
40MB	1139	1399	1769	2119	3689
65MB	1249	1509	1879	2229	3799
100MB	1519	1779	2149	2499	4069
150MB	1749	2009	2379	2729	4299
200MB	1829	2089	2459	2809	4379
345MB	2609	2869	3239	3589	5159

- EGA LCD PORTABLE GENOA Model + $340 (Run 386 Window and Unix)
- EGA LCD PORTABLE YAMAHA Model + $210
- VGA LCD PORTABLE AVAILABLE CALL

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Circle 589 on Reader Service Card (RESELLERS: 590)

286-12	All Systems Include:	386-20
$1,499 Landmark = 16 MHZ	• 100% IBM Compatible • AMI BIOS • 2 MB 0 Wait State RAM • Math co-processor support • Clock/Calendar w/battery • Intel CPU running at true rated speed • 8 expansion slots • 1.2 MB 5¼″ floppy drive • 1.44 MB 3½″ floppy drive • 2 serial/2 parallel/1 game port • 101 key enhanced keyboard • UNIX/XENIX/NOVEL/OS2 Support • 40 MB 24 MS Hard Drive • 1024 x 768 16 bit VGA Card/ 512 K • 1024 x 768 VGA Monitor	**$1,999** Landmark = 27 MHZ
286-16		**386-25 CACHE**
$1,599 Landmark = 21 MHZ		**$2,599** Landmark = 45 MHZ
386-SX16		**386-33**
$1,799 Landmark = 21 MHZ		**$2,999** Landmark = 58 MHZ
386-SX20		**486-25**
$1,899 Landmark = 24 MHZ		**$3,699** Landmark = 113 MHZ

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The First Compiler for Symphony

With Composa, you can compile applications created with Symphony, Lotus's integrated business program, into stand-alone executable files. Composa supports both formulas and macros. You can use the program to add pull-down menus for the end user, set application title pages, and assign different foreground and background colors.

Composa supports all Symphony functions, including spreadsheet, database, word processor, communications, and graphing. The compiler uses minimum recalculation technology and expanded and virtual memory. It takes advantage of math coprocessors to make your application run faster than it would under Symphony, Sheng Labs says.

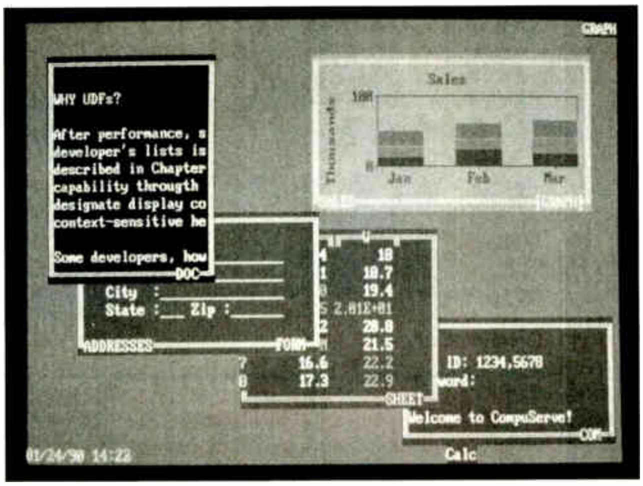
For sophisticated developers, Composa lets you define specific functions in C or assembly that you can link into your executable file.

Composa runs on the IBM PC with 512K bytes of RAM and a hard disk drive.

Price: $795.

Contact: Sheng Labs, Inc., 4470 Southwest Hall St., Suite 282, Beaverton, OR 97005, (800) 548-1270 or (503) 646-3691.

Inquiry 1179.



Composa lets you compile Symphony applications that don't require Symphony to run. The compiler supports the spreadsheet, word processing, communications, and graphing functions of Lotus's integrated product.

Sticky Notes for HyperCard Users

Sticky Notes+ lets a HyperCard user place special notes on cards in stacks when extra space is needed. You can use the program to create note cards in the Sticky Notes+ stack for special references to cards in other stacks. The Notes let you go directly to the card referred to by a note card.

Price: $49.95.

Contact: Survivor Software, Ltd., 11222 La Cienega Blvd., Suite 450, Inglewood, CA 90304, (213) 410-9527.

Inquiry 1183.

Screen Saver for the Mac Prevents Boredom

When you leave your Mac keyboard or mouse untouched for a few minutes, the Protector Shark screen saver pops up an image of a shark and a diver doing battle on your screen.

In addition to acting as a screen protector, the utility acts as a game without requiring you to close your other applications. Ibis Software says that you can control the diver to shoot the shark. You help the diver evade the shark by moving the mouse and shooting spears with the space bar.

Protector Shark works on the Mac SE and higher.

Price: $49.95.

Contact: Ibis Software, 90 New Montgomery, Suite 820, San Francisco, CA 94105, (415) 546-1917.

Inquiry 1181.

UPS Card Provides Power Backup

Dakota Microsystems has put an uninterruptible power supply (UPS) on an add-in board that plugs into a single PC-bus slot.

The PowerSave card has a nickel-cadmium battery pack on one end and an intelligent subsystem on the other. The batteries provide 200 W of power, and they can be recharged hundreds of times. Unlike external UPSes, which monitor only AC power input, the PowerSave sits on the PC's bus, downstream from the system's power supply, and works if either source fails.

If internal DC power falls below 4.75 V, the PowerSave senses the problem and takes over within 2 ms, the company says. After supplying full power for 2 seconds, PowerSave's on-board microprocessor initiates a shutdown sequence.

Price: $339.95.

Contact: Dakota Microsystems, 301 East Evelyn Ave., Building A, Mountain View, CA 94041, (800) 999-6288 or (415) 967-2302.

Inquiry 1182.

Save a Tree with LaserJet Utility

A new version of TreeSaver, the utility for LaserJet printers that lets you print two or four pages on a single sheet of paper, now supports applications using Compugraphic or Bitstream font-scaling technology. TreeSaver reduces the amount of paper, toner, and copying necessary for documents. It also helps reduce postage, fax, and storage costs. You can use it to reduce full-size pages to fit personal organizers.

TreeSaver 2.0 automatically scales soft fonts, reducing their size by 40 percent and then rotating them 90 degrees so that each page fits on half a sheet. The program can also reduce a letter-size page—in 5 percent increments—to a percentage that you specify.

Version 2.0 includes a font utility program for downloading TreeSaver's 27-character-per-inch font and 16-cpi Courier font. Discoversoft says that documents printed in double mode with the Courier font more closely resemble true photo reductions. The serif Courier font is also more readable than the LaserJet's Line Printer font, the company says. The 27-cpi font lets you print reports two to a page, even when they are already in compressed format.

Discoversoft offers versions for the DeskJet and DeskJet Plus.

Price: $89.95.

Contact: Discoversoft, Inc., 1516 Oak St., Alameda, CA 94501, (415) 769-2902.

Inquiry 1180.

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80286 (BATTERY)

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$1699 20 MB

$1899 40 MB

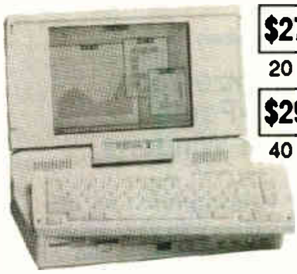
- 80286-12 Microprocessor, 12/6 MHz; 80287-8 Co-Processor socket is optional
- 2 - 2/3 Exp. Slots (one 16-bit bus and one 8-bit bus)
- 1.44 MB Floppy Disk Drive, 20 MB 28ms Hard Drive
- 1 MB RAM standard on board (optional 2 MB/5MB) extendable to 16 MB, 64 KB ROM with setup utility
- 1 parallel port, 2 serial ports

LA3540

$2199

- 80C286 Microprocessor, 6/20 MHz; 80C287 Co-Processor optional
- 1 MB RAM expandable to 5 MB
- 1.44 MB 3.5" Floppy Disk Drive
- B & W CCFT supertwist LCD, 640 x 480, External MDA/ CGA/EGA/ and VGA Display Compatible
- 81/82-key low profile keyboard

LP-286C



$2795 20 MB

$2995 40 MB

- 80C286 Microprocessor, 16/8 MHz; 80C287 CoProcessor
- 1 MB RAM expandable to 8MB
- 1.44 MB Floppy Disk Drive, 20/40 MB Hard Drive
- 32 Gray, LCD, 640 x 480 VGA Display
- 86 Key Detachable Keyboard

80386SX (BATTERY)

LA5040

SERVICE PLEDGE GOVERNMENT COMPUTER NEWS

$2499

- 80386SX Microprocessor, 6/20 MHz; 80387SX CoProcessor optional
- 1 MB RAM expandable to 5 MB
- 1.44 MB 3.5" Floppy Disk Drive
- B & W CCFT supertwist LCD, 640 x 480, External VGA, EGA, and Double Scan CGA
- 81/82-key low profile keyboard

80286 (AC ONLY)

LP-286B

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- 80286 Microprocessor, 16/8 MHz; 80287 CoProcessor
- 1 MB RAM expandable to 5 MB
- 1.44 MB Floppy Disk Drive, 40 MB 28 ms Hard Drive
- One parallel port, two serial ports
- Gas Plasma, 640 x 400 EGA/CGA/MDA Display
- 85 Key Keyboard

80386SX (AC ONLY)

LP-386SX

$2995 40 MB

- 80386SX Microprocessor, 16/8 MHz; 80386SX-16 CoProcessor
- 1 MB RAM expandable to 5 MB
- 1.44 MB Floppy Disk Drive, 40 MB 28 ms Hard Drive
- One parallel port, two serial ports
- Gas Plasma, 640 x 480 EGA/CGA/MDA Display
- 85 Key Keyboard

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Circle 587 on Reader Service Card (RESELLERS: 588)

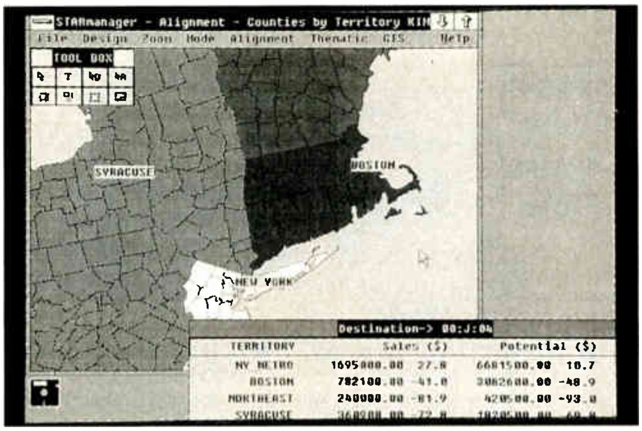
Organize Your Sales Force Under Windows

StarManager lets you organize your sales force by letting you view maps and their associated sales data.

The program uses area codes as its most basic sales unit. When you group the area codes into sales regions, you can analyze territories using what-if scenarios. You can link the map and spreadsheets so that changes in one are reflected in the other.

The program accepts data in dBASE, Lotus 1-2-3, and ASCII formats. StarManager can support up to 15,000 ZIP codes, while an advanced version can handle all the ZIP codes in the U.S.

Price: StarManager, $595; StarManager Advanced, $1995.
Contact: TTG, Inc., 10 State St., Woburn, MA 01801, (617) 932-6500.
Inquiry 1163.



By viewing both maps and underlying data, you can equitably distribute sales opportunities and solve problems like overlap and highway access with StarManager, TTG says.

Augment Manuscript SCT Files with SCED

Version 1.1 of SCED, a program for annotating and editing screens captured with Lotus Manuscript's screen-capture text (SCT) utility, lets you preview how a screen or printed output will appear after Manuscript has converted it from a full-color display.

You can use the global color change option to change all characters of a certain color to one of the five Manuscript-supported text attributes—normal, reverse video, bold, underline, or bold underline—for better print contrast, according to developer S/Wizardry. You can also limit color changes to a connected set or block of characters.

SCED lets you edit and annotate screens captured with the SCT utility, adding boxes and arrows for emphasis. You can use SCED to create screens from scratch for use in proposals and prototype documentation. SCED also converts SCT files into ASCII for use in other programs. SCED can parse captured screens from Irma session logs from one file to individual SCT files for use in Manuscript.

Price: $45.
Contact: S/Wizardry, Ltd., Division II, 329 North State St., Orem, UT 84057, (800) 336-6644 or (801) 227-5000. For technical inquiries: P.O. Box 869, Troy, NY 12180, (518) 273-5025.
Inquiry 1167.

A Database for Poets

If you're a poet or writer, one of the problems in sending out submissions is making sure you don't send simultaneous submissions to a publisher who doesn't accept them. A program called Fame lets you track the poems and stories you write, the publisher you sent them to, a submission's status, and which articles are available for submission, factoring in whether or not the publisher accepts simultaneous submissions.

The program requires 256K bytes of RAM on the IBM PC. If you buy the program, you need to send a disk and a self-addressed envelope.

Price: $15.
Contact: Fame Program, 10 Nancy Lane, Framingham, MA 01701, (508) 877-0214.
Inquiry 1165.

Store Planning and Design with AutoCAD

With StorePlan 1.1 from Graphic Systems and AutoCAD, you can produce retail store designs and layouts and generate perspective views of a finished design from any angle, StorePlan's developer reports. The program includes databases for tracking how much square footage each department in a store occupies, the types of finish materials and their costs, fixtures, and the types of furniture a store uses to display its wares. As you modify your design, the corresponding databases and reports are updated.

StorePlan works with AutoCAD release 10 or higher on the IBM PC. The company is beginning work on a version for the Mac.

Price: $1495.
Contact: Graphic Systems, 74 Varick St., Suite 203, New York, NY 10013, (212) 941-5572.
Inquiry 1164.

Interpret Statistical Results with Executstat

A new version of Executstat, a program designed for general business users who use statistical analysis for research, forecasting, and quality assurance, includes an interpreting feature that explains statistical results to someone who's not a statistics expert.

After Executstat 2.0 displays its results, the Interpret feature explains them in a short paragraph. A hypertext help system explains statistical concepts.

Executstat combines numerical analysis with graphing. Supported graph types range from simple *x*, *y* plots to dynamically rotating three-dimensional displays. Statistical analysis capabilities range from basic mean, median, and mode to coefficient of variance and multiple regression of up to 256 variables.

Executstat 2.0 runs on the IBM PC with 640K bytes of RAM and a hard disk drive.

Price: $295.
Contact: Strategy Plus, Inc., Five Independence Way, Princeton, NJ 08540, (609) 452-1345.
Inquiry 1166.

CORRECTION

Scope International's Job-Hunt (What's New Regional, August) requires only 256K bytes of RAM to run, not 360K bytes.

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- External SCSI Port
- 1 Parallel & 2 Serial Ports
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Options:

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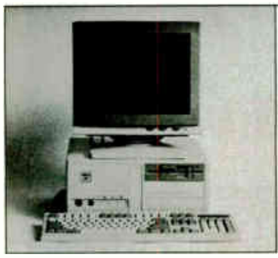

TECH™ 386SX $1,895

- 80386SX-16 CPU
- 1MB RAM expandable to 8MB on motherboard
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- 40MB IDE hard drive
- 16-bit VGA with 512K
- 14" 1024 x 768 VGA color monitor
- 1 parallel, 2 serial & 1 game ports
- 101 key keyboard
- MS DOS 3.3 or 4.01

TECH™ 286.........$1,495

- 80286-12 CPU
- 1MB RAM expandable to 8MB on motherboard
- 1.2MB 5¼" or 1.44MB 3.5" drive
- 40MB IDE hard drive
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- 14" 1024 x 768 VGA color monitor
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- 101 key keyboard
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PONI Microsystems 386SX-LT ...$2,995

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- 85 key keyboard
- External ports for floppy drive, keyboard and VGA monitor
- Parallel and serial ports
- UL, CSA, FCC-B approved

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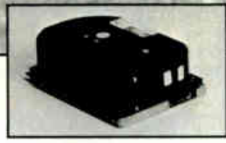

200MB, 3.5" High Performance Hard Drive Kits

MAXTOR LXT200A, IDE	$1,095.00
CONNER CP3204, IDE	1,095.00
IMPRIMIS 94351, IDE	1,095.00
MAXTOR, LXT200S, SCSI	1,395.00
CONNER CP3200, SCSI	1,395.00
IMPRIMIS 94351, SCSI	1,395.00

Each kit comes complete with 16-bit hard/floppy controller (SCSI kit comes with Adapter AHA 1542B, 16-bit 15MHz SCSI controller) • "1 to 1" interleave • 64K "Look Ahead" read buffer • cables • installation guide

High Performance 5.25" Hard Drives

MANUFACTURER/MODEL #		CAPACITY	DRIVE ONLY	DRIVE KIT
MICROPOLIS	MC1654	160MB	$ 995	$1,195
	MC1664	330MB	1,495	1,695
	MC1568	660MB	2,295	2,495
	MC1598	1.2GB	4,795	4,995
MAXTOR	T8380E	370MB	1,595	1,795
	XT8760E	680MB	2,395	2,595
	TAHITI	1GB	5,695	5,995
NEC	D5655	150MB	995	1,195

Each kit comes complete with Adapter AHA 2322 ESDI Controller for dual floppy/dual hard drives. All kits includes cables, mounting hardware; installation software and installation guide. Novell/XENIX drivers available. SCSI versions are available for additional $150.

High Performance 3.5" Hard Drives

MANUFACTURER/MODEL #		CAPACITY	DRIVE ONLY	DRIVE KIT
CONNER	CP3044	40MB	$ 365	$ 395
	CP3184	80MB	565	595
	CP3104	100MB	665	695
	CP3204	200MB	1,065	1,095
TEAC		40MB	365	395
SEAGATE	ST157A	44MB	335	365
TOSHIBA	MK234FC	100MB	655	685
IMPRIMIS	94356	105MB	655	695

SCSI versions available

Drive kit comes complete with 16 bit hard/floppy controller (SCSI kit comes with adapter AHA1542B, 16 bit, 15 MHz SCSI controller) • "1 to 1" interleave • "Look Ahead" read buffer • cables • installation guide.

Enhancement Products

NEC 2A VGA MONITOR 14"	$475
NEC 3D VGA MONITOR 14"	595
SCEPTRE VGA MONO MONITOR 14"	165
LOOP VGA COLOR MONITOR 14"	365
SCEPTRE TTL MONO MONITOR 14"	125
VGA CARD W/256K, 16-BIT	95
VGA CARD W/512K, 16-BIT	155
MONO GRAPHIC CARD W/P.P.	25
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1MB SIMM 80NS	75
2400B MODEM INT.	90

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Circle 598 on Reader Service Card

A Lesson in Maintenance

When you start getting enough errors to measure, it's time to pull out the toolbox

Sometimes I think I'm not very bright. Wait—that doesn't sound right. Before this degenerates into false modesty, what I mean is, sometimes I do things that if someone else did them, I'd say that the someone else was stupid.

At least this time it was instructive.

For the past few weeks, I've observed progressive flakiness in my Maximum Storage APX-4200 external optical WORM (write once, read many times) drive. Nothing fatal. No data lost. Just lots of retry errors, sometimes failure to copy to the WORM, sometimes failure to read data off a WORM cartridge, but trying a read or write later on another drive machine (we have two) shows the files are still intact and read fine. It was annoying rather than disastrous, and I didn't think about it much; which, if not stupid, certainly wasn't smart.

As I've said here before, I'm very fond of WORM drives; indeed, anyone whose microcomputer work is valuable should get a WORM, because unlike other backups, a WORM drive not only keeps all back copies of files—the obsolete versions you never need until after you erase them—but it's *used*. The best backup software is useless if it's inconvenient. A WORM is very convenient.

For example, while I'm writing this, I'm also doing a backup of this hard disk to the WORM drive; Maximum Storage's WORM software works just fine with Desqview, and a full backup going on in the background doesn't slow Q&A Write down a bit.

For historical reasons, the APX-5200, Maximum Storage's latest model, is attached to the Premier 9000 in the other room. (Maximum Storage also has an internal model, the APX-5100.) Each cartridge holds a gigabyte, and that drive gets used to back up every machine in the house. Incidentally, we usually use LapLink III for that. If the machines can be brought close enough together, we connect the parallel ports with the LapLink cable; otherwise, we use the DeskLink cable that lets us string telephone wire between computers and invoke LapLink III with the command line "LL3 /3"; this tells the program you've got only a three-wire connection. Either way, we have no trouble transferring files to and from the Premier 9000 and the APX-5200.

The earlier-model APX-4200 (which has 400 megabytes per cartridge side) is attached to my main machine, the Cheetah 386, which runs under Desqview. I have configured things so that the WORM drive is available in all Desqview windows, yet I can still have more than 520K bytes in a window. There's actually not much choice, since the Maximum Storage software must be loaded as part of CONFIG.SYS, unlike LAN and CD-ROM drivers, which can in part be loaded as command files.

On that score, my only criticism of Maximum Storage is that they don't have software that can use expanded memory. The software does work with Desqview's QEMM and LOADHI.SYS, which stuffs the WORM software into the extended-memory area between 640K bytes and 1 MB; but I do wish they could pack part of their system software up into expanded memory and get it out of the way completely.

Anyway, the APX-4200 was acting funny, and I ignored it, until one day it just didn't work at all. First it copied some stuff into the wrong subdirectory, and then attempts to access the drive got one or another DOS error message. Retries wouldn't cure the situation. I wasn't in a real panic, because I was sure the cartridge itself would be readable on the other machine, and besides, there was nothing wrong with the Cheetah's hard disk drive, anyway. Backup system problems are significant only when the primary system goes.

Still, I did want to be sure that the cartridge was all right, so I took it out of the drive with the intention of reseating it. You do that with a WORM drive by turning the drive off and back on while holding down the eject button.

The cartridge was quite warm to the touch.

Then I made stupid move number two. I tried to reseat that cartridge and read it again. It didn't work, so I pressed the eject button, and about then the significance of the cartridge's warmth sunk in. If the cartridge was too warm, what must the electronics be like? Time and past time to examine the system. The WORM drive sits on a shelf above my work area. I pulled the drive out from the wall, managing to knock a canister of pencils and pens on the floor, and tilted the drive forward so I could put a screwdriver to the cable screws.

The cartridge fell out and landed nose-down on the floor.

Don't Panic

I muttered—or shouted, actually—something to the effect that whenever I try to do anything, I must first do two other things, one of which is impossible, and retrieved the cartridge. It was a warm day, and I'd turned off all the machines not actually in use, so I had to fire up the Premier 9000 to read the cartridge on its WORM drive. It came up in DR DOS; we were testing that last night. Because it is very fast and very reliable and has the WORM drive directly attached, the Premier 9000 is a convenient machine to use for testing new software.

I put the cartridge into the Premier 9000's WORM drive. It wouldn't seat. A WORM cartridge has a metal shield that

continued

protects the media; it's something like the one on a 3½-inch floppy disk. That shield is held together with two little brads, and one of the brads was missing, having evidently been jarred loose when the cartridge fell 4 feet to the floor. It was impossible to find the brad, so I made one out of a small nail. I didn't have any tool capable of installing the brad in the proper way, but Krazy Glue took care of that. I let the glue dry and put the cartridge in the drive again. No problem. It read fine.

Since I wasn't sure that the last copies to that cartridge were correct—they appeared to be, but they were in the wrong subdirectory—I thought while I had the chance I'd create a new subdirectory into which I'd move all the files I was unsure of. Unfortunately, the command MD STUFF got an error message: "Unable to create directory."

Now what? The disk showed 114 MB free, so that sure wasn't the problem. Maybe, I thought, it's DR DOS. Whatever it was, all the files on the cartridge were readable, so I hadn't lost anything. Now back to examine the Cheetah's WORM drive.

I had a measurably high error rate with the APX-4200 WORM drive for more than a month, and I hadn't done anything about it. As I said, stupid.

Voices from the Past

It took about 1 second to spot the problem: the fan filter on the WORM drive was utterly clogged.

Longtime readers will recall that once before I had problems with another WORM drive, and when I took it apart, I found I had dust balls, dog and cat hair, and general crud inside the drive case. As a result, Maximum Storage redesigned the system, moving the fan and adding a fan filter. I'd long ago traded my first WORM for the new model—and immediately forgot about the design change.

Very longtime readers will remember Bill Godbout's Law: "If the error rate is high enough to measure, it's too high." He meant that when computers have problems there's a reason, and when the error rate is measurable, it's time to find the cause and fix it. With Godbout's CompuPro S-100 equipment, the almost invariable cause of the problem was a dirty fan filter. If you washed that at regular intervals, you never had difficulties.

I'd had a measurably high error rate with the WORM drive for more than a month, and I hadn't done anything about it. As I said, stupid. All I'd have had to do was *look* at the back of the drive case. I felt quite sheepish as I washed the fan filter, and for good measure I went looking for other machines that might have the same problem.

continued

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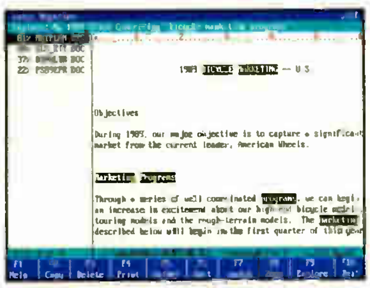

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For those who haven't looked into DOS arcana, DOS puts two 30K-byte hidden files on any disk that is to be used for booting DOS. They are, in essence, DOS itself.

Once I'd cleaned every fan filter in the house, I reconnected the APX-4200 and put in my field-repaired cartridge. It seated at once, and the drive happily reported the files intact. I did a file comparison on a couple of them. No problems. But when I attempted to create a new subdirectory, I got the "Unable to create directory" error.

Maximum Storage provides a test program with their machines. When I ran that, it reported that everything was in fine shape, but it couldn't do a write test because the disk was read only. I removed the cartridge and looked at it. Sure enough, the nosedive to the floor had jarred the disk's write-protect slides into the "protected" position. When I slid them back to read/write, everything worked fine.

For the rest of the afternoon, I did torture tests on the APX-4200. I initialized a fresh cartridge, created new subdirectories, and started copying the 200 MB or so from the Priam hard disk drive to the WORM. No problems. I also removed and reseated the field-repaired cartridge several times. No problems there, either.

The upshot is that I've got even more confidence in both the Maximum Storage WORM drive and the durability of WORM cartridges. I've also had a dramatic reminder of Godbout's Law.

DOS Wars

I'm not happy with DOS 4.01, and I'm not alone. Its major feature (other than the silly shell, but I don't know anyone who uses it) is the ability to recognize enormous disk drives, but you pay for that. Not only are there some incompatibilities with some programs using Rational Systems and Phar Lap Software DOS extenders, but DOS 4.01 is considerably larger than DOS 3.3. I've never experienced any of the incompatibilities, which mostly surface when running very large programs (particularly CAD), but I certainly do notice the extra size of the program.

One alternative we've tried at Chaos Manor is Digital Research's DR DOS 5.0, which has a number of neat features. It stuffs most of itself into high memory, allowing an enormous (up to 624K bytes) temporary program area (TPA). Also, it recognizes big disk drive partitions and comes with a lot of neat utilities. Alas, so far it also has problems. Not only are there timing errors with 486 machines, but we experienced difficulties with the Premier 9000, which is a 386/33. In both cases, the system creates a big TPA and has no problems at all with programs small enough to run in 624K bytes or less, but it can't find the rest of the expanded or extended memory.

Digital Research is working hard to fix those problems, and by the time you read this they may well have done it. That's the good news.

The bad news is that some of DR DOS 5.0 is written in C, and the primary programming is being done in England. I've noticed that just about every time I find a large program with known glitches that no one seems able to fix, that program is written in C and is likely written by a programming team in a remote location. However, I'd sure have more confidence in DR DOS 5.0 if it were being done in assembly by a team supervised by Gary Kildall. Bill Godbout once said Kildall was the best living assembly programmer, and I'm inclined to agree. Oh, well.

Meanwhile, there's Microsoft DOS 5.0, which is out in early beta testing and already has generated considerable enthusiasm from some third-party developers. It has many of the features of DR DOS 5.0, including a large TPA (about 635K bytes, last I heard), the ability to work with networks (including LANtastic), EMS memory management, and compatibility with Phar Lap Software, Rational Systems, and other DOS extenders.

I'm really looking forward to both DR DOS 5.0 and Microsoft DOS 5.0, and I'm very grateful for the competition. I like the way Microsoft competes by improving products rather than starting lawsuits; I wish Apple and Lotus would do that.

Meanwhile, we're still using DOS 3.3. Alex likes the Compaq MS-DOS 3.31

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that recognizes big disk drive partitions. "The best bits of DOS 4.0 without the warts," as he puts it. My Zenith machines have a Zenith MS-DOS 3.3 Plus that does the same thing. I think I'll go try that on the Premier 9000. . . .

Fooling About with DOS

Well, that was an interesting experiment.

My first move was to boot the Premier 9000 with a Zenith MS-DOS 3.3 Plus floppy disk. That worked fine, and I was able to get a directory and do CHKDSK on the Premier 9000's C drive. No problems. CHKDSK showed 150+ MB, with 65 MB free. Next thing, then, was to do SYS C:. That had worked, changing the Premier 9000 from DR DOS 5.0 to MS-DOS 4.01.

SYS told me there was no room on the Premier 9000's C drive. Still under Zenith MS-DOS 3.3 Plus, I went to the C drive and ran Norton Commander. It showed, interestingly, that I had not only the two DR DOS hidden files on the C drive, but also the corresponding pair from DOS 4.01. For those who haven't looked into DOS arcana, DOS puts two small (about 30K bytes) hidden files on any disk that is to be used for booting DOS. They are, in essence, DOS itself, and most of what we think of as DOS is the file COMMAND.COM, which they call. Anyway, there were four, not two, of those files, which looked a bit dangerous to me, so I used Norton Commander to erase them.

I like the way that Microsoft competes by improving their products rather than by starting lawsuits; I sure wish Apple and Lotus would do that.

At this point, of course, I had a machine that could be booted *only* with a floppy disk. I went back to the A drive and did SYS C: again. It appeared to work; the "system installed" message came on-screen, so I opened the floppy disk drive door and rebooted. The Premier 9000 flashed "no bootable partition."

By coincidence, Alex was here. He installed Compaq MS-DOS 3.31 on the Cheetah Gold 486 and was now in theory testing the system, which actually means that he was playing the insidiously seductive Railroad Tycoon game. Mind you, this is a pretty good test, since it uses a lot of memory, does a lot of calculation, and really wrings out the video system.

Anyway, Alex stopped building beer trains (he's running the England scenario) long enough to say, "Boot up with the DOS you want to install, go to Norton Disk Doctor, and do the 'make bootable disk' option." Alex went back to the Brighton-to-Canterbury run while I did that.

Norton Disk Doctor reported success.

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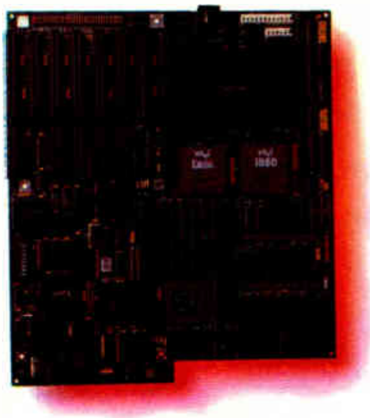

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Circle 129 on Reader Service Card

I rebooted. "No bootable partition," the system reported. That got Alex away from the trains long enough to use SpeedStor (one of the more essential DOS tools to have around, because when you need it, you need it *bad*). SpeedStor reported that Zenith's DOS didn't know that it can do large partitions. Of course that's wrong, and we don't have that problem on Zenith machines; but it's what we were told. Probably has to do with being halfway between DOS 3.3 and 4.01; it isn't reporting what SpeedStor wants to hear.

Enough, I decided, and I got out the Premier 9000's "Panic Disk." This is a floppy disk that brings the machine up complete with all the drivers, so that the system can find all its disk drive partitions, WORM drives, high memory, and suchlike. I have one of these for every machine in the house, and if you haven't made yours, stop reading this and go make one now. While you're at it, clean all your fan filters. I'll wait.

Once the Panic Disk booted the Premier 9000 with DOS 4.01, I used Norton Disk Doctor to make the C drive bootable and pressed the reset button. All's well, and I'm back where I started earlier today.

The moral of this story is: first, make a Panic Disk for your machine. Second, have Norton Disk Doctor around. You don't want to use it indiscriminately, but for some operations it's extremely convenient.

Finally, Zenith doesn't recommend their MS-DOS 3.3 Plus for non-Zenith machines, and neither do I. It's rock solid on Zenith machines. I've been running it on a Z-386/25 for months, with CD-ROM and WORM drives and LANtastic and a lot of weird software, and there have been no problems at all.

Compaq MS-DOS 3.31

Compaq MS-DOS 3.31 installed fine on the Premier 9000. The only incident was that, due to the general stupidity of DOS 3.3, I had to use Norton Disk Doctor's "make disk bootable" utility rather than the DOS SYS.COM. (SYS isn't bright enough to remove the old IO.SYS and MSDOS.SYS files and then copy over the new.) Otherwise, no problems. By the time you see this, I can be pretty sure there won't be any problems.

We now have Compaq MS-DOS 3.31 on both the Cheetah Gold 486 and the Premier 9000. I suppose I ought to test the installation on the Premier 9000. A rail line running from Brighton to Glasgow should do the trick. . . .

(Hours later.) Windows 3.0 works just fine running under Compaq MS-DOS 3.31. Larry Aldridge of Sterling Microsystems reports that he has found some problems with Compaq MS-DOS 3.31 with 486 machines and currently recommends that for a 486 you use standard MS-DOS 3.3, even though this means having a vast number of disk drive partitions if you have a large hard disk drive. On my 486, it goes out to the T logical drive. So it goes.

The DOS problems that Aldridge has noted are confined to very large CAD programs and other programs that use DOS extenders; if you don't use those, you *probably* won't have any trouble with a 486 and MS-DOS 3.31, which is solid on 386s.

Inside Information

I first learned about Mike Wiener and Micrplytics years ago when I met him at Comdex. Wiener had licensed index-

continued

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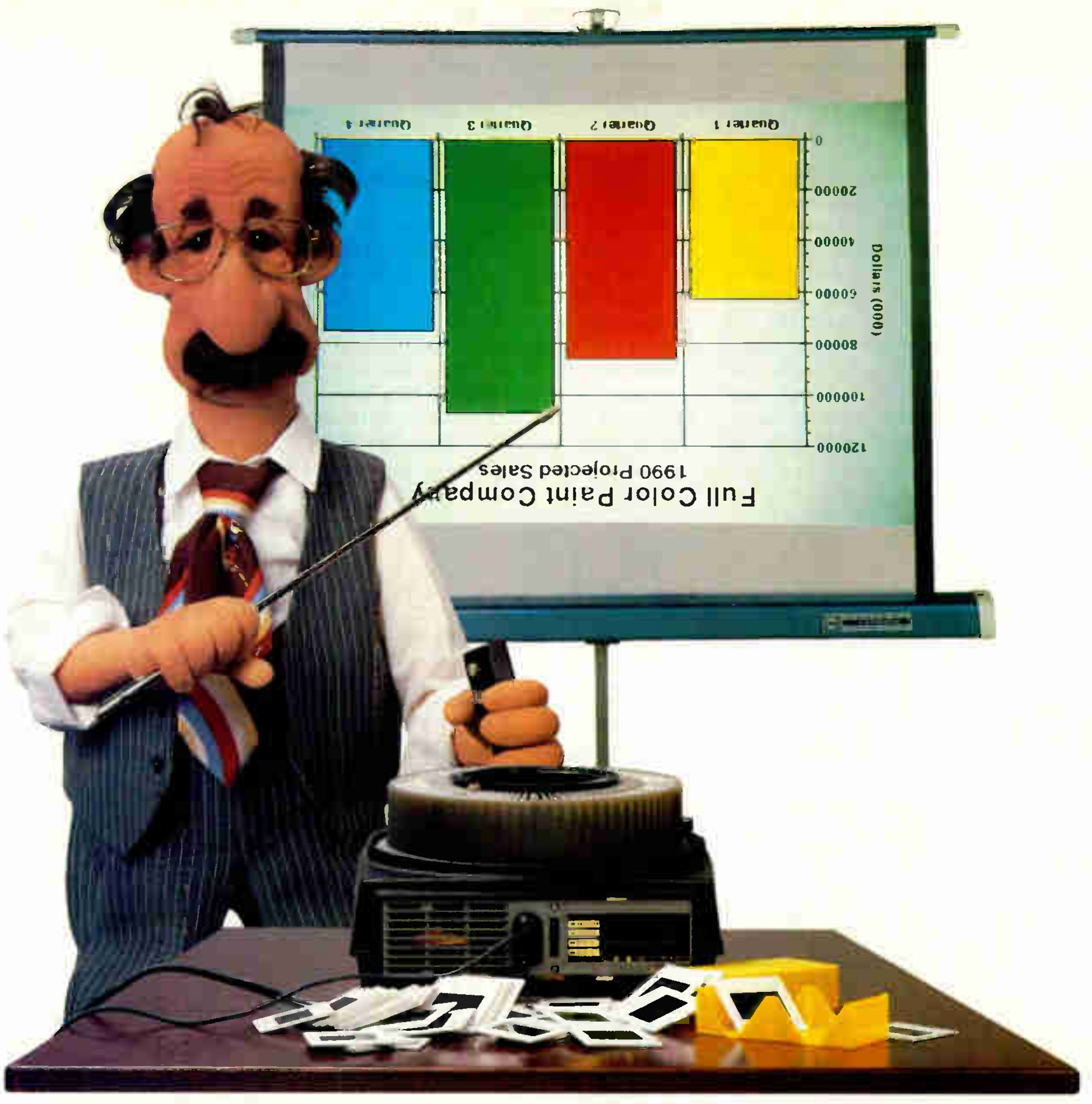

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and-search algorithm technologies from Xerox's Palo Alto Research Center, and I was much impressed by the speed of the programs he demonstrated. As usual, the PARC gurus had developed splendid technology but hadn't made it into a product. Wiener saw the potential, and the result was the nearly indispensable Word Finder family of products. I'm using Word Finder now; it works quite well with Q&A Write. Just put the cursor on a word and press Control-F10; up pops a list of synonyms, if there are any. It all happens *fast*, too.

The latest Microlytics product is Inside Information for the Macintosh. This is a program unlike any I've seen before: it's hard to describe. It begins with seven general categories of knowledge: Nature, Science and Technology, Domestic Life, Institutions, Arts and Entertainment, Language, and The Human Condition. These are then subdivided in various ways to some five levels deep. The end product is a word, and a one-line definition of the word.

You can ask directly for the definition of a word, but that's not really what this program is about. The notion is that you want to know the word that describes a condition or thing, and you use the outline feature to zero in on it. Or, perhaps, you want a word defined in context.

One way to illustrate is to give a few examples. I'll start with the general category, go through the subcategories, and finally give the word with its definition:

Nature—Human Body—Anatomy—Reproductive System—family jewels: "testicles (slang)."

The Human Condition—The Dark Side—Intrigue, Deception—Pranks and Tricks—dido: "prank, mischievous act."

Language—Structure and Usage—Rhetoric and Figures of—adage: "proverb, wise saying."

One more example ought to give you the picture.

Arts and Entertainment—The Arts—Music—Musicians and Performance—conductor: "leader of orchestra."

In fact, though, all entries are not as trivial as this; but it's easy to get the impression that they are, and I did, until Wiener himself gave me some pointers via E-mail.

In fact, there's quite a lot of information in there, but that's not obvious, nor is it trivial to learn the program. For example, I looked for the word *paranoid* under the Insanity category of The Human Condition. Not there. However, it is in another section entirely, Society—Psychology—Syndromes, where you will also find dementia praecox and every phobia you've ever heard of.

The notion is that if you are trying to think of a word, you use this program to noodle around until you find it, or you browse through words similar in category but wildly different in spelling (e.g., dementia praecox, schizophrenia, and mania). Roberta suggests people learning English and beginning writers will particularly appreciate it, and she likes it because she hates a thesaurus.

The software is magnificent. It's fast and intuitive—provided, of course, that you understand the Mac way. There are a number of ways to enter the table, including Reverse Dictionary, in which you add words until you find what you want. The Inside Information box gives the example, "If you want to know the term for the notch that holds up a supporting beam, use the Reverse Dictionary and enter a few descriptive words. Quickly you'll

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see 'beam pocket' is the term for which you've been searching." That's all true.

On the other hand, I go through The Human Condition, Cognition, Verbs of Thought, Knowledge and Understanding, and come up with "see-through," which is defined as "penetrate," and I feel the mountain has labored to produce a mouse. Another attempt, though, tells me stuff about airplanes I didn't know.

In other words, the program is better than the database; but the database is pretty good. If it were on my PC, I'd probably use it; I don't know if I like it enough that I'll fire up the Mac to get at it. We'll see. It's certainly unusual.

Interactive Dynamic Systems

If Inside Information is a broad-structured program, Interactive Dynamic Systems goes in the other direction with their program Desire; that is, I won't say this will do you no good if you don't know what a differential equation is, but it's likely.

Desire stands for "direct executing simulation in real time": in other words, it's an interactive problem-solving and modeling system, with similarities to Wolfram Research's Mathematica.

You also get a 185-page book on models and modeling, and how to use Desire to solve problems. The book is *dense*; on the other hand, it's informative and gives lots of examples. That's the good news.

Alas, the bad news is that you'll spend half an hour fighting the terminology, the crummy user interface, and the general density of the system before you'll be able to run the examples.

The examples are interesting, ranging from a Desire simulation of Jay Forrester's World Dynamics model—the one that was used to justify "the era of limits"—through predator/prey ecological simulations, to models of a pilot ejecting from a plane. In the World Dynamics case, you'd need the book to understand what Forrester thought he was doing, but you can run his model in Desire right out of the box, once you figure out how to run *anything* with this interface.

You will eventually learn, though, and the World Dynamics model is worth the price of the program. As the author comments, "hands-on, interactive manipulation of investment and death rates on the direct-executing system soon makes the user feel like a microcosmic god."

This is one of those programs that I wish mightily I'd had when I was an undergraduate; if anything can give you a feel for the use of complex math, it's a program like this that takes the pain out and leaves you time to have fun playing with the system.

Fair warning: there is heavy going here. There are also some heavy payoffs. The interactive nature of the program makes it not easy, but possible, to understand.

Mac Grolier

Grolier's Academic American Encyclopedia on CD-ROM is now available for the Mac. The disk is identical to the older PCompatible product. It cost me an hour to be able to make that statement. That wasn't due to *my* stupidity. Let me explain because it might be instructive.

The disk appeared to be identical to the one furnished with the PCompatible product, but I like to verify things. The Apple CD-ROM drive uses those horrible little "jewel box" carriers. (They're horrible because you can't change disks in one without using both hands, the carrier costs more to manufacture than the disk itself, and you need one for every disk you use frequently, thus adding $10 to $20 to the cost of using that CD-ROM.)

The new Denon CD-ROM SCSI drive also uses carriers; moreover, we'd just finished installing LANtastic to network several machines and let them share the two Denon drives installed on the Z-386/25. Incidentally, that works: I can run CD-ROM resources across the network. It's not a trivial setup, and there are significant resource costs to doing things in this fashion; for details, see my column in BYTE's upcoming Fall 1990

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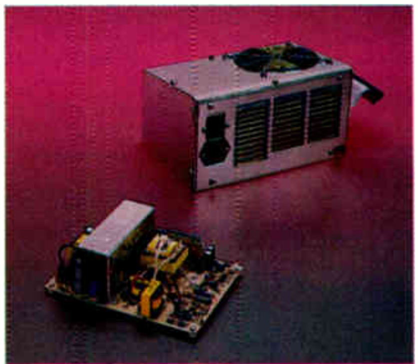

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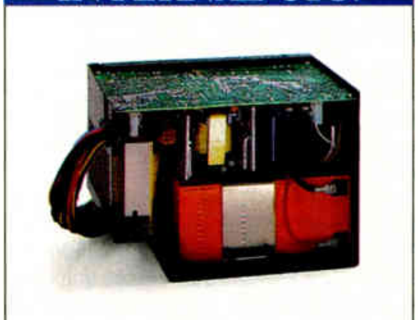

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Anyway, the Grolier CD-ROM ran fine on the Mac. Installation was simple enough. You do have to do things the Mac way: clicking on a program doesn't actually *run* it, but merely changes the menu bar at the top of the screen. You must go up there to tell the machine what you want. In a word, real Mac users will say Grolier has done a good job of integrating their CD-ROM to the Mac.

As with the PC version, searches are fast and smooth, the user interface is intuitive, and in general it's quite a neat operation. Of course, there's only text, no pictures.

Anyway, the CD-ROM furnished with the Mac version appeared identical to the PCompatible CD-ROM, right down to the ISBN. It was a fair inference that they were the same, but I do like to test such things. Since the CD-ROM was already in a carrier and the Denon drives use carriers, and I'd never run Grolier's on the Denon drives, the next step was obvious.

There was no Electronic Encyclopedia software on the Z-386/25, so the first thing to do was transfer it from the Cheetah 386. That way, I'd be able to not only look at its performance on the Z-386/25 with the Denon drives, but also test it out across the network. (The Cheetah 386, my ultrareliable workhorse, won't go on the network until I'm thoroughly satisfied that the network setup is rock solid.)

I transferred the software with sneaker net, copied from the floppy disk to the Z-386/25, and ran the Electronic Encyclopedia program. It brought up the prompt and copyright screens, thought for a moment, and reported "unable to locate CD-ROM," adding the gratuitous advice that I ought to check to see if I have the proper disk in the drive. I did. It was in the D CD-ROM drive, and I could get a directory from it. Maybe it's confused, thought I, and it removed whatever was in the E CD-ROM drive (although other CD-ROM software doesn't have a problem with more than one disk in the SCSI daisy chain). No joy.

OK, it's the configuration; this software expects an Amdek Laserdek drive. I need to reconfigure. There's a configure program, run that. No joy. The program lets me play with colors and stuff, but it's monumentally uninterested in the kind of CD-ROM drive. OK, there's an installation program on the floppy disk. Run that.

It looked good for a moment, but then the program said it was unable to load the EE.EXE installation program. There sure was no such program on that floppy disk, nor on my Cheetah hard disk. Clearly, this is a program that exists only on the original-issue Grolier floppy disk.

The trouble is, this is Chaos Manor; that floppy disk is long gone, since its contents exist on several hard disks and a WORM drive. It never occurred to me that those imbeciles would use some kind of strange copy-protection scheme for a CD-ROM retrieval! I mean, if you don't have more than one CD-ROM, you *cannot* be using it on more than one machine at a time! I spent a fruitless 10 minutes looking for the disk, and it's possible one day it will turn up—I never really throw anything away—but that will be futile anyway. Read on.

By now I was ready to find and beat senseless the person who had designed that ridiculous installation scheme, but there was one way to test that the Mac and PCompatible versions were identical: I took the CD-ROM out of the Amdek drive on my Cheetah 386, put it in a carrier, removed the Mac version that was showing me the names of articles about Charlotte Corday (Corday was a minor but colorful figure in the French Revolution), and substituted my own. The Mac proceeded without a hitch, and just to be sure, I then popped the Mac version into the Cheetah's Amdek, which ran it fine. So, I can safely say the Mac and PCompatible versions of the older text-based Grolier's are identical.

New Grolier CD-ROM

The new Grolier disk has pictures. It will *not* work with daisy-chained CD-ROM drives. Installation is automatic, and it builds a configuration line with the word DENON and the symbol N:2 in it, meaning that the configuration apparently believes that there are two Denon CD-ROM drives on-line; but when I invoke the program, I get precisely the same message I got when attempting to view the old (text-based) Grolier disk: "unable to locate CD-ROM disk."

Apparently, the people at Grolier believe their software will retrieve from a Denon CD-ROM drive installed as one of a pair, but they never tested it; because it sure doesn't. I have tried every combination, putting the CD-ROM in the D drive with and without disks in the E drive, and vice versa. I even dumped the network software and rebooted on the theory that anyone insane enough to cripple an installation program might have some paranoia about operating across a network, but no joy. In every case I can get a directory off the CD-ROM, but Grolier's Electronic Encyclopedia just isn't going to access that disk.

I then installed this thing on the Cheetah 386, where it works. Installation was automatic, and there were no problems at all. Of course, I installed from the original software disk. (Why they can't put the retrieval software on the CD-ROM itself is beyond me: probably the same distaste for their customers that caused them to cripple the installation program.) The press release says there are some 3000 updated articles, "as well as four-color drawings, paintings, and photographs," but it doesn't say how many. It also informs me that this same CD-ROM is readable on a Mac. It probably is, but not with the retrieval software that I put in for the text version, and they didn't send the Mac software for this version.

Moreover, the press release says that "a network version is available," implying that the one you normally buy won't work with a network; meaning that this thing is useless to me in any case, since my goal is to install the CD-ROM and WORM drives on a remote machine, thus freeing up my main machine and its work area. I don't know. It may be that the very presence of the LANtastic network card—even though it hasn't been implemented and no network drivers have been loaded—is detected by Grolier's paranoid software, and that's the reason it won't work with the twin Denon drives. More likely it's just buggy software. I know almost everything else works fine with the Denons, even across the network.

What we have here, then, is a decent product published by a firm that is more concerned about squeezing the last dime out of its software than about being sure the software works. Look: if you buy the CD-ROM for $395, why in the world should they care how it's used? If they sold you the books, and one kid used Volume One while another looked up *zebras*, no one would think of trying to charge an extra fee. If one kid carries an encyclopedia to another's house, you wouldn't make him or her carry a copy of the sales contract.

Yet here they have gone to considerable lengths to make it tough to use the electronic version, in fear that—that what? They don't put the retrieval software (and installation program) on the CD-ROM itself; I suppose because that would make it easy to leave multiple installations of the retrieval software? What use would it be to have the dumb software unless you have the CD-ROM? And if you have the CD-ROM, why the heck does Grolier want to make it harder for you to use it in more than one place?

The pictures and articles are excellent. This would be a better product if the company adopted less paranoid policies. I understand that they are reconsidering. More next month.

Winding Down

I'm out of space, but I have to work on the *IBM Special Edition* column anyway. Upcoming: CD-ROM on the LANtastic network; more on the Cheetah Gold 486; several new computers, including low-end systems with more bang for the buck; Mannesmann Tally printers; and, as they say, much more.

The shareware of the month is BUYAHOME.EXE, which is obtainable from the listings section of my tojerry conference on BIX. It unpacks itself into a database and decision-aid program that should be very helpful to anyone contemplating buying a house. Try it: I'm pretty sure you'll like it. If you do, don't forget to send in the registration fee to Shareable Software.

PC-Write Lite, a stripped-down, lean-and-mean version of Quicksoft's PC-Write, is now available with Cyrillic capability installed by our friend Arkady Borkovsky. This is probably the most bang for the buck you'll ever get in a word processing program.

The book of the month is by Eliot A. Cohen and John Gooch, *Military Misfortunes* (The Free Press, 1989). This is an excellent—and readable—study of campaigns that went wrong, and why, including the U.S. failures in antisubmarine warfare in 1942. The computer books of the month are the Microsoft Press *Learn XXX Now* volumes, where XXX is anything from Excel to QuickBASIC for the Mac. All give systematic introductions to their subject matter, and all come with "working models" of the programs they teach. I've tried a couple, and Roberta has worked most of the way through the QuickBASIC introduction and likes it a great deal.

The game of the month is still Microprose's Railroad Tycoon. If you ever liked to play with trains, you'll love this.

In the morning, I'm off to the Berkshires to see how they use computers in movie special effects. There's even talk of making a film of one of my books, which is interesting, and of giving us a large enough special-effects budget to build a real live spaceship, but I'll believe that when it happens. ■

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."

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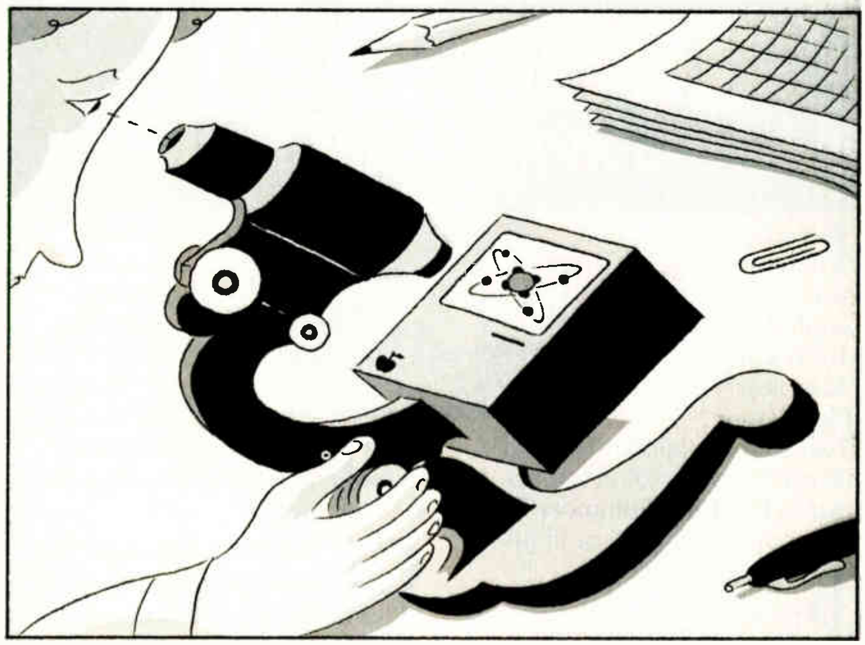

A start-up company provides tools to examine research data

One of the digs I get from colleagues about the Macintosh concerns its lack of good scientific software. Just a few years ago, I would have agreed with this; the Mac simply couldn't compete with DOS- or Unix-based scientific software. Statistical analysis, laboratory telemetry, simulation systems, visualization software, and other categories were poorly represented on the Mac. The advent of the Mac IIci and IIfx has changed all that. Software vendors now have high-performance machines, plus a friendly and powerful environment, to port existing programs or write new ones.

The National Center for SuperComputer Applications tool suite, a set of scientific programs, has been around since the early days of the Mac II. These public domain Mac programs were developed by Brand Fortner's Mac scientific visualization group at the University of Illinois's NCSA. This tool suite, in various beta and released forms, has been available from NCSA for several years for just the cost of the media.

The good news is that it's still available, and it does a good job of helping you analyze and visualize your data: data that's probably been created on a supercomputer. The better news is that Fortner has started a new company, Spyglass, that sells commercial versions of the NCSA products.

Through a Glass, Starkly

I've used the NCSA versions for some time and was dubious of the need for commercial versions of the software. But I've been working with the first two Spyglass versions of the tools, Transform and View, and a beta version of Dicer, and my opinion has changed a lot.

Where the NCSA versions were quite clearly public domain—with many rough edges and weak documentation—the versions from Spyglass have been refurbished. More than that, the value that Spyglass has added in commercial packaging, customer support, and other intangibles helps make the NCSA tool suite far more accessible to engineers and commercial research scientists than before. Transform and View now feel like commercial programs that you can trust, rather than public domain freebies that were a little iffy.

If you are already a serious NCSA tool suite user, however, you probably won't get as much out of the version 1.0 releases of Transform and View as new users will. The real improvements in their interfaces and additional features won't come until version 1.1 (which, according to Spyglass, will be shipped free to version 1.0 users).

The Spyglass catalog will soon include all four major NCSA programs: Transform, View, Format, and Dicer. In a nutshell, these programs are tools for the analysis, visualization, and longer-term management of scientific and engineering data. Fortner, for instance, is an astrophysicist, and he uses the tools in his own research.

Data with a View

Transform is the key program in the group. With it, you can manipulate floating-point data and convert it directly into visualizations (i.e., color images). Additionally, Transform can represent your data as an interpolated image, a polar image, or a line graph.

The beauty of this program is the ease with which you can see the image and its associated data. You can select part of the image and instantly see the values it represents, or the converse, as quickly.

continued

ILLUSTRATION: MIKE KLIEN © 1990

You can open a number of data sets and compare their images directly. Or you can derive new data sets almost instantly by typing your analytic expressions into a notebook window, an operation that's similar in function to Mathematica.

Transform does an impressively good job of pulling you into your data and leaving you there to ponder its meaning, without being obnoxious about its analytical power. I never felt overwhelmed by its capabilities—something that I usually can't say when using visualization software on high-end graphics workstations.

Transform, like the other Spyglass applications, supports the public domain Hierarchical Data Format. This is essentially a file format that can hold all kinds of data objects, including floating-point numbers, color palettes, text notes about the data, and images, in the same file. Both NCSA and Spyglass offer FORTRAN and C libraries that read and write HDF files, which are likely to become the microcomputer lingua franca of scientific software. The Spyglass applications can also use Clipboard input, ASCII text files, and PICT files.

To animate and further analyze the images that Transform has created, you use View. View changes the animation method or sequence so that the resulting patterns will often reveal new insights into your data. The advantage of image analysis for almost any discrete scientific data is apparent the first time you pop the image up on your Mac screen. By varying colors, color tables, light sources, and other screen characteristics, you can "see" important areas in your data that more conventional statistical analysis would have missed or obscured. View can display images as color rasters, surface plots, contour plots, dithered images, or a series of cross sections.

Format—a Spyglass program that I haven't used yet—makes it easy to punch up presentations out of your visuals. Format works something like an animation and presentation editor—sort of a hybrid of MacroMind Director and Microsoft PowerPoint. I expect it to work much like the NCSA version does, since it's derived from it.

Data Sliced and Diced

The most interesting Spyglass program is Dicer. Although I've used the NCSA version, I wasn't prepared for just how impressive the commercial beta version would be.

Dicer does pretty much what you'd think: It lets you slice and dice three-dimensional data. Dicer presents your data as a 3-D color cube that you can slice horizontally, vertically, or as a series of parallel slices. Each slice can then be repositioned interactively, while you change the colors and color tables, surface shading, and other visual factors. This tool gets you inside your data and lets you rip it apart in ways that have to be seen to be understood.

As good as these initial Spyglass offerings are, many improvements are necessary. The most important of these are slice extraction and animation from 3-D data sets and 24-bit color image support. Right now, the Spyglass programs are stuck with the same 8-bit color tables that hampered the NCSA tools. Spyglass promises that both improvements will make it into the version 1.1 releases.

The Spyglass software is important for those who need visualization analysis tools. But it also points to a better future for microcomputer-based scientific analysis tools. Data visualization software

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15265 Alton Parkway • Irvine, CA 92718 • In CA (714) 727-3300 • FAX (714) 727-1913 has largely been the province of expensive high-end graphics workstations (Silicon Graphics and Sun machines come to mind). That has kept it out of the mainstream of scientific and engineering circles. I'm hoping that Spyglass will set a trend for other Mac software companies to get in on the action. Scientific and engineering visualization software, beyond CAD, are just in their infancy. The Mac should make a dandy platform for their growth.

Tip of the Month: Bad Drives and Bankrupt Vendors

Right after I got back from vacation, I fired up my Mac IIci and its attached Jasmine DirectDrive 180. To make a long story short, after about 5 minutes of work, the DirectDrive died, with a horrific death rattle.

After cursing for 10 minutes or so, I tried to think about what to do. So I called Jasmine. Oops. Jasmine had filed for bankruptcy, remember? Surprisingly, I got through, but they couldn't help me. There were no technical-support people "available," which is always an ominous statement. When I asked them what I should do, I was met with silence. Finally, I got them to give me a list of former Chicago-area Jasmine dealers.

One of these was an old friend of mine. I brought the dead drive over to him. After rummaging through his old-parts bin and ancient Jasmine technical manuals, he was able to fix my drive. It turned out to be yet another power-supply problem, and the drive was miraculously undamaged. It booted up instantly when the power component was fixed.

After this little episode, I've finally put together my battle plan for dealing with bankrupt Mac companies that have left me holding the bag.

First, when you hear about a bankruptcy that affects the equipment you rely on, make your plans *now* to migrate data or operations over to other equipment, and do this before the company shuts its door.

Second, if this happens too fast and you get caught, call the vendor's last known number, since it might know of a local dealer who can help you. Insist that the vendor give you this information. Contact the dealer and develop contingency plans for defunct equipment.

Finally, your best defense is a good offense: Cultivate a friendship with a good dealer. Dealers might hear of vendor troubles long before you do and can help you prepare. ■

ITEMS DISCUSSED

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Inquiry 1146.

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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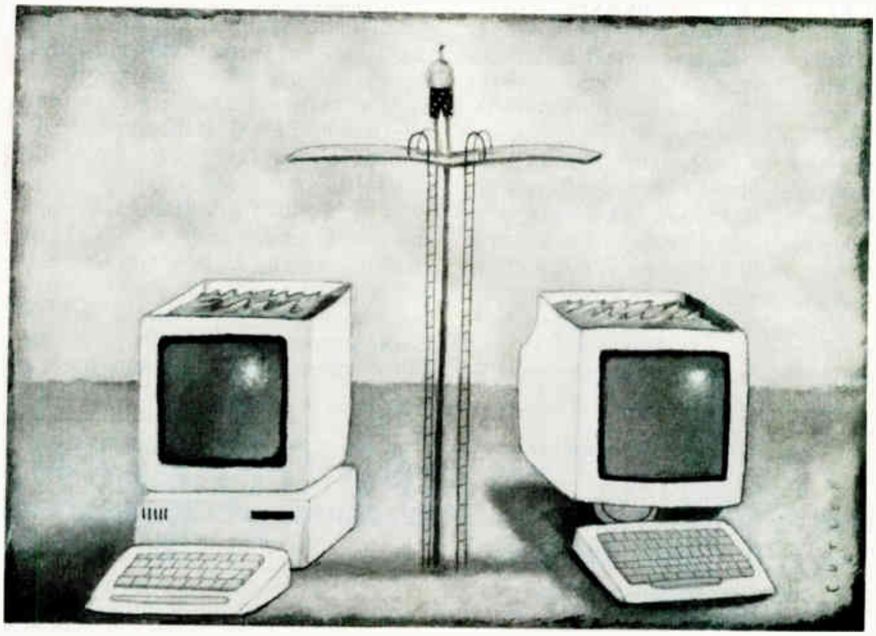
Evaluating RISC workstations, ATs, and inexpensive Unix



Last year I wrote a column about workstations, partly due to my feeling that workstation prices would drop. Boy, was I wrong. They *plummeted*. Sun now has a workstation for under $5000, Digital Equipment introduced some powerful new ones and dropped the prices of its older models, and a few models in IBM's new line may threaten almost everything it makes, right up to its mainframes. And then there's the Unix clone for 286-/386-based personal computers that costs less than $100. Does any of this interest you?

This column starts a brief series on workstation technology, including a smattering of facts on RISC and complex-instruction-set computers (CISCs), and what these new machines can potentially do for you. Are you better off with a vanilla 386/486, or should you get involved with workstations now? And for those who want to run Unix on their home computers but don't have enough money for a new workstation or even a full release of Unix, is there any hope?

Back to Basics

Until a few years ago, most CPUs were designed to be almost as complex as their makers could imagine. Since memory-addressing needs were increasing, designers rejoiced in making tricky addressing modes. And because language technology was changing, they lured compiler writers by creating new instructions that could be used to replace long streams of assembly language.

This didn't always lead to faster machines, but techies loved to point to their favorite CPU and say things like, "Look, you need just one machine instruction to search this entire file of movies and put it in order of gross receipts." In fact, some of the complex, fancy instructions would actually take longer than the streams of simpler instructions they replaced (anyone remember the block-move instruction on the Z80?). So progress, as defined by instruction sets, was difficult to measure, although everyone agreed that higher clock speeds would eventually mean faster computers.

Then the concept of RISC attracted interest. Instead of making a processor chip with hundreds of instructions, designers of a RISC chip would select a small number of instructions and optimize the hardware to run those instructions as quickly as possible. In other words, a RISC processor would do only a few things, but it would do them well.

It's important to understand that a RISC machine is not a special-purpose processor. It is not a process-control machine that has a small instruction set deliberately limited to keep the cost down, nor is it optimized for certain operations only, such as graphics. The designers of RISC machines generally do statistical analyses of large pieces of general-purpose code (such as all the kernel, system, and application programs on a large Unix machine) to find out which machine instructions are most often used.

Although RISC chips are in the same order of magnitude as far as the number of transistors per chip goes, the RISC philosophy differs from that of CISC (the kind of computer everybody's used to, including the 386 and 68020) as far as what those logic elements are dedicated to. The high performance of RISC comes from a reduced number of clock cycles required for critical instructions. Modern RISC processors may have as many instructions as their CISC counterparts.

IBM, the originator of RISC, would like to reword the expansion of the RISC acronym to be "reduced-instruction-set

continued

ILLUSTRATION: DAVE CUTLER © 1990

cycles," since its RS/600 processor chip set actually has 184 machine instructions. (The Z80 has only 67, and the 386 has 177.) Early RISC machines generally were not much faster than CISC machines. RISC gave designers a certain amount of simplicity in hardware design so that faster RISC chips required only incremental advances in technology. At the same time, a standard RISC instruction set might allow binary compatibility across processors of differing speeds.

These last two points are central to the design philosophy of Sun Microsystems's SPARC architecture. SPARC chips are all binary compatible, and the scalable design means that a SPARC-based computer can be anything from a laptop to a mainframe. While SPARC was invented at Sun, it's a fully licensable (nearly free) architecture that has been implemented by several semiconductor manufacturers and used by other computer makers. Part of the allure of SPARC and RISC chips is that they are fairly easy to design and manufacture.

Most manufacturers no longer refer to clock speed to show that their RISC machines are faster than competitive CISC designs (although a 33-MHz 386 is still likely to be at least twice as fast as a 16-MHz 386). Instead, the term "VAX MIPS" (million instructions per second) is generally used, which itself is a misnomer. The Dhrystone benchmark is run on the machine, and the result is divided by the Dhrystone figure for DEC's older VAX-11/780 machine. Thus, the final result is actually a calculated multiple of "how many times faster than a VAX" a given machine is supposed to be.

What About Workstations?

All this talk about RISC does have a purpose. It's to point out that many of today's low-cost workstations are RISC-based, because RISC technology has matured to the point where it's more cost effective than CISC, if the ultimate goal is more bang for the buck (or should that be "MIPS for the money"?).

In the world of workstations, the ultimate goal *is* speed and power. Since all workstations run Unix across networks and have high-resolution graphics and a window system, performance is king. Nobody cares much about DOS compatibility or even what CPU is being used, as long as applications will run as fast and as inexpensively as possible.

This is a far cry from the world of personal computers, although the end goal is the same. Whether you have an office full of PCs or Macintoshes, there's a strong tendency to stay with the same technology. Companies that set up workstation networks are looking to get their work done. If their servers are from Pyramid, and some of their workstations are from DEC, if Sun comes out with a $5000 workstation that suits them, they just might buy some Suns. They can do it because using Unix standards lets them set up such a heterogeneous network.

The dilemma for those in the market for a new machine arises when some of these newer workstations are compared with high-end PCs. PCs are familiar and comfortable to many people, but workstations have so much power they can't be ignored, especially if you're thinking of buying a PC primarily to run Unix. The prices are competitive in many cases, and there's always that nagging suspicion that workstations were designed to run Unix but PCs weren't.

continued

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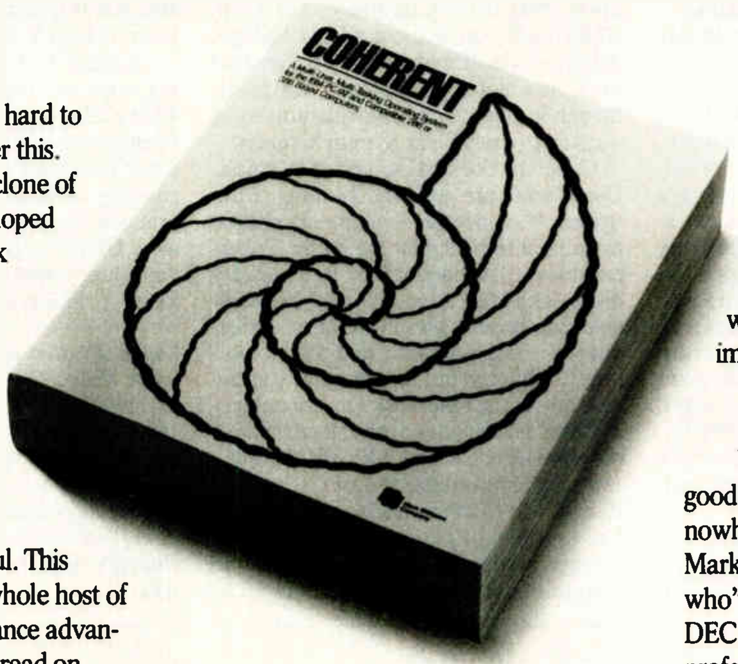

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I'm going to leave you hanging right here until next month. There are no easy answers, but there are still plenty of questions that should be asked before you take the plunge!

Write Something Coherent, David

Luckily, that is not what BYTE's editors have been telling me, but readers have been asking me something close to that for a while now. The Mark Williams Company (60 Revere Dr., Northbrook, IL 60062, (708) 291-6700, fax (708) 291-6750) has been advertising a 286/386 version of Coherent, its Unix-like operating system designed for truly small (i.e., personal) computers. The reason Coherent has been getting so much interest is that it resides in less than 10 megabytes of disk space, it can read and write DOS files, it includes a C compiler and UUCP (Unix-to-Unix copy), and it costs, at this writing, just $99.95. So, quite a few interested readers have been asking me, "Is this thing for real, and if so, how good is it?"

Alas, the perils of publishing are such that I received a copy of Coherent only a day or so before the deadline for this column, so I can do no more at this time than give a few impressions. I haven't had a chance to do anything resembling a complete review, so remember that this is all quite preliminary.

Note that Coherent was written at the Mark Williams Company, not from AT&T code, so, without a Unix license, the price is legitimately low. At the same time, it's not a "certified" Unix, although it seems to be equivalent in some ways to an early Unix System V release.

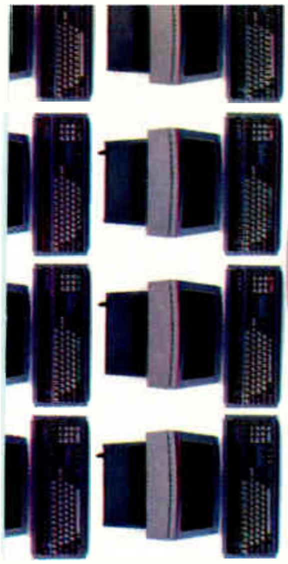
Coherent does exist, and it is small. Users who are already running Unix System V on personal computers will be astounded to hear that the entire Coherent release fits on just four high-density disks, and that includes machine-readable `man` pages. The installation procedure is straightforward and fairly foolproof: After the initial boot disk, you can load any of the other disks in any order.

Coherent includes over 150 executable programs, including LEX, YACC, and a few publicly available programs, such as Kermit and MicroEMACS. Unlike many Unix systems, Coherent comes with just a single manual and a set of release and installation notes—but that manual is over 1000 pages long, so there is no skimping on documentation. After looking around the system briefly, I can report that the kernel seems to fit somehow into 64K bytes (the `/coherent` file is about 77K bytes), while the shell executable file is a mere 26K bytes. Take *that*, Unix System V release 3.2!

I hope to get UUCP running on Coherent soon so that I can transfer some source files (and the BYTE benchmarks) from my main Unix machine to the computer running Coherent. Compiling and running these programs, as well as the practical aspects of getting Coherent up as a UUCP node, should tell me—and you—just about everything we want to know. I'll keep you posted. ■

David Fiedler is executive producer of Unix Video Quarterly *and coauthor of the book* Unix System Administration. *He has helped start several Unix-related publications. You can reach him on BIX as "fiedler."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



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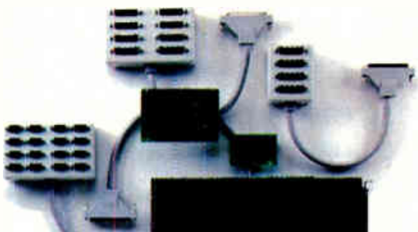

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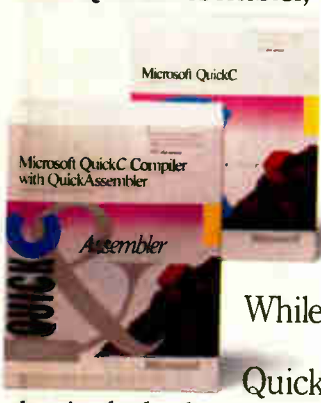

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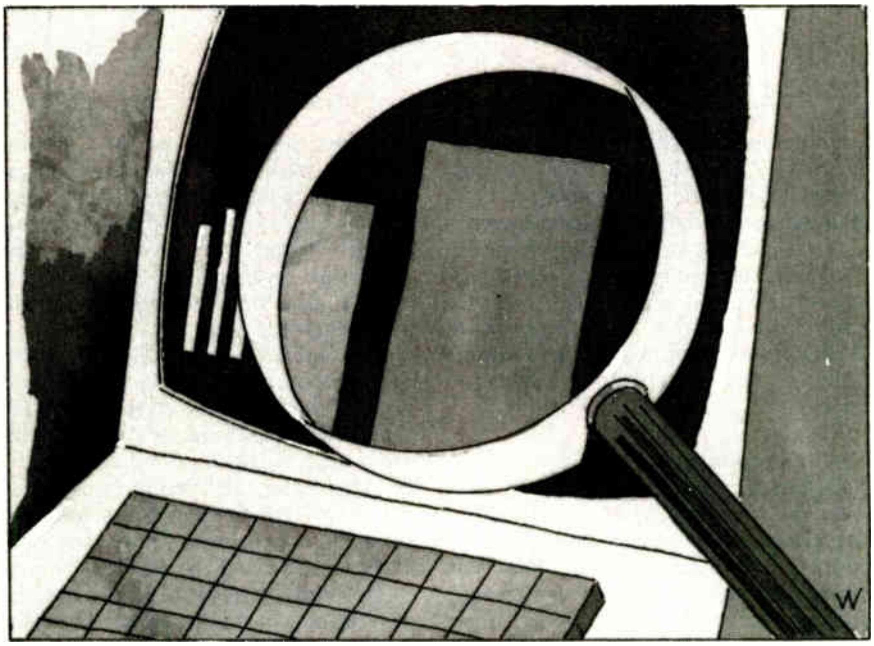
Despite fundamental differences between slides and a computer monitor, they both have a place in your presentation



In August, I discussed ways that you could use graphics software to liven up your business presentations. Now it's time to take the next step. Once you've created those great-looking images, you have to find a way to present them.

It wasn't so long ago that most business presentations were written out by hand and then made up on a lettering machine and transferred to acetate for use as an overhead transparency. Some offices made do by typing out the text of the slides using an IBM Selectric Orator ball and then copying the result to acetate. If you wanted color, you had to place the original acetate into your plotter and hope for the best.

Getting an image of a screen into your presentation meant that you had to do a screen print to paper, copy it onto the acetate, and then project that. Unfortunately, the print was usually so faint that you couldn't see it if you put the slide on the overhead projector, so you resorted to handing out hard copies—what one colleague of mine calls "lap slides." But passing out copies of screen shots no longer satisfies audiences.

In a professional presentation, most audiences now expect to see 35mm slides as well as the actual computer video. There are a couple of problems with 35mm slides, however. They are expensive—costing about $10 per slide—and they take a couple of days to produce, which could be too long if you have been asked to put together a last-minute presentation. Fortunately, you can now make 35mm slides directly from your computer. You can also use your computer to deliver your presentation without making the audience crowd around a 13-inch monitor.

Showing Off

While slides and a computer monitor are fundamentally different, they both have a place in your presentation. In fact, you can use both at the same time very effectively. Your challenge is to find a way to create slides and screens that look equally well done, and then to find a way to present them. While the look of both slides and screens depends on your sense of aesthetics and design, the quality of the presentation depends on your using the appropriate tools for the job. Thus, you must use something other than acetate transparencies on the overhead projector.

Of course, doing away with overhead transparencies can cost you a lot in flexibility and speed, since all that's required to produce a transparency is a copy machine or a laser printer. Polaroid has a solution in the form of its Digital Palette CI-3000, a film recorder that attaches to the parallel port of an IBM PC or compatible and makes color 35mm slides with software such as Harvard Graphics and Applause II—packages that I discussed in August.

The Digital Palette will accept camera backs for 35mm and 4- by 5-inch transparencies, as well as some other sizes. Since Polaroid makes an instant 35mm slide film, you can create impressive color slides in about the same time as you could formerly create boring black-and-white overhead transparencies. The result is quite professional.

One problem of moving to computer-generated slides is that you can't just copy an existing document to make a

continued

ITEMS DISCUSSED

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Datashow 480.................. $1895
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Digital Palette CI-3000...... $3995
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SilentPartner
IBM PC-specific............. $349
IBM PC-universal $419
Macintosh $399
Presentation Electronics, Inc.
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Rocklin, CA 95677
(916) 652-9281
Inquiry 1224.

transparency. You can get around this dilemma by using a scanner to bring the image into one of the graphics packages that support the Digital Palette. Depending on the scanner and the software, however, the resolution may not be adequate. Polaroid also makes a device called the Bravo Slide Maker, which looks like a photocopier but transfers color or black-and-white documents to slide film.

Using the Tube

Of course, you can always use the computer monitor itself to show the images it generates. Most presentation graphics packages have some sort of slide-show capability that will let you flip through images one by one. Unfortunately, most of the good ways to do this are either expensive or not very portable.

The easiest way to show images directly from the computer is to use a huge monitor (Mitsubishi makes one that's 37 inches diagonally). I didn't try one out for this column because they are not something you'd use for anything but a permanent installation. Huge monitors are hugely expensive and hugely heavy. I wouldn't even attempt to move such a monster without a lot of help. Video projectors are lighter but still expensive and very sensitive to movement. While the output from a properly adjusted video projector can be impressive, it can also be difficult to keep in tune.

Because of these parameters, companies have developed devices such as the Sayett Datashow 480 (formerly the Kodak Datashow 480). The Datashow is an LCD panel that sits on an overhead projector and allows a computer's video to be projected onto a screen. It supports both IBM and Macintosh computers in resolutions up to VGA (for the PC). Used properly, the Datashow—and similar products from Sharp and other companies—can make computer images reasonably pleasant to watch. Be careful, though, that the material you're showing has reasonably high black-and-white resolution, since these devices convert colors to shades of gray.

The Sayett Datashow 480 attaches to the computer's monitor connector in place of the monitor. You then place the device, which looks like a frame containing a glass window, on top of the overhead projector, and you're in business. These LCD panels seem to be sensitive to the quality of projector you're using, and earlier models could be heat sensitive.

This means that if you plan to use that 30-year-old, beat-up overhead projector you have in the closet, your images will probably look less impressive than they might otherwise. Good optics and a clear focus are important to the success of using the Sayett Datashow and similar products.

Keeping It Under Control

Picture yourself standing in front of a large group of people (at the corporation's annual meeting, for instance) trying to control the slide projector while you're running the computer attached to the Datashow while you're trying to give a coherent presentation. You can see that there are disadvantages to having several sources of images. It's not unlike the days when you had a person assigned to flip overhead transparencies, but who never flipped them at quite the right time. Things just didn't go smoothly.

Fortunately, a company called Presentation Electronics has developed a remote control for the keyboard of a PC compatible or a Macintosh with which you can control your computer from across the room. The SilentPartner looks like a TV remote control and sends digital infrared signals to a receiver that connects the computer and its keyboard. The receiver draws its power from the computer and allows simultaneous use of the keyboard.

The SilentPartner is very flexible. The device is accompanied by a cable that allows the receiver to be attached to the computer's serial connector. Using this connection, and the software that has been provided with the SilentPartner, you can program the remote control for any key and key sequence, and for a number of macros. While it's not able to do everything a complete keyboard can do all at once, you can program it with any function that's available from the keyboard. You can also use the serial cable for those computers that don't have detachable keyboards, such as laptops, so that you can use the SilentPartner with them as well.

Having the SilentPartner on hand to use with your presentations means that you can stand at the podium and still have control over everything. You can change slides with the remote control that comes with virtually all slide projectors used for presentations, and you can also control the computer at the same time. Now all you have to do is deliver the presentation.

A Few Laffs

A little humor often helps make an otherwise slightly dry presentation palatable. One possible source comes from a company called Keyboard Comedy, which makes a product called The Computer Comic.

The Computer Comic is a 3K-byte resident program that calls up a joke every time you press Alt-J. Some of the jokes are pretty funny, some are about computers, and some are written by professional Hollywood joke writers. They might lighten up the very technical or figure-laden material in some of your presentations. ■

Wayne Rash Jr. is a contributing editor for BYTE and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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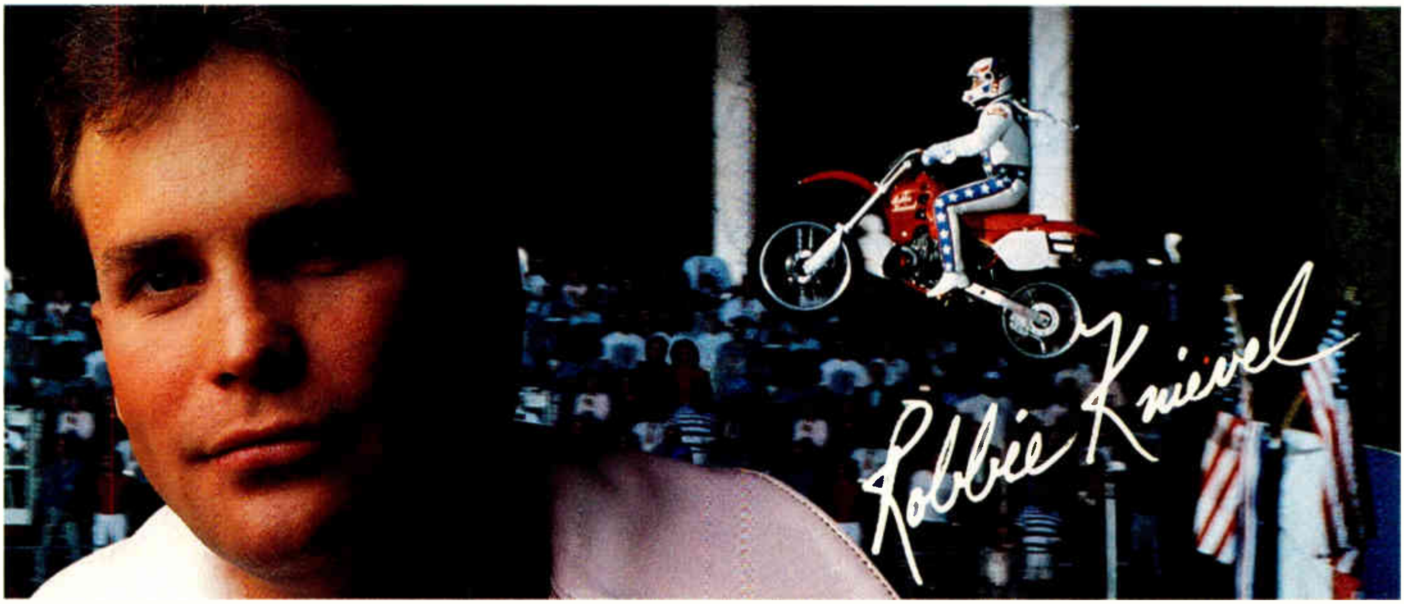

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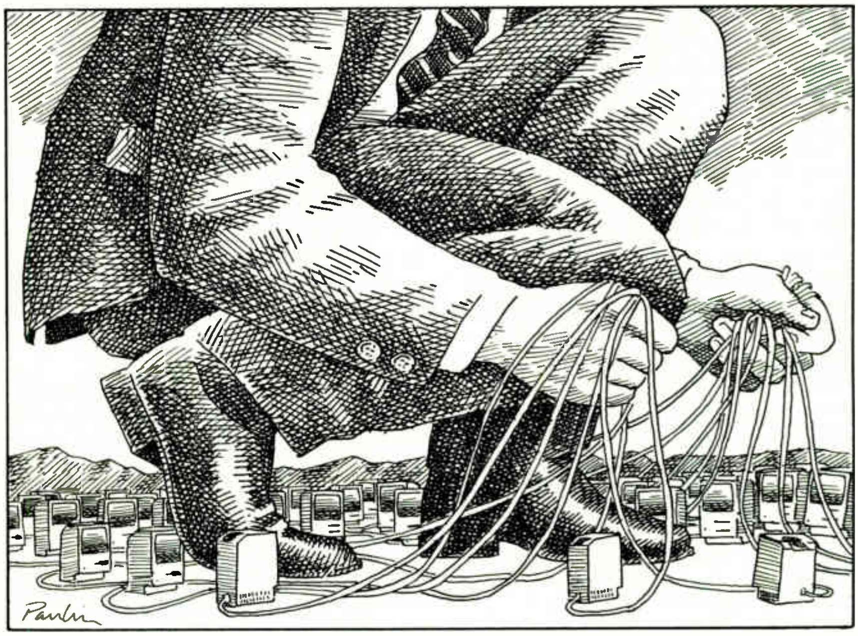
WELCOME TO LILLIPUT, DEC

DEC's new version of LanWorks lets Macintoshes talk VAX



Microcomputers have long lived in a world mostly divorced from the land of the larger minicomputers and mainframes. One of the biggest of the big-system players, Digital Equipment Corp., has made several trips into the land of the little, but few have been successful. Remember the Rainbow?

Well, DEC may have finally found its gateway to Lilliput: LANs. LANs occupy a middle ground between microcomputers and larger systems; they typically use microcomputer technology, but they serve multiple users. And DEC understands serving multiple users well.

DEC's minicomputers have an obvious role in LANs as the server—the big machine in the middle. DEC already has several PC-to-VAX integration products. Unfortunately, they largely ignore established microcomputer protocols, such as those used by NetWare. They even have minicomputer-style names: PCSA (Personal Computing Systems Architecture) for the software, and DEPCA (Digital Ethernet PC Adapter) for the Ethernet board. In an obvious attempt at a cheap face-lift, DEC has changed the names of those products to LanWorks for PC and EtherWorks, respectively—not much, but at least a nod in the microcomputer direction.

With its LanWorks for Macintosh, however, DEC may finally have gotten it right. While not perfect, this product clearly fits into the Macintosh world. DEC and Apple sowed the seeds of LanWorks for Macintosh in their January 1988 joint announcement of Mac-VAX integration products. After more than 2½ years, DEC should finally be shipping the product soon.

When in Lilliput...

For a change, this DEC product works the microcomputer way: LanWorks for Macintosh adheres to the existing Mac networking standards. The only concession that Mac users must make is to get an Ethernet board or a LocalTalk/Ethernet gateway; VAXes still don't support LocalTalk.

With an Ethernet board installed, a Mac can treat a VAX LanWorks for Macintosh server just like a normal Mac AppleTalk Phase 2 server. LanWorks for Macintosh's file services use Apple's AppleTalk Filing Protocol standard software; you just pick the VAX server from the Chooser, and you're in business. No additional Mac software is necessary.

The same thing goes for printing. LanWorks for Macintosh conforms to Apple's Printer Access Protocol; hence, client Macs are unaware that they are talking to a VAX. Macs on the network can print to DEC PostScript printers attached to the VAX, and those printers look just like LaserWriters under the Chooser.

Meanwhile, on the VAX

On the VAX side, the "printers" that the Macs see are the standard VMS print queues, with all the normal VMS print-queue management services. VAX and Mac users can share printers without a hitch.

LanWorks for Macintosh does an equally good job on the VAX side with files. It stores the data forks of Mac files as standard VMS files, although it necessarily stores the resource forks and desktop information separately. This approach lets Mac and VAX users see the same files.

Of course, Macintosh files are useless to VAX programs that can't read their formats, so LanWorks for Macintosh includes a small set of file-conversion

continued

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programs. Its standard conversion tool can move data between one VMS format—DEC's emerging Digital Document Interchange Format standard—and three common Mac formats—MacWrite, MacPaint, and PICT. This utility runs only on the VAX and doesn't support many formats, but at least it's a start.

LanWorks for Macintosh also provides some basic terminal services with two Apple terminal-emulation products: MacTerminal and MacX.

MacTerminal lets Macs act like DEC VT100, VT102, or VT320 terminals. It uses the Mac Communications Toolbox, so Apple or third-party vendors can add support for new media and protocols. The Communications Toolbox initially includes drivers for DEC's Local Area Transport and CTerm protocols.

MacX brings DECwindows (the company's X Window System implementation) to the Mac. The program includes both the X software and a TCP/IP protocol stack, so Macs can act as X terminals not just with VAXes running VMS, but also with other systems running TCP/IP. One important such system is DEC's own Unix for VAXes, Ultrix.

LanWorks for Macintosh also supports All-In-1 Mail and VMS Mail. All-In-1 Mail for Macintosh even lets Macs act as clients for DEC's distributed mail services, a comprehensive set of wide-area mail protocols based on the emerging X.400 E-mail standard.

The Paths Between

At the core of the communications portions of LanWorks for Macintosh is a new version of AppleTalk for VMS 3.0. DEC claims that this new version runs three to seven times faster than its predecessor, but we were unable to verify that claim on a shipping copy of the software.

DEC has added another communication feature that will interest many Mac users: *DECnet tunneling*. This strange name refers to the ability of a VAX to run AppleTalk protocols over DECnet. With it, you can route AppleTalk messages through a DECnet network of VAXes to Macs connected to other VAXes. For the many organizations that already have large networks of VAXes, DECnet tunneling means easy links between all the Macs hooked to those VAXes.

With all these features, you might imagine a painful setup process. Not so. Every Mac can automatically see these VAX servers, so you only have to install the software on the VAX and hook the Macs and VAX to an Ethernet, and you are ready to go. If you want some of the special Mac software, such as MacTerminal or MacX, on your Mac, just copy it from the VAX server.

Future Travels

Just as encouraging as DEC's present micro foray is the groundwork that the firm is laying for future Mac-VAX cooperation. Two products are particularly interesting.

Rdb/VMS's SQL/Services, a separately priced product, provides an application programming interface (API) for writing Mac Structured Query Language (SQL) applications that manipulate data in an Rdb/VMS VAX database.

The other product, Network Innovations' Data Access Language, used to go under the name CL/1. As with SQL/Services, you pay extra for the VAX DAL interface to Rdb/VMS. DAL is also like SQL/Services in that it provides an API that lets Mac users work with Rdb/VMS databases.

The difference between the two products is that the DAL Rdb/VMS interface is but one implementation of a standard API. Other implementations of that API work with many other database systems, including Ingres, Informix-SQL, Oracle, and Sybase. HyperCard's external code facility even comes with DAL support, so you can build HyperCard applications that use host database data. DAL allows a Mac developer to write one set of code that can work with many different database systems, a feature that will ultimately benefit both developers and users.

Faulty Steps

Despite its many good moves, DEC has not done everything right with LanWorks for Macintosh. One problem is the firm's pricing strategy. The VAX side is practically free; you pay only $440 for the distribution media and the documentation. Each Mac on the network, however, requires its own $295 license. If you have many Macs, the price gets out of hand quickly. This pricing scheme is also not enforceable, because any Mac on the network can see and copy files from the VAX's disk.

VAXes also still don't directly support

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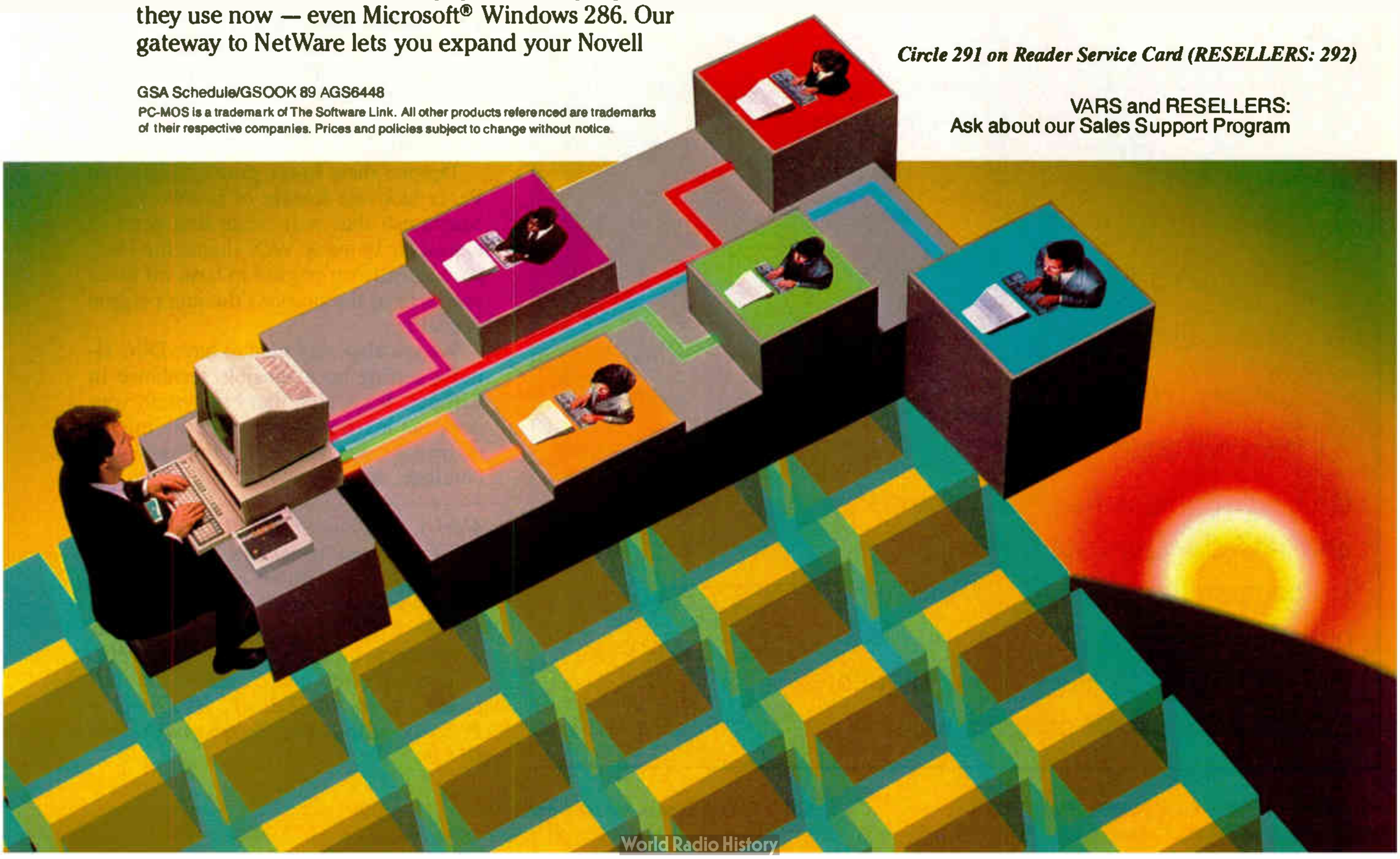

LocalTalk. Any Mac on a standard Apple LocalTalk network must go through an Ethernet-to-LocalTalk router to work with the VAX.

Finally, DEC is by no means the only firm to provide solid Mac-VAX links. Pacer Software and Alisa Systems have offered similar, and in some ways better, products for several years.

Pacer's PacerShare is a direct competitor to LanWorks for Macintosh. PacerShare even uses the same AppleTalk for VMS 3.0 protocol. In addition, Pacer offers both a multisession terminal emulator, PacerLink, that's superior to MacTerminal, and a version of its server software for Ultrix.

Pacer's pricing is based on the number of Macs simultaneously communicating with the VAX—a saner and more easily enforced scheme than DEC's. Pacer's prices range from $2400 for five users ($925 more than DEC's) to $30,000 for 250 users ($43,750 less than DEC's).

Alisa's goal is to provide better file and print services than DEC's products. DEC actually based LanWorks for Macintosh on Alisa's AlisaTalk and other products, but Alisa is currently moving on to the next generation. For example, one useful new feature that Alisa plans to add in its next release is the ability to manage VAX resources from a Mac.

Alisa uses yet a third pricing scheme, this one based on the size of the VAX CPU rather than on any count of the Macs. The company has a price for each of DEC's five CPU levels, with a maximum cost of $14,400—the lowest of the trio by far if you've got a big VAX and lots of Macs.

Despite their lower prices, Alisa and Pacer lack one feature of LanWorks for Macintosh that will make that product appealing to many VAX shops: the DEC name. Still, we're glad to have all three products in the market; the competition is healthy.

We are also very glad to have DEC finally setting up a sensible residence in Lilliput. It's a sign that big-system vendors can learn to work well with microcomputers. Let's hope that the trend will continue. ■

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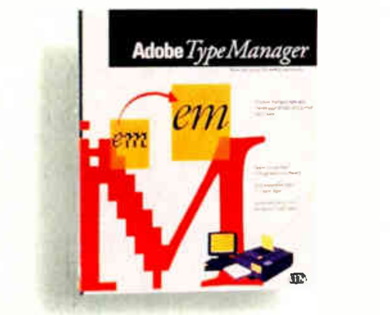

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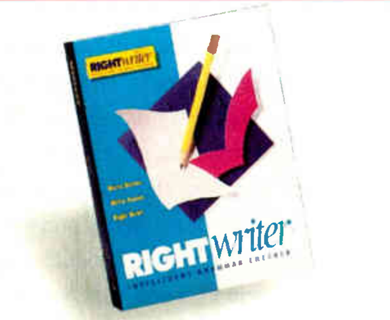

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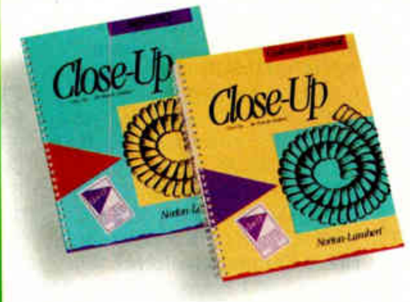

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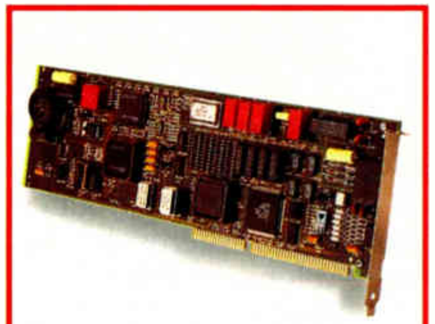

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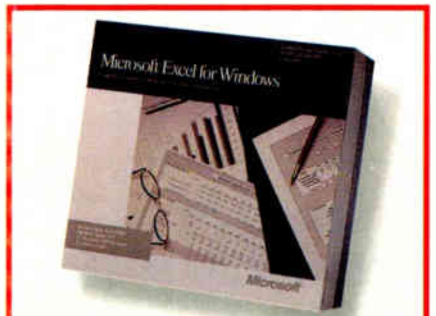

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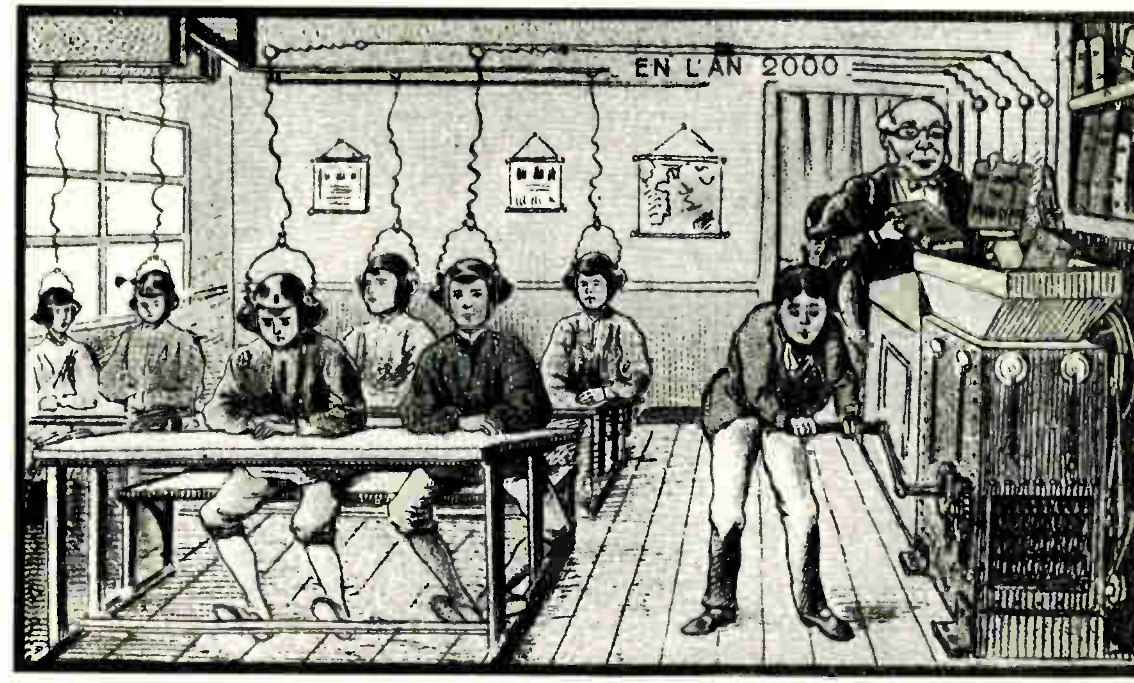

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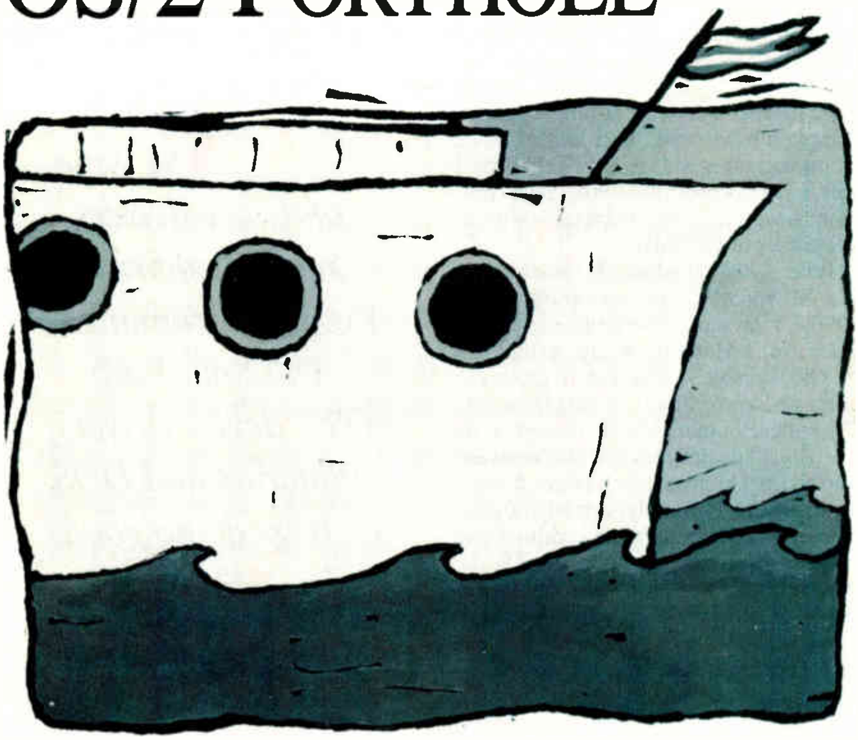


Two ways to run Windows programs under OS/2

Editor's note: *Beginning with this issue, you'll note a change in this column, formerly OS/2 Notebook. The new title reflects the growing interest in Microsoft Windows as an operating environment for single-user PCs. We'll be asking a variety of authors to contribute to the column, beginning with Martin Heller, a developer of both Windows and OS/2 software and a frequent contributor to BYTE.*

July 1987, New York, New York: Microsoft's Steve Ballmer is addressing a group of 600 software developers and giving a demonstration of Windows 2. OS/2 1.0 is in an early beta stage, and Presentation Manager hasn't gotten off the drawing board. "If you want to know what PM will look like," Ballmer says, "look at Windows. If you want to write for PM, write for Windows first."

I take this advice to heart, since I have been dabbling with Windows from its alpha-test days. Later that day, John Butler talks about the design of PM's display model, the Graphics Programming Interface.

It doesn't sound like Windows' Graphics Device Interface (GDI)—it's at least twice as complicated, and it seems to owe as much to the clunky but internationally standardized Graphics Kernel System and to mainframe graphics protocols like GDDM as it does to Windows.

Of course, if I'm suffering Windows-to-PM shock, imagine how the IBMer sitting next to me must feel: This is a long way from the 3270 terminals he programs in COBOL. "I don't think we're in Kansas anymore," he mutters.

After that, I buttonhole Jon Shirley in the foyer outside the conference room. "Don't worry too much about it," he says. "We'll have the same problems porting our Windows code to PM as everybody else, so we'll include the tools to make it easy in the Software Development Kit."

May 1988, Andover, Massachusetts: A box big and heavy enough to hold a Saint Bernard arrives from Microsoft: the PM Software Development Kit. I install it as fast as I can stuff the disks into my computer and dive into the CardFile sample, which illustrates building Windows and PM executables from common sources. It's a mess. On top of special header files and special libraries, the code is full of `ifdef` lines.

Worse, it doesn't work. Only one line of each card appears, and at the bottom of the display area. What's wrong? They haven't implemented multiline edit controls. Oops. I go back to my Windows programming.

Two Years of Progress

May 1990, Redmond, Washington: A convocation of Windows programmers, generally optimistic about the forthcoming Windows 3.0 rollout, assembles at the Microsoft campus for a briefing on Windows-to-OS/2 migration.

Two questions hang in the air. Will OS/2 2.0 run unmodified Windows binaries? What about the recently announced System Migration Kit (SMK), which is intended to bridge the gap between emulation of Windows functions and a full port to PM?

After the marketing types hype Windows 3.0 and OS/2, we get the straight stuff from the actual Windows development team. First we see an alpha copy of OS/2 2.0 running Corel Draw (the Windows 3.0 version, right out of the box) on an alpha copy of something that's called the Binary Compatibility Layer. One of the presenters keeps calling OS/2 2.0

continued

ILLUSTRATION: ANDREA BARRETT © 1990

"Cruiser," and the BCL "Porthole." Porthole running on Cruiser generally works, but it's kind of slow.

Next we see Windows applications converted to PM by means of the SMK (also called Porthole). With the SMK and some luck, you can just relink your Windows 3.0 application, and it will run under OS/2.

We also see applications taken a few steps further: Windows applications linked with the SMK (SMK applications) that call OS/2 dynamic link libraries (DLLs); SMK applications that use OS/2 threads; and SMK applications that use OS/2 kernel services (from separately compiled functions). This looks like the technology that will finally fulfill Ballmer's 1987 promise. We leave Redmond—well-fed, well-watered—with alpha copies of the SMK.

June 1990, Boston, Massachusetts: It's Microsoft's "Programming in the 1990s" road show. Over rolls and coffee, Microsoft's Martin O'Riordan (formerly of Glockenspiel) tells small groups of press and consultants about Microsoft's C++ development efforts (based on the C++ 2.1 specification, with extensions for the Intel architecture); Mark Roberts (formerly of Ryan McFarland) talks of compiler code-generation optimization in some depth.

After lunch, Manny Vellon (previously of Hewlett-Packard) gives us a glimpse at future development environments (better integration of tools, persistent storage of symbols as well as code, graphical user interfaces, incremental compilation, versioning, and checkout control). Over Häagen-Dazs bars, Mark Walsen (formerly of Intermetrics) talks about Windows development tools and techniques, and David Wood (formerly of Stella Systems) talks about Windows-to-OS/2 mapping layer technology.

The BCL has come a long way in a month. Corel Draw runs faster on a 20-MHz machine than it did in May on a 33-MHz machine. And none of the graphics are upside down this time. Wood, manager of the development team, allows as how they have begun to optimize the code a little. More interestingly, he announces that the BCL for OS/2 2.0 and the SMK for OS/2 1.2 (and later 1.x versions) constitute about 90 percent of the same source code.

No one is promising that the BCL will ship with OS/2 2.0, and no one is saying exactly when OS/2 2.0 will ship—but the BCL is obviously coming along nicely, even if OS/2 2.0 is showing some signs of slipping behind schedule. Wood describes the current pre-beta version of SMK and BCL as "totally usable," and I have to agree.

Working with the SMK

July 1990, Andover, Massachusetts: I can convert sample Windows applications to PM using Porthole, but my commercial applications won't convert so easily. I need an OS/2 version of db_Vista, unless I want to go through the agony of converting the code to use another database. Coverage analysis (using a SNOBOL program provided with the SMK) tells me that the only Windows service I use that isn't supported yet is the help engine. I persuade one of my publishers to order the OS/2 version of db_Vista.

> *The issue of device drivers remains thorny. Programs running in OS/2 must use OS/2 device drivers; Windows and DOS drivers do no good.*

Only a few Windows features won't be supported in OS/2 2.0 with the BCL (e.g., the sound functions). But the issue of device drivers remains thorny. Programs running in OS/2 must use OS/2 device drivers; Windows and DOS device drivers do no good under OS/2.

There are a few more restrictions in the SMK for OS/2 1.2: no palette management functions (since OS/2 1.2 has no Palette Manager, unlike Windows 3.0 and OS/2 2.0), no graphics flood fill, no direct interrupt calls, and no direct loading of Windows font files. Microsoft plans to provide utilities to convert Windows fonts to PM fonts—you'll then have to ship the converted fonts with your SMK application.

To rebuild your application with the SMK, you start by linking with special SMK versions of the C and Windows libraries. You also have to install the SMK DLLs in the LIBPATH of every target machine you want to run the SMK application on and install the PM versions of the Windows system fonts, as well as any fonts you've converted. Start the SMK application, and OS/2 will recognize it as a PM application that requires a whole bunch of DLLs—Kernel, User, GDI, and so on—corresponding to the equivalent parts of Windows.

More magic: The DLLs convert Windows Clipboard bit maps, metafiles, text, and Dynamic Data Exchange messages to and from their PM equivalents on the fly. Under OS/2 2.0, Corel Draw (for Windows 3.0) can copy a metafile to the Clipboard, and DeScribe (for PM) can paste the metafile correctly (I've actually seen this done). Your own Windows application, once linked with the SMK, can do the same sorts of things.

If you're as fond of pushing the envelope as I am, linking with the SMK libraries is only the beginning. The second step is to add threads. Why? To make up for any speed hits because of the mapping layer. Properly done, breaking your application into threads can make a big (read a factor of 2 or better) difference in real speed and an even bigger perceived difference (some things look instantaneous).

I expect to spend several days optimizing thread use for each of my SMK applications; if I'm unlucky, I'll have to spend several more days debugging the thread use with CodeView and/or MultiScope. (You debug SMK applications like PM applications, not like Windows applications.)

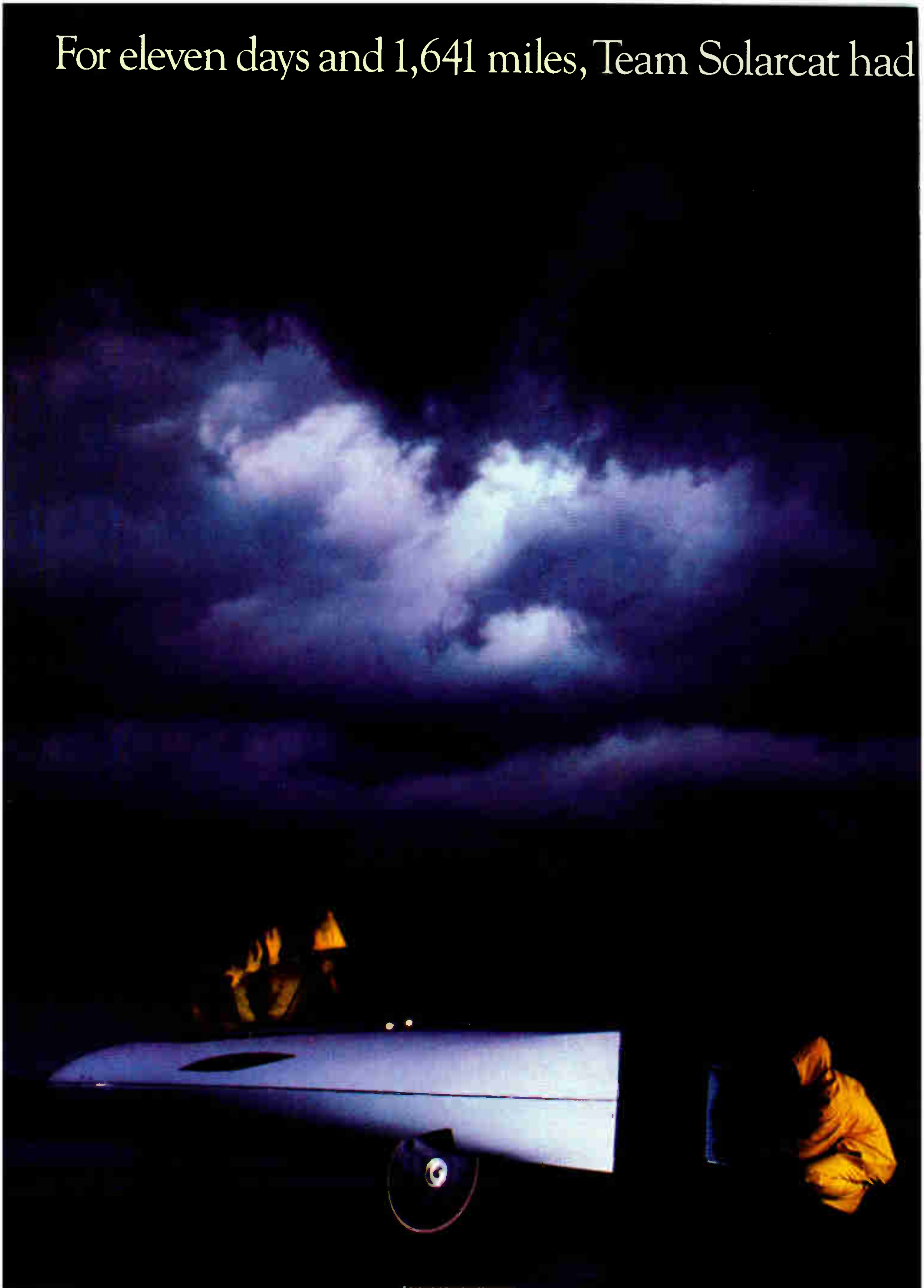
After I've got the thread structure the way I want it, I'll add support for long filenames and extended attributes. Long filename support is easy—mostly a matter of expanding some string sizes and marking the application. Extended attributes are a little harder, but I'd like to use them to supplement the signatures I build into my programs' file formats.

Finally, I'll start profiling my SMK programs. Where there are bottlenecks, I'll think about replacing slow emulated Windows and DOS functions with faster native PM and OS/2 functions. I want my quickly ported Windows program to look and feel like I lovingly and tediously recoded it for PM.

You won't tell on me, will you? ■

Martin Heller develops software and writes about technical computer applications. He holds a Ph.D. in physics. He can be reached on BIX as "mheller."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.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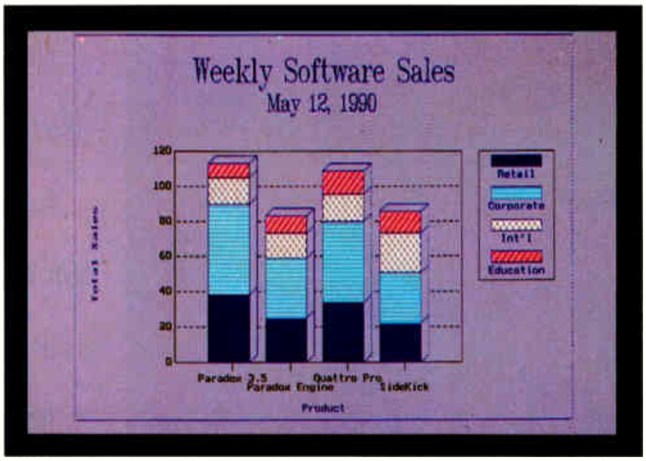


Paradox: The SQL with Many Improvements

Borland's top-of-the line database, Paradox, has never quite managed to budge dBASE out of its number one position in the database sweepstakes. But that may change quickly with the introduction of **Paradox 3.5**. Borland has incorporated proprietary technologies that it developed to dramatically speed up the program. Also new is SQL Link, an almost-painless way of using Paradox for accessing data from networked database servers that understand Structured Query Language.

With Paradox 3.5, the basic user interface remains virtually unchanged. Instead of experimenting with radical new ways to interact with the program, Borland has stayed with the comfortable row-and-column basic interface coupled with its check mark–based query-by-example method of ferreting out the data that you're looking for.

Many of Paradox 3.5's improvements are hidden in the code. Borland's programmers have incorporated an extended version of the company's VROOMM (Virtual Object-Oriented Memory Manager) into the package. First introduced in Quattro Pro, VROOMM essentially breaks Paradox into code "objects" that are swapped into and out of memory as they're needed. VROOMM also automatically uses available extended or expanded memory. And a new feature called TurboDrive is a VROOMM extension that configures Paradox 3.5 for the type of processor that it's being run on. On a 386 machine, it lets Paradox use up to 16 megabytes of extended memory.

I tested Paradox 3.5's sorting abilities with a name-and-address database that contained 29,366 records. Running on my 33-MHz 386, Paradox 3.0 gave me time for a leisurely lunch, taking 56 minutes, 42 seconds to sort the database by ZIP code. But when I loaded Paradox 3.5 and did the same sort on a fresh copy of the database, it was soon apparent that VROOMM was taking advantage of the 7 MB of extended memory in my system. It took only 12 minutes, 11 seconds to do the sort, a 77 percent improvement.

Other improvements in Paradox 3.5 include a number of new commands and functions for PAL (Paradox Application Language), export and import capabilities for Quattro Pro and Reflex files, and custom configuration options that let you fine-tune Paradox 3.5 for nearly any hardware situation.

What really sets Paradox 3.5 apart from the competition is SQL Link. In today's work-group-oriented environments, more and more data is stored centrally on dedicated database machines that are accessed through a LAN. And learning the intricacies of SQL isn't easy.

Instead of going head to head with the companies selling popular SQL servers, Borland has wisely chosen the option of providing Paradox 3.5 with a "front end" to SQL. SQL Link, which is included with Paradox 3.5 (but has to be installed separately), lets you use the familiar Paradox interface to work with data on a SQL server. SQL Link automatically translates Paradox commands into SQL and sends them to the server. It then puts data returned from the server into standard Paradox tables. Currently, SQL Link works with IBM OS/2 Extended Edition Database Manager, Microsoft SQL Server, and Oracle.

Installing SQL Link was easy; I simply told the installation program that I'd be using it with OS/2 Extended Edition Database Manager. Then it was a simple matter to start the main Paradox 3.5 program, choose the SQL options on the Tools menu, and tell SQL Link my user name, my password, the name of the server, and the name of the database I wanted to work with. Once the connection was established, I was able to use Paradox in the normal manner: creating and manipulating tables and running queries.

Like any serious relational database, Paradox requires a serious commitment to learn to use effectively. But of the serious databases, it remains one of the most intuitive to use. And the new features and performance improvements of Paradox 3.5 place it in a solitary spotlight.

—Stan Miastkowski

THE FACTS

Paradox 3.5
$795; upgrade from Paradox 3.0, $149.95

Requirements:
Core program: IBM PC, AT, PS/2, or compatible with 512K bytes of RAM.
SQL Link client: IBM AT, PS/2, or compatible with 1 MB of RAM and a network adapter card.

SQL Link server: IBM OS/2 Extended Edition 1.2 Database Manager, Microsoft SQL Server 1.0 or higher, or Oracle Server 6.0.

Borland International, Inc.
P.O. Box 660001
Scotts Valley, CA
95066
(408) 438-8400
Inquiry 1157.

Low-Cost EISA Machine Designed for Upgrading

Some computer makers have strained their credibility by building 486 systems with an AT bus; BYTE once described such a product as putting "a Ferrari engine on a Yugo chassis." But Advanced Logic Research (ALR) has pulled an interesting switch: The company's new **Business VEISA 32CSX** is based on the speedy 32-bit Extended Industry Standard Architecture (EISA) bus, but its brain is the 16-bit 386SX—in other words, a Yugo engine on a Ferrari chassis.

Why did ALR create such an odd creature? The answer is simple: upgrading. The ALR 32CSX is the ultimate design for people who want to spend as little as possible but also protect their investment. Its 386SX CPU costs about the same as a 286, but it executes 386 instructions, so it will run the protected-mode software of the future. And its bus, overkill for a 16-bit CPU, won't peter out if you yank out the 386SX and drop in an i486 sometime down the road.

THE FACTS

Business VEISA 32CSX with 1 MB of memory and a floppy disk drive, $2795; with 2 MB of RAM, a 40-MB hard disk drive, and a 14-inch VGA color monitor, $4299.	Advanced Logic Research, Inc. 9401 Jeronimo Irvine, CA 92718 (714) 581-6770 **Inquiry 1158.**

The ALR 32CSX is a relatively small and quiet machine. It uses a 20-MHz 386SX processor with 32K bytes of cache. It offers three 32-bit EISA slots, plus one 8-bit and two 16-bit ISA slots, and three dedicated processor/memory slots. The 32CSX can accept up to 17 megabytes of RAM on the system board, or up to 49 MB with the addition of standard single in-line memory modules. As with the Compaq Flex or AST Premium architectures, ALR uses a separate synchronous bus for communication between the processor and memory, which boosts throughput and saves overloading the I/O bus.

Even with the 386SX processor, the EISA bus has its uses. With its bus-mastering abilities, you can get excellent I/O performance from appropriate network or disk drive controller boards. And as more data-intensive imaging applications come along, EISA's 33-megabyte-per-second data transfer rate will become even more critical to overall system throughput.

The principles of modularity and expandability behind the ALR 32CSX are commendable, and I applaud the company's effort to make the best use of customer investments. However, I can't help but think that the 386SX on an EISA bus is just a little peculiar. Low-cost EISA systems are a great idea. But if you really need the bus bandwidth of EISA, you should probably go out and buy the Business VEISA and immediately upgrade it to a full-bore 386 or 486.

—Andrew Reinhardt

Catch the Mac's Screen with MediaTracks

While the Macintosh's graphical user interface solved some problems in how users work with computers, it also created others. One of these problems is demonstrating new software: An event-driven interface requires a knowledgeable person to supply the proper events. But what if you just bought some sophisticated software and need some examples to get you started? Farallon Computing's **MediaTracks** solves this problem elegantly: It uses the Mac itself to record and play back a demonstration.

A ScreenRecorder desk accessory captures actions as they occur on the Mac's screen into a virtual "tape" file, and a MediaTracks application lets you edit these tape files, adding sound and interactive controls. The ScreenRecorder DA uses a driver that intercepts QuickDraw calls to the screen and routes them to a file. Because this driver lives outside the application zone, it continues recording even when you quit an application (thereby clobbering everything in the application zone, including the ScreenSaver DA) and launch another application. ScreenRecorder also works on color Macs, but the screen capture is black and white only, to reduce the amount of data stored to disk.

If you plan to create a demonstration on a Mac II with a large screen and run demonstrations on a Mac SE, you can reset the screen size in ScreenRecorder's Preferences menu and reboot. The driver adjusts the screen's size to the target display's dimensions.

MediaTracks' videotape/film-splicing analogy lets you edit these tape files quickly and easily. You can splice out errors in a recorded session, add new sessions, or adjust the playback speed of certain sections (called clips) of the tape.

continued

You can crank up the playback rate of clips where a file loads, while using real-time rates during menu selections, for example. You can also add sounds to liven up a demonstration or provide a voice-over that explains what is happening on the screen. These sounds can be imported from SoundEdit or resource files, or you can plug Farallon's MacRecorder sound digitizer into one of the Mac's serial ports to capture voice-overs on the fly.

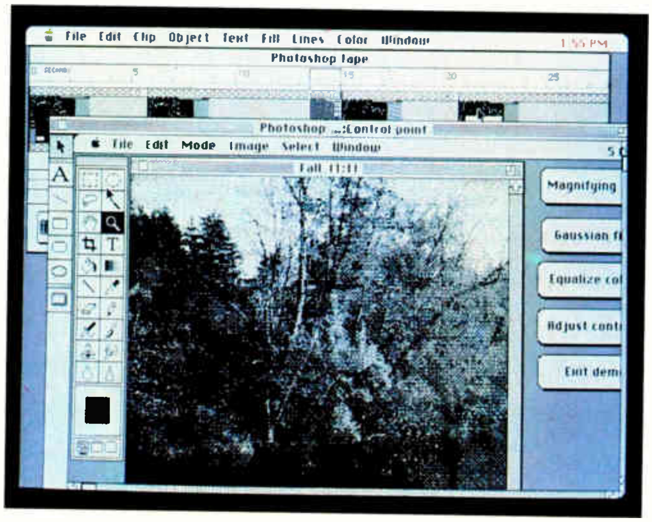
Finally, you can add interactive buttons that control the tape's playback, play sounds, play other clips on the tape, play other tapes, or emit HyperCard messages. With the proper arrangement of buttons and clips, you can easily create a demonstration tape that lets the novice examine an application's features in any order and review them. Tapes can be saved in MediaTracks format (requiring the MediaTracks player) or as a stand-alone application.

Since the object of MediaTracks is to provide demonstrations that run on all Macs, I examined a beta version of MediaTracks 1.0b7 and ScreenRecorder 2.0b7 across most of the Mac product line. This included a Mac IIfx using Apple's 8•24 display board and 8 megabytes of RAM, a Mac IIci with a SuperMac Spectrum/24 Series III board and 4 MB of RAM, a Mac Portable with 1 MB of RAM, a Mac SE with 1 MB of RAM, and a Mac Plus with 2 MB of RAM and an HD20 hard disk drive. The ScreenRecorder DA added little overhead to operations as I captured sessions to disk, but it was most noticeable on the Mac Plus. A full-screen 2-minute, 32-second session in Photoshop on the Mac IIci created a tape file only 216K bytes in size.

Editing tapes with MediaTracks was a snap. The carefully thought-out interface uses a filmstrip that shows images, timing, clips, and their names. A small sound track shows where sound has been added. After capturing a Photoshop session, I used MediaTracks to create a demonstration where you select a Photoshop operation by clicking on the appropriate button. I had no problems moving either tape files or stand-alone applications between the various Macs.

MediaTracks' powerful interface makes it easier for writing demonstration software than HyperCard does, although MediaTracks has many hooks in it to work in concert with HyperCard. While its biggest use will be for demonstrations, MediaTracks' interactive controls make it suitable for employee training programs and tutorial work.

—Tom Thompson



THE FACTS

MediaTracks
$295;
with MacRecorder, $495

Requirements:
Mac Plus, SE, SE/30, Portable, or II with a hard disk drive and running System 6.0.3 or higher.

Farallon Computing, Inc.
2000 Powell St., Suite 600
Emeryville, CA 94608
(415) 596-9100
Inquiry 1159.

Sharp Packs the Bits down the Line

Telecommunications at 2400 bps seems pretty wimpy these days. Unfortunately, the price of the shiny new generation of 9600-bps modems (often $750 to $1000) is high enough to give pause to those of us who lack unlimited credit.

But some solutions won't cause wallet failure, and Sharp's first entry into the PC modem field is a case in point. The **Sharp 9624e** (for external) is nominally a 2400-bps modem, but it includes MNP level 5 error correction and some proprietary Sharp hardware. (An internal add-in modem for PCs—the 9624—is also available.)

If you've never used an MNP 5 modem, it's very easy to get attached to. Even though the local Peterborough telephone office has a digital switch and fiber-optic trunk lines, the old copper running to homes and businesses is prone to noise. MNP 5 takes care of that, and those pesky random noise characters were banished from my screen. And if you're hooked up to another MNP 5 modem at the other end, the built-in data compression coupled with the error correction can effectively double the data transfer rate.

Sharp's ace in the hole with the 9624e is something the company calls EBR-9600 (for

continued

THE FACTS

Sharp 9624e
$399

Sharp Digital Information Products
16841 Armstrong Ave.
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12. ANSI Standards: CrossCode C tracks the ANSI C standard, so *your* code will always be standard, too.

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SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 23
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extended baud rate). EBR-9600 is tucked away in hardware, in a custom chip set in the modem. By itself, it transfers data at up to 4800 bps. But couple it with data compressed by MNP 5, and the effective transfer speed can be up to 9600 bps.

There is, of course, a caveat: To take advantage of EBR-9600, you need a Sharp 9624 modem at both ends of the communication link. I tested a pair of 9624e modems: one at home and one connected to my office system. I ran Digital Communications Associates' Remote[2] software on both systems. When the modems connected and the green EBR light on the modem went on, it was immediately apparent that data was traveling much faster. The slow graphics screen updates that I'd grown used to were considerably faster with the Sharp modems.

But the proof is in data transfer. Remote[2] provides a handy little "meter" that tells you exactly how fast data transfer is proceeding. First, I transferred a 240K-byte .EXE file. The average transfer rate was about 5200 bps. Things got much better with a 720K-byte plain ASCII text file, where the average transfer rate was approximately 7100 bps. Of course, neither figure comes near the 9600-bps rate that Sharp claims, but it's still considerably better than what I'd been used to and is probably typical of what the Sharp modems can do.

Now that everybody wants communications capability, I've seen too many cheaply built modems lately. They generally do the job, but for how long? Not so with the Sharp; it's solidly built, and the power supply for the external unit is huge. This is a unit built for heavy full-time use.

Besides MNP 5 and EBR-9600, the 9624e has other tricks up its electronic sleeve. If you're into minicomputer or mainframe connectivity, you can switch the 9624e into synchronous mode, hook it to a terminal, and communicate to your heart's content. The 9624e's manual is also one of the best that I've ever seen. If you're a beginner, it will tell you all you'd ever want to know about the mysteries of modem communications. But more experienced users aren't forgotten, either. Later sections of the manual go into excruciating technical detail on the 9624e.

At $399, the 9624e is an excellent value. And for $299, the internal model (which requires an 8-bit slot) is an unbeatable deal, especially if you can pair it with another 9624.

—*Stan Miastkowski*

New Life for Old Macs

If you have an old Macintosh 128K or 512KE collecting dust, Atlanta Technical Specialists offers a kit that can make over that beige clunker into a system the caliber of the Mac Plus. The **ATS Convertible Classic** kit provides a PC-style chassis that contains a fan-cooled 200-watt power supply, an 800K-byte floppy disk drive, a battery pack (to power the Mac's real-time clock), cables, a video circuit board that both inverts Mac video signals and converts them to TTL levels (to drive low-cost PC monitors), and an instruction manual.

Why use a conversion kit rather than upgrade to a Mac Plus? With ATS's kit, you get a beefy power supply (compared to the SE's 80-watt supply), and the cavernous chassis space lets you install third-party accelerator boards easily. Another benefit is a larger monitor: You'll still have the same 512- by 342-pixel image, but on a 12-inch (rather than 9-inch) screen. On the downside, there's no legal supplier of those Mac 128K ROMs, and if the installation work is done poorly, the system works poorly.

I examined an ATS Convertible Classic system that was equipped with SCSI, a SyQuest 40-megabyte SCSI removable cartridge drive, a Seagate 80-MB SCSI hard disk drive, and a Gemini 68020/68030 accelerator board using a 20-MHz 68030 CPU and 4 MB of RAM. ATS saved me the wiring hassles by shipping a fully built kit.

Throwing one switch powers up the Convertible Classic and all the peripherals. This is an improvement over individually switching on each external SCSI device that's clustered around a Mac. However, adding SCSI devices to the Convertible Classic presented the problem of how to determine the SCSI IDs of the internal devices and whether or not they're terminated. As an experiment, I plugged in devices to see if they worked. The Apple scanner worked flawlessly, but the CD-ROM drive worked intermittently, and I experienced some crashes, probably due to improper bus termination.

Most of the Mac software ran under System 6.0.5 on the Convertible Classic, as did my usual INITs (e.g., ATM 1.2, Boomerang 2.0.1, and Master-Juggler 1.53). Networked laser printing worked fine, as did AppleShare, once I located a network node with the old-style DB-9 connectors. Actually, the Convertible Classic would be ideally suited as a file server: There's room to add lots of mass storage, and if you use Farallon's Timbuktu/Remote to operate it, you can even skip the cost of the monitor.

If you're thinking of salvaging that old Mac, you might consider the Convertible Classic kit. ■

—*Tom Thompson*

THE FACTS

ATS Convertible Classic
$400

Requirements:
Mac 128K or 512KE motherboard, 128K-byte ROMs, a TTL monitor, and 1 MB of RAM.

Atlanta Technical Specialists, Inc.
3550 Clarkston Blvd., Suite F
Clarkston, GA 30021
(404) 292-6655
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Smalltalk-80 Enters the Nineties

ParcPlace Systems adds 24-bit color support and integration with host window systems in version 4.0 of Objectworks\Smalltalk

Jon Udell

What a difference a decade can make. In 1981, BYTE featured a visionary computing environment and programming system called Smalltalk-80. Although at the time they seemed fanciful, two aspects of that system—its graphical user interface (GUI) and object-oriented flavor—now define the essence of modern computing. The Macintosh, Microsoft Windows and Presentation Manager (PM), and the Unix X Window System (all based on bit-mapped graphics, overlapping windows, and the use of a mouse) derive from Smalltalk-80. So do C++, object-oriented Pascals, and other languages that support inheritance, encapsulation, and polymorphism.

Now comes Objectworks\Smalltalk 4.0 from ParcPlace Systems, the latest release of the venerable Smalltalk-80. Featuring support for 24-bit color and integration with host window systems, it runs on the Mac and, under X, on a half dozen Unix platforms. There's also a Microsoft Windows 3.0 version waiting in the wings.

Trailblazing is hard work. While pioneering object-oriented programming (OOP), Smalltalk-80 had to roll its own graphics kernel, window system, and multitasking executive. Nowadays, these are commodity items. Version 4.0 announces ParcPlace Systems' intention to delegate to its supporting platforms some of the burden that Smalltalk has traditionally borne alone.

There's a remarkable irony here. The system that first demonstrated the GUI and OOP paradigms now must convince the world that it can successfully coexist with the GUIs it inspired, and that its OOP technology remains vital.

I worked with an alpha version of Objectworks\Smalltalk 4.0 for the Mac and ran the software on an 8-megabyte Mac IIfx. Although I've used other Smalltalk and Smalltalk-like environments, notably Digitalk's Smalltalk/V (for the Mac and OS/2 PM) and Whitewater's Actor (for Windows), this was my first exposure to Smalltalk-80 (now called simply Smalltalk). The system retains the look and feel pioneered nearly a decade ago and popularized in Addison-Wesley's classic "red" and "blue" books. Experienced Smalltalk-80 users will feel right at home with the pop-up menus, multipane browsers and inspectors, and ubiquitous text editor.

New users, though, may find Objectworks' GUI jarring. It's true that version 4.0 maps Objectworks windows to host windows, in contrast to earlier versions that ran an independent Smalltalk window system within a single large host window or on the full screen. But that's about all the current version concedes to the host GUI. The Mac's menu bar, for example, offers little to the Objectworks user except the option to quit. All significant control flows from pop-up menus that are linked to Objectworks windows.

The Evolution of Expectations

Whether Objectworks developers need or want a true Mac (or X) interface is debatable. As a developer, I wouldn't particularly care. The system has its own self-consistent logic, and after a short while I didn't have any trouble with it. But what about users of Objectworks-based applications? That's a much stickier question.

Objectworks offers what is arguably the world's cleanest approach to portability. A Smalltalk system is composed of two basic parts: the *image*, a bunch of objects that make up both the development system and layered applications, and the *virtual machine*, which executes the image on a given platform. Objectworks guarantees that you can move an image from one virtual machine to another—say, from the Mac version of Objectworks to the Sun version. This would not normally be considered a port. There's no recompilation from source code. You just drop the image onto another virtual machine, and it runs identically.

Binary compatibility across the variety of platforms that Objectworks supports is nothing to sneeze at. Yet it's a measure of the distance traveled in the last decade that many users expect even more. They want applications to be available under multiple GUIs *and* to take on the look and feel of each. That's a tall order, and one that Objectworks 4.0 does not attempt to fill.

How, in theory, could it work? Well, the Mac, Windows/PM, and X GUIs share a number of analogous user-interface objects: menus, scrolling lists, buttons, and dialog boxes. The Smalltalk system could, on each platform, define low-level objects in terms of the relevant native application programming interface (API) functions and then define platform-neutral Smalltalk objects in terms of those low-level objects.

With its Mac and PM implementations of Smalltalk/V, Digitalk, ParcPlace

Systems' major competitor, has taken the first of these two steps. Smalltalk/V Mac and Smalltalk/V PM provide Smalltalk encapsulations of their respective host APIs, although they don't define a neutral API that is common to both. However, ambitious Objectworks developers who want to attempt this feat themselves will have to start at ground zero. Version 4.0 doesn't encapsulate host APIs.

Programming the Smalltalk Way

Although GUIs have evolved in ways that can make Objectworks\Smalltalk seem a bit dated, it still exemplifies the seamless integration to which all programming environments aspire. Except for a few primitives (i.e., points at which the Smalltalk system makes direct contact with its underlying platform), everything is written in Smalltalk and available for inspection and modification.

Smalltalk programming is safe, incremental, and exploratory. By safe, I mean that you can't touch memory directly. Smalltalk objects used as data repositories, typically those that descend from class Collection, grow and shrink automatically. Anyone who's chased a wild pointer in a C program can attest to the value of this scheme.

There is, of course, an attendant penalty. Storage allocation is straightforward, but to reclaim memory from objects that have outlived their usefulness requires a bit of work. Along with the standard "generation scavenger," which eliminates dead objects while periodically transferring them between two storage hemispheres, version 4.0 implements an incremental garbage collector that can perform useful reclamation work during otherwise idle cycles.

With the addition of the incremental garbage collector, ParcPlace claims that users should never experience a reclamation-related delay. I found that to be true. Perceptible or not, however, safe automatic memory management buys convenience at some considerable cost.

Justifiable? It's an endless debate; you'll have to decide for yourself. When I developed commercial applications using a proprietary system that managed memory in a similar way, I found that the benefits of safety far outweighed the costs.

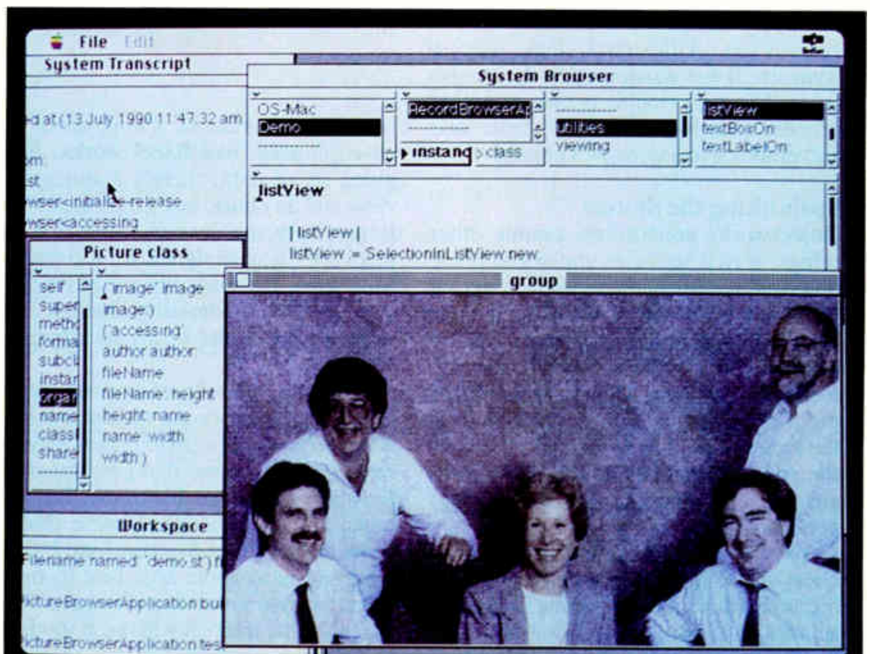
The Incremental Approach

Smalltalk programming proceeds by small increments. The unit of compilation is the method (i.e., the code that describes a Smalltalk object's response to a message). (Substitute "function" for "method," and "argument" for "message," if you like.) When you compile a method (it happens almost instantaneously), what results is a new Smalltalk image that incorporates the changed behavior. There's no linking phase. This arrangement is normally called interpretive execution, and Smalltalk is usually thought of as an interpreted language.

However, modern Smalltalk implementations aren't just byte code interpreters. In the case of Smalltalk-80, compilation occurs in two stages—first to byte codes, and then to native machine code. The byte code representation keeps the image both small and portable. When a method executes for the first time, the system compiles the byte codes down to native code. The native code methods accumulate as a working set in a sizable cache—about half a megabyte on the Mac, somewhat larger on Unix machines.

All this infrastructure takes up a lot of

continued



Objectworks 4.0 delivers support for 24-bit color and integrates with Macintosh and X Window System host windows. The Objectworks development team appears in the photo called by the Smalltalk application.

PHOTOGRAPHY: PAUL AVIS © 1990

room. My alpha version of version 4.0 soaked up a full 4 MB. Even after I ran the *stripper*, a tool that removes compilation, debugging, and browsing support from an image to create a stand-alone application, it still needed almost 4 MB. So if you want to take advantage of Objectworks' new host window integration and run it side by side with Mac applications, plan on having plenty of memory—6 MB at least.

For development, though, the incremental, try-and-see approach can't be beat. Moreover, although Smalltalk systems are large, proponents argue that they need not be slow. I'll go along with that. While it's true that I ran Objectworks on the world's hottest Mac, in general I found the system to be nearly as snappy as programs like MindWrite or PixelPaint Professional running on the same machine.

One exception was Berkeley System Designs' After Hours screen saver; it ran slowly in the presence of Objectworks. That made me suspect that Objectworks, under MultiFinder, consumes more than its share of cycles.

On the other hand, an Objectworks application can in some cases be more responsive than a native Mac application. The system continues to implement its own multitasking executive. Because Smalltalk processes, like OS/2 threads, require little in the way of private resources, they are cheap to deploy. Most decidedly unlike OS/2 threads, they're easy to use. Although a single process controls all the windows that the system owns, I had no trouble creating another process that independently wrote text and graphics to a window I created.

Spelunking the System

Objectworks constitutes, among other things, a rich set of exemplary applications that you are encouraged to adapt for your own purposes. Chief among these are the browsers and inspectors used to explore the system's class hierarchy, methods, and data. The art of Smalltalk programming lies in understanding what the system can already do and in finding the path of least resistance between its current state and the one that is your application.

You can ask the system all sorts of questions. What classes exist? To what hierarchy does a class belong? What instances of a class exist? What messages do those instances implement? Which classes contain methods that implement a message? Which classes contain methods that send a message? What are the current contents of the instance variables of a given class instance?

The browsers and inspectors serve two purposes. They deliver up-to-the-minute answers to these kinds of questions. At the same time, they show how Smalltalk can manage a user's interaction with a complex and rapidly evolving information system—namely, Smalltalk itself. To put Smalltalk to work in the real world, then, you leverage that capability and aim it at data models of your own.

The browsers use the infamous Smalltalk "model-view-controller" architecture. The idea sounds straightforward enough: An information *model* exists independently of one or more *views* (visual representations) and associated *controllers* (user interfaces). Think about how an application like Excel works. For a given set of data, there's a spreadsheet view and an equivalent graph view. That is precisely the sort of thing that Objectworks was designed to accomplish. Moreover, the class library has built-in support for broadcasting changes in an information model to all its dependent views.

The art of Smalltalk programming lies in knowing what the system can already do and in finding the path of least resistance between its current state and your application.

It's a big, densely interwoven system, though, and you've got to absorb a lot of it before you can begin to make real progress. I won't pretend that I mastered it in the short time available to me. But I did come away with a strong sense that the folks at ParcPlace Systems have thought long and hard about how best to model dynamic systems and how to build flexible tools that interact with such models.

As you explore the system, its radical openness may surprise you. After I made what I thought was an innocent change to class ExternalReadWriteStream, I found that I couldn't save my image. I'd damaged code that the system needed to propagate itself! Fortunately, I'd been working with a copy of the original image, so it was no worse than a convincing demonstration of one of the tenets of Smalltalk programming: Work with subclasses of core system components, not the components themselves.

Along the way, you'll find plenty of useful conveniences. With the project manager, you can create and switch among multiple desktops. Moreover, each desktop maintains an independent record of the changes applied from it to the system, so you can pursue alternatives in parallel.

The change manager lets you browse and reconcile changes associated with multiple projects. When you compile methods, the compiler not only finds syntax errors, it offers to correct them. Because it knows the class, message, and variable names appropriate to the context, it does an amazingly good job.

The debugger does just about everything that you can imagine. You can even interrupt the running system (with Control-C) to jump into the middle of an interesting behavior and identify the parts that are responsible. There is also a handy profiler that analyzes any block of code that you feed it. All these tools profitably exploit the extraordinarily deep and uniform access to system internals that is the hallmark of Objectworks\Smalltalk.

New Features

The Smalltalk-80 Form and Bit editors, which inspired MacPaint and all its descendants, have now become relics. In their place, the new system relies on platform-specific painting and drawing tools. The least common denominator for all platforms will be 24-bit color. Class Image defines a portable RGB picture format. It also defines methods for altering the bit depth of an image, capturing an image from the screen, and exchanging images between Objectworks and the host clipboard.

Although it wasn't 100 percent complete in my alpha version, I was able to use class Image to move 8-bit color images between PixelPaint Professional and Objectworks. Although file formats for color images vary from platform to platform, instances of class Image transferred in snapshots of the Smalltalk virtual image are fully portable. If you've spent as much time as I have wrestling with image translators, you'll love this feature.

Fonts, like illustration tools, have

continued

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THE FACTS

Objectworks\Smalltalk 4.0
(Price not determined at press time.)

ParcPlace Systems
1550 Plymouth St.
Mountain View, CA 94043
(415) 691-6700
Inquiry 1184.

come far. With version 4.0, Objectworks no longer rolls its own. Thanks to several new font classes, you can build an ideal font description (query) that resolves to a best fit on a given platform. The system's own text editor, which has always supported a rich text format, didn't use the new font classes in my alpha version. I hope that it will; that would make a great example and would enhance an important reusable component.

The graphics display and view protocols have been completely reworked. All graphics primitives now render through an instance of class GraphicsContext, which supplies a clipping rectangle, a pen, and foreground and background colors. To activate reusable components like text editors, buttons, and lists in a host window, you *wrapper* them; that is, embed them in objects of class Wrapper, which can provide borders and controls as well as translation and clipping.

In general, window management now conforms to the way the dominant GUIs work. When a view receives an update message from its model, it should send a message that invalidates its display and then expect a message requesting an update. Views need no longer react to window activation and deactivation; that's the host's job now.

Smalltalk and Business

Objectworks\Smalltalk isn't the tool of choice for developing shrink-wrapped word processors or spreadsheets. Compactness and raw speed have never been Smalltalk strengths. But neither is it useful solely for prototyping, as is sometimes alleged. It certainly lends itself to rapid prototyping, but it really comes into its own over the long haul as the systems that it models change.

ParcPlace Systems' clients tend to be large companies wanting to model complex business processes (e.g., an airline reservation system, a factory, or an investment bank). Objectworks\Smalltalk is a comprehensive toolkit dedicated to building and maintaining these types of software models. It embodies time-tested strategies for managing complexity and change.

Version 4.0 adds welcome support for host windows, fonts, and color, all transparently portable. Still, I'm waiting for the other shoe to drop. As the GUI juggernaut continues to roll, users increasingly expect portable software to exhibit appropriate local diversity; that is, to do "the right thing" under the Mac interface, Windows/PM, or Motif. Objectworks\Smalltalk needn't *require* such diversity; I'm sure some customers do prefer total uniformity across platforms. However, better support for the look and feel of native platforms would broaden the system's appeal. It would be the icing on the cake. ■

Jon Udell is a BYTE senior technical editor at large. You can contact him on BIX as "judell."

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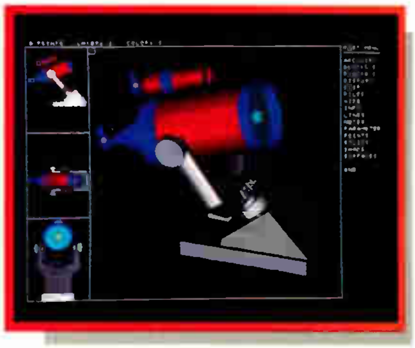

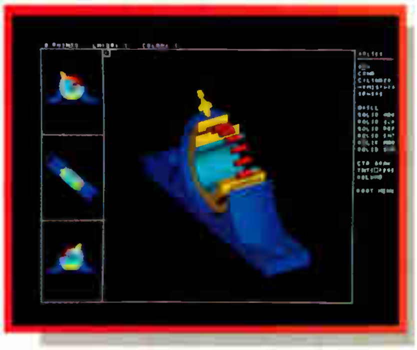

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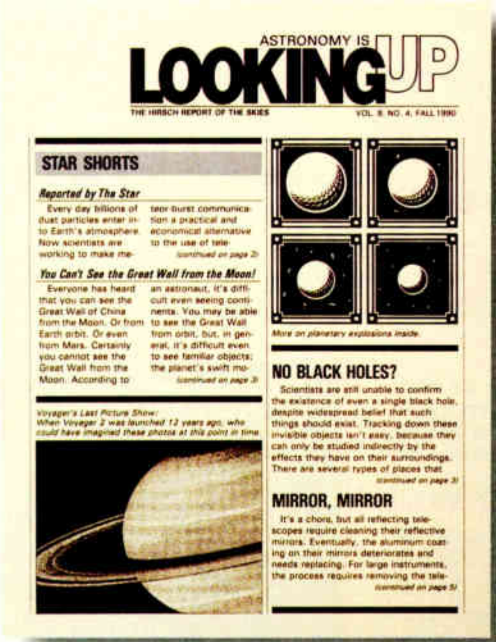

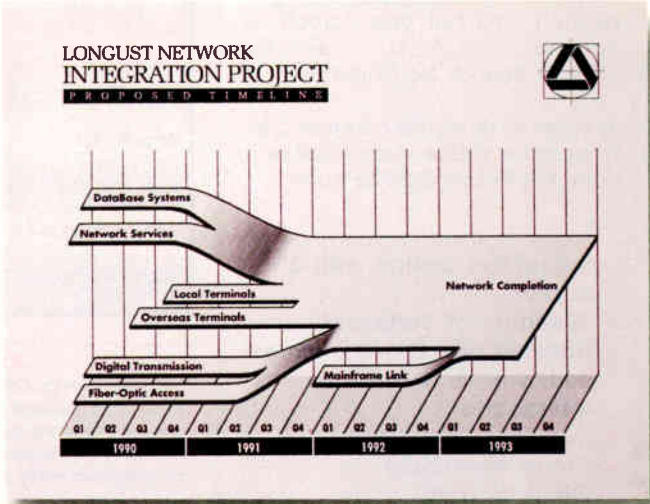

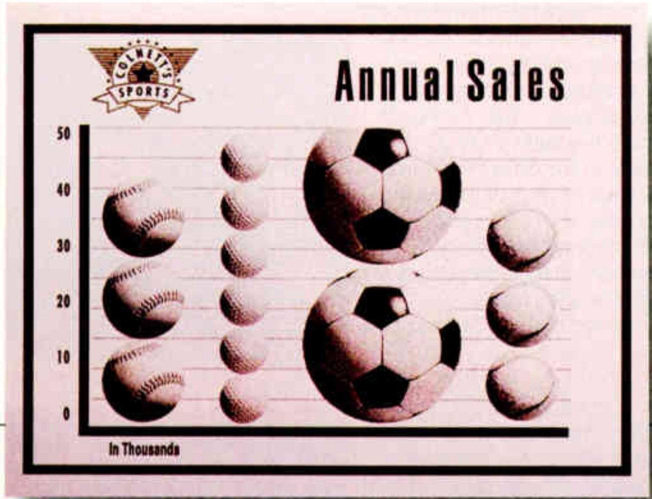

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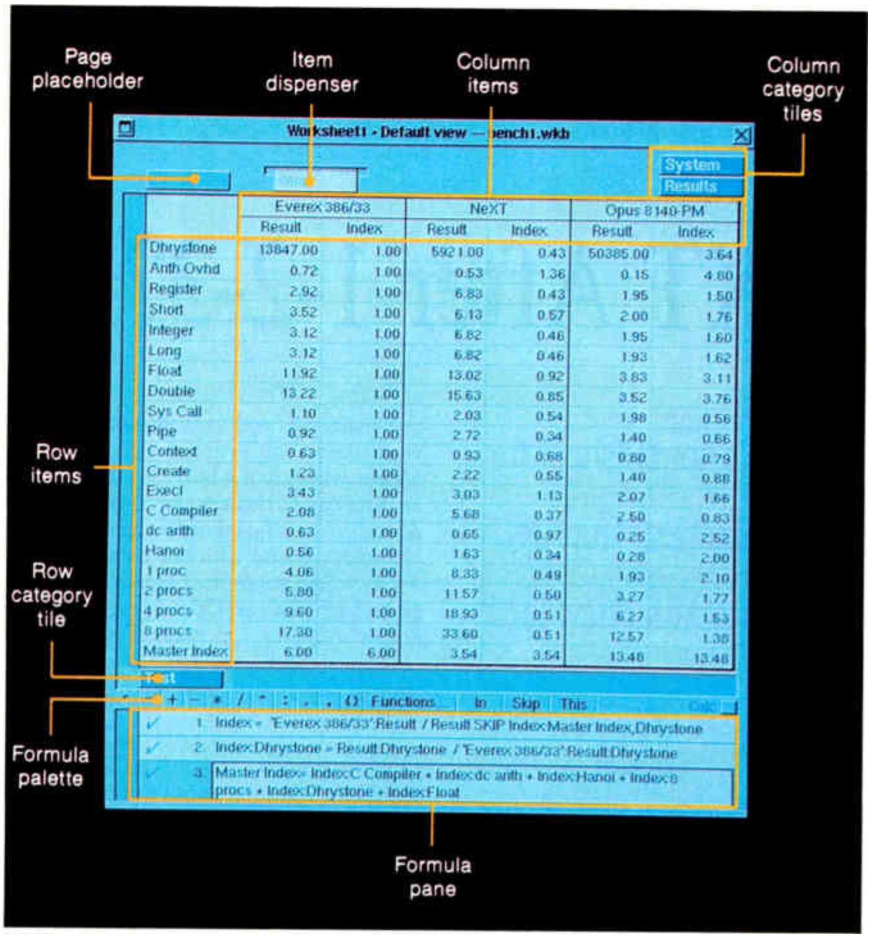

Photo 1: *A sample Improv worksheet with the key interface elements highlighted.*

you create cells as you need them. This is a good idea—it cuts down on the clutter—but adding cells as you go takes some getting used to. The keypad Enter key, as described above, is the global "make another one of whatever is selected" key, and it creates new cells, too. Cells are not added one at a time, of course. With the benchmark worksheet, I created all the column categories and items first. Then, stepping down the rows with the Enter key, I created and named the row items. Each time a new item is added, empty cells are created.

For those who are in a hurry, Improv offers two shortcuts to the creation of new cells. First, if you highlight an item and start drumming on the Enter key, it will create new items (and, therefore, cells) named after the parent category. If the category is named `Month`, the default item names will be `Month1`, `Month2`, and so on.

The other approach is more fun. At the upper left of the window lies the *item dispenser*, a nifty device that works like a roll of paper towels. You select an item, click on the "towel" sticking out of the item dispenser, and drag the mouse down until you have the number of items you want. You then tear off the sheet of items and drop the items on the worksheet. This is illustrative of Improv's interface philosophy: The most common operations are the ones that are the easiest to perform.

Facing the Interface

When you sit down with Improv, you must be prepared to be completely lost for a few minutes. There is no 1-2-3 interface compatibility—no menu comes up when you press "/." But there is a simplicity to it, and a continuity that makes it quick to learn and endearing to use. The interface is simple enough that, once you understand the hierarchy of categories, groups, items, and cells, the rest follows naturally.

Nowhere is the uniqueness of Improv's interface more apparent than in *flexible views*. Take a moment to study the layout of the data in the worksheet in photo 1. It is laid out properly for rapid data entry, and you can see the bottom line clearly enough, but it takes time to compare results between systems.

In an ordinary spreadsheet, you could set aside a group of cells below the main table to present the data more clearly. Getting the data into those cells would involve tedious copying or the creation of formulas that referred back to the original data.

In Improv, the worksheet in photo 2 was created with a single action: drag and drop. By moving the `Systems` category tile from the row to the column area, I instantly created a revised view of the worksheet. Systems got stacked together in adjoining rows, making comparisons a breeze. The data doesn't change, and you can shuffle the category tiles any way you like. If you drop a category tile over the page placeholder, Improv will devote one display page to each item under that category.

The data hierarchy in Improv doesn't end with pages. Each worksheet can hold multiple *views*, where each view presents the data differently. A single Improv file (called a *model*) can hold multiple worksheets (with unique data) as well. Cells in other worksheets (within the same model) can be referenced in any formula by prefixing the cell address with the worksheet name followed by two colons (e.g., `Profit and Loss::FY 90:Q1:Net Income`).

The Secret Formula

There's really only one reason to reference a worksheet cell or group of cells, and that is to perform some calculation on them. Lotus innovated again with respect to formulas. In 1-2-3, the norm is to define one formula in each cell that needs calculating. It is not unusual to find large spreadsheets with hundreds of formulas, woven in a fragile web of interdependence.

Improv breaks the link between cells and formulas. Formulas are entered in the *formula pane*, a resizable subwindow of the worksheet window. Each formula consists of a right side that describes the calculation, and a left side that specifies the placement of the results. I say "results" because a single formula can produce and place multiple data values in a worksheet. If you create a worksheet with items `Cost`, `Quantity`, and `Total`, the formula `Total=Quantity*Cost` will calculate *all* the totals in one operation.

Entering formulas almost never requires using the keyboard. Double-clicking in the formula pane places you in edit mode and brings up a palette of formula construction buttons. Clicking in the worksheet adds the appropriate identifier to the formula. Category, group, and item names can all be used to select data for formulas.

Erroneous formulas are trapped immediately, and an explanatory error message that briefly describes the specific problem is displayed. A mouse-click brings up a dialog box with a detailed description of the error and a pointer to the location in the formula where the calculation failed.

Formulas can also overlap, placing their results in the same cells. Improv flags these, too, and, instead of blindly following the "last formula takes precedence" rule, it lets you select which formula will prevail.

The 1-2-3 functions are duplicated in Improv, and 1-2-3 spreadsheets can be imported to and exported from Improv. When importing spreadsheets, you can determine whether label names will be converted to items. Also, Improv will filter through the formulas, reducing them to the minimum set required to derive the desired result. The reduction varies, but most large spreadsheets, loaded with copied formulas, can be duplicated in Improv with only a handful of formulas.

Another important factor lending to the reduction in the number of formulas is the *recurrence formula*. A single expression can replace countless copied formulas. `Quarter[THIS]:Cost=Quarter[PREV]:Cost*1.25`, for example, escalates costs by 25 percent each quarter, starting from a constant value and stopping when there are no more cells. `FIRST`, `LAST`, and `NEXT` can also be used inside the brackets, as can an integer index. `Prices[3]` refers to the third cell under the item `Prices`.

Formulas can be restricted to operating on certain cells with the `IN` and `SKIP` clauses. `IN` restricts calculations to deal only with specified cells. `SKIP` operates similarly, instructing a formula *not* to mess with the specified cells. The result is that formulas can have scope, and portions of a worksheet can be made to calculate differently from others.

Gone is the age-old problem with clobbering formulas by accidentally typing over them. Improv will not allow data entry in any calculated cell. Selecting a formula will highlight the cells it affects.

The symbolic arrangement of data in Improv makes formulas easier to create, easier to read, and, therefore, easier to maintain. With well-chosen item names, most formulas read like English; look closely at the formulas in photo 1 and see if you understand what's going on.

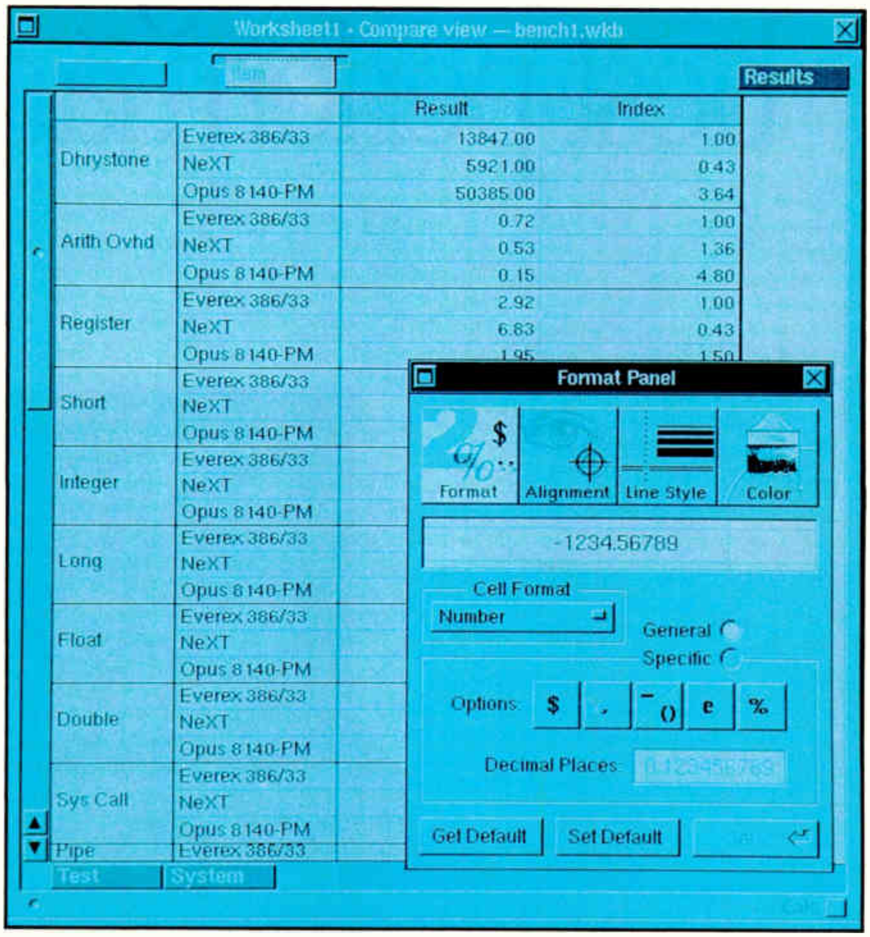

Photo 2: *The same worksheet as in photo 1, after having its data rearranged with flexible views. The format box is typical of Improv's interface: stylish and functional.*

The Hatchet Falls

Improv is *much* easier to use than to describe. There is great depth to its abilities, but the interface causes it all to make sense. To discuss *everything* that makes Improv special would fill several articles this size. Instead, here are a few points of interest that shouldn't be overlooked.

Presentation Builder is an Improv tool through which you create graphs from worksheet data. You can add freehand drawings, paste in worksheet contents, and bring in PostScript and TIFF graphics files. Help is rampant, and it can be brought up in context-sensitive, click-to-describe, and other modes. If you ask to open an Improv file that is currently in use by somebody else on the network, a warning panel is presented (which you can override).

In all, Improv knocked me out. It is the first *new* program that I've seen in months, and Lotus's design ideas are truly innovative. Lotus claims that the primary market for Improv will be experienced spreadsheet users who have outgrown the limited, traditional programs. That may be, but I'm convinced that new users, even those who have never used a computer before, will find Improv easier to learn and use. Running under Unix, Improv benefits from virtual memory, transparent networking, and multitasking. Running on the NeXT, it inherits the stunning NextStep graphical interface.

Lotus could have played it safe, producing (as with the Sun version of 1-2-3) a text-based spreadsheet that runs in a graphical window. Instead, the company decided to take a chance, and the results are astounding. You may never own a NeXT machine, but if you sit down to use a spreadsheet five years from now, chances are it will have a lot in common with Improv. ■

Tom Yager is a technical editor for the BYTE Lab. He can be reached on BIX as "tyager."

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Is the Typesetter Obsolete?

One thing is certain: You *can* do professional publishing with these high-end DTP packages

Stanford Diehl and Howard Eglowstein

Come on, admit it. You're still sending your serious documents out to a professional typesetter while your desktop computer sits by and collects dust. Perhaps you're printing your text from your word processor, cutting it up, and manually pasting the pieces together with rubber cement. Forget the typesetter, and put away those X-Acto knives. Desktop publishing (DTP) software has come a long way since you've last seen it.

We've taken a look at seven of the biggest and best of the DTP packages available for the Macintosh, the PC, and Unix workstations. Following a trend in the computing industry, DTP packages keep getting bigger, richer in features, and more complex. In the end, though, they should make your page look pretty; that's the primary goal.

While three of the reviewed packages—Interleaf Publisher, FrameMaker, and, to a lesser extent, Ventura Publisher—focus on long, technical documentation, the mainstream DTP products are primarily page-layout tools. With these packages, you pull in text from your word processor along with graphics from your drawing package and then move them around on the page until you get the effect you want. And since we are looking at packages at the high end of the market, the layout tools should be flexible, offer precise control, and provide some aesthetic perks.

We chose the products that are the acknowledged leaders in the professional DTP market; in other words, the products reviewed here are often used to publish newspapers and magazines. We did leave out, however, WYSIWYG word processors, such as Samna's Amí Pro, whose DTP features may rival the packages here but whose primary appeal is word processing. For further information on WYSIWYG word processors, see BYTE's September Product Focus, "Word Processors That Build Character."

What Is DTP, Really?

Five of the seven packages are meant for page layout, where you prepare your text in a word processor, your graphics in a drawing package, and your charts and tables in charting, CAD, or spreadsheet software. You then use the page-layout software to place the pieces so they look good on the page, with the layout software handling the columns, text wrapping, and typography.

The result is a page that's better-looking than what many people can do by hand, and one that's prepared faster and easier than when using a dedicated typesetter. You can make minor changes directly from the layout software; for bigger fixes, you go back to the word processor or graphics software. Included in this group are Letraset DesignStudio, Aldus PageMaker 3.01 (for the PC) and 4.0 (for the Mac), Quark XPress, and Ventura Publisher—five software packages that do the same kinds of things, but in different ways.

The other two packages that we reviewed use another approach to the DTP process. To keep the distinction clear, we'll refer to this class of software as *document publishing* programs. Where document publishing differs from page layout is in its attempt to encompass all the tools that a workgroup might need to manage a reasonably sophisticated technical document. This stuff isn't meant for advertisements or brochures, but for serious, lengthy documents, such as software manuals or textbooks. FrameMaker and Interleaf Publisher are two such products that have been ported to the desktop environment.

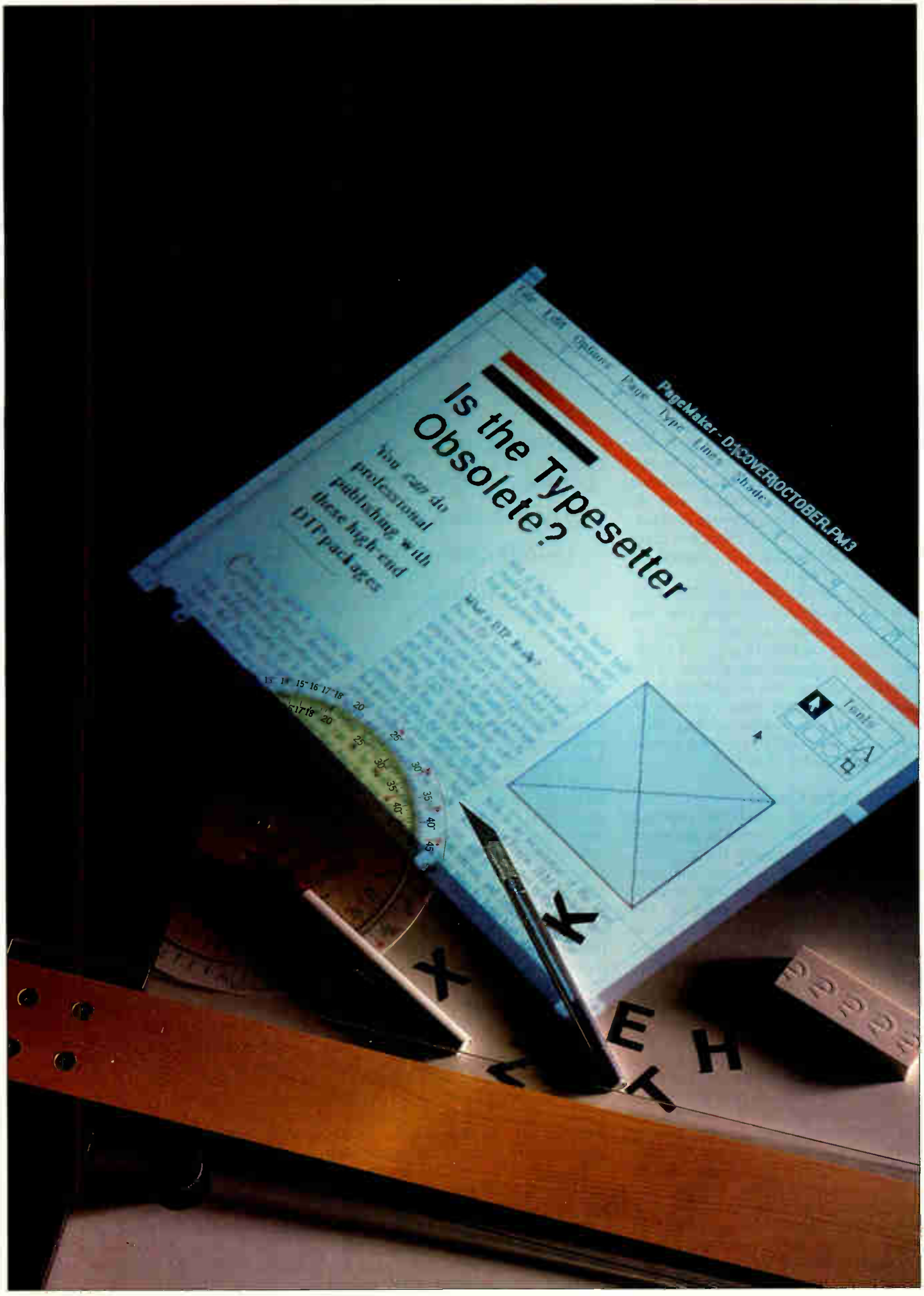
The idea behind document publishing is simply this: Instead of a word processor to write the text, a graphics package to draw the illustrations, and a page-layout package to assemble the pieces together, these functions are simply blended together into one package. One clear advantage is that a writer will know exactly how the text will flow in the finished document. With both FrameMaker and Interleaf Publisher, the graphics capabilities are scaled down to be undaunting to a technical writer, yet they're powerful enough to draw a reasonably sophisticated image. That's a good trick to pull off, and one that both companies have managed to do with some finesse. Perhaps best of all, the layout package is the word processor, so there's no problem with keeping the layout and word processor versions of the text in sync.

Laying It on the Line

We tested the seven DTP packages in two phases. We asked the page-layout software to produce a complicated layout with precise format specifications. Document publishing software is best at long documents, so we used it to generate a typical computer software user's guide of about 100 pages.

We used the page-layout packages to duplicate our March Product Focus, "A VGA on Every Desk." The project required using several sizes of type, importing TIFF and Encapsulated PostScript (EPS) files, creating footers with page numbers and headers with graphical elements, setting up a table with shaded lines and bulleted entries, and placing elements precisely on the page. We also

continued



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devised an ad to test text wrap capability.

We tested the Macintosh layout packages on a Mac II with 5 megabytes of RAM and a Radius Color Two-Page display. PageMaker 3.01 and Ventura Publisher (both the GEM and Windows 3.0 versions) ran very well on a Compaq 386/20 with 6 MB of RAM and a Radius TPD/PC monochrome monitor. We ran Interleaf Publisher on a Compaq 486/25 with 4 MB of RAM. FrameMaker ran on a Mac IIfx with 4 MB of RAM, a 13-inch AppleColor display, and Apple's Macintosh Display Card 8•24.

All the software installed easily, except for Quark XPress. With the proliferation of computer viruses making the rounds these days, putting a write-enabled master disk in a floppy disk drive is generally considered to be a bad idea. Quark XPress requires you to enable writes on one disk during the installation process—a risky proposition with the master disk of a $795 software package. Fortunately, it was easy enough to make a duplicate of the disk and complete the installation from the copy.

Testing the document publishers required a less visually complex page, but more word processing and formatting. We typed in the first 10 pages of a 100-page user's manual, using most of the available editing and formatting functions. To get a better handle on the software's ability to manipulate long documents, we filled in the rest of the manual with imported ASCII text.

Exploring the Layout

Three of the five page-layout packages use *frames* to place items on the page. You create a rectangular frame, which can contain text or pictures, and work within it. Once the frame is established, you can move, resize, or delete it. The notable exception to the frame-based products is PageMaker, which uses a more free-form approach. You can place text and graphics anywhere on the page. Once placed, an item becomes an independent block that you can manipulate much like a frame.

PageMaker and DesignStudio use a *pasteboard* to make it easier to move design elements from one page to another. In a conventional layout, the designer will usually place the page on a drawing table (the pasteboard) and use the table surface to organize the design elements. The computerized version does the same thing, giving the designer a familiar metaphor. (According to the manufacturer, Quark XPress will have a pasteboard function in version 3.0.) Ventura Publisher gives you a palette of available files that serves the same purpose as the pasteboard. We preferred the pasteboard to Ventura Publisher's file list or Quark XPress's use of the standard clipboard for storing elements. Having the design elements spread out on the pasteboard puts them right at your fingertips; the file palette requires you to remember what the elements look like.

More Than One Master

Another useful tool for page layout is master pages. Items placed on master pages show up automatically on all pages of the document. They are mainly used for repeated elements, such as page numbers, company logos, and headers. If you don't want the master items on any particular page, you have the option of disabling the feature. PageMaker, DesignStudio, and Quark XPress offer you two master pages—left and right—per publication. Unlike DesignStudio and PageMaker, Quark XPress's master pages are not retroactive. If you create a page and then go back and add an element to the master page, the change won't be reflected in the pages that you've already created; you have to delete the pages and recreate them. For version 3.0, Quark XPress will have master page support for up to 127 master pages, and they will be retroactive.

> *PageMaker, DesignStudio, and Quark XPress offer you two master pages —left and right— per publication.*

Ventura Publisher does not support master pages, but a couple of similar features make this less of a problem. First, you can set up headers and footers for both the left and right pages. You can then selectively turn these headers and footers off as you please. Ventura also has the capability of duplicating any frame across all pages.

We used master pages for our layout project when they were available. We set up a master page with headers and footers. The header contained two text elements and two lines of different weights. Our repeating header did not show up on the opening page spread, so we turned the master pages off. In Ventura Publisher, we placed all four of the header elements into a single frame and then configured it as a repeating frame. We could then turn the repeating frame off for the pages where the header did not appear. We used footers for the page numbers. However, we found Ventura's footers rather inflexible. You can't freely move a footer around on the page, nor can you include graphical elements. It's not clear why you would ever want to use footers when the repeating frame will do the same thing with considerably more flexibility.

Another useful design tool, supported by DesignStudio, is thumbnail views (see photo 1). Thumbnail views allow you to quickly preview the design of an entire document. You can also easily add, delete, or rearrange pages with this feature.

Just Rulers

All the programs except Interleaf Publisher can display a ruler at the top and sides of a page; this feature is indispensable if you need to duplicate exacting design specifications. As you move the mouse, the present cursor location is reflected by a hairline marker on the horizontal and vertical rulers.

Our project required placing the design elements precisely on the page. It was a simple matter to measure the original; we just marked the coordinates of each element to be placed. You can configure the rulers to reflect any desired measurement system: inches, centimeters, picas, or points. DesignStudio also displays the cursor's *x*,*y* location at the bottom of the page.

Guidelines make precise placement of objects even easier. Combined with a ruler, guidelines make it child's play to place items precisely where you want them. PageMaker, Quark XPress, and DesignStudio follow the same procedure for setting up guidelines. You simply place your cursor on top of the ruler, click, and drag. You now have a guideline stretching across the page. You can move the guideline anywhere you like and then release the mouse button. When you place an element, it will "snap" to the guideline. Guidelines dragged from both the horizontal and vertical rulers establish a precise intersection point. An object can then be placed directly at the intersection of the guidelines.

Ventura Publisher doesn't offer guidelines. Without them, not only is precise

continued

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placement of an object more difficult, but aligning objects across a page spread becomes a chore. Ventura definitely needs guidelines. However, an underlying grid helps cover this deficiency.

Ventura Publisher and DesignStudio both have a set of underlying horizontal and vertical lines that form a grid on the page. Elements snap to the grid in the same way that elements snap to guidelines. DesignStudio is the only program to offer both guidelines and a grid, although you can't use them at the same time. DesignStudio's grid is made up of a series of boxes. You specify a grid of, say, four boxes across and four boxes down, and then you draw a frame. The frame automatically expands to cover whatever boxes it touches. With Ventura, you can configure the grid precisely, using a variety of measurement units. In our project's features table, every other line was shaded. Each line measured 11 points, so we configured the grid to 11 points, starting at the upper left side of the table. We shaded the lines by placing yellow rectangles behind the text and snapping the rectangles to the grid. Unfortunately, the grid is invisible, which makes it somewhat more difficult to work with.

For additional flexibility, Quark supports *nudging*. With this feature enabled, you can move objects in 1-point or $^1/_{10}$-point increments by using the Mac's arrow keys.

The Right Type

The latest versions of DTP software have made impressive gains in typography capability (see table 1). You now have tighter control over the way your type looks and how the type flows across the page.

All the DTP programs allow you to use an unlimited number of fonts on a page. That's as it should be, although conventional wisdom usually calls for an absolute maximum of four fonts within a publication. Perhaps a dialog box should pop up if more than four fonts are used, warning the user that the document violates this usage rule. Unfortunately, however, none of these products supports "ugly alerts" yet.

The overall character height plus ascenders and descenders is known as the *point size*. PageMaker 3.01 and Ventura Publisher give you font sizes in increments of half-points. PageMaker 4.0 offers font sizes in tenths of a point. Quark XPress 2.12 supports quarter-point sizes, but version 3.0 promises to deliver point sizes in thousandths of a point. DesignStudio supports font sizes in hundredths of a point.

Get the Lead Out

Back when type was set by hand, small pieces of lead were used to set the spacing between lines. Leading is typography-speak for the amount of space between lines of text.

Traditionally, leading is measured as the additional space added between two lines; in the DTP environment, the leading and character size are usually added into one number. For example, the text you're reading now is printed in roughly a 10-point character. Two points of leading are added to each line, making the baselines of any two lines about 12 points apart. You'd specify this in a DTP package by selecting a 10-point character with 12-point leading. *Auto-leading* is a convenience added to the specification. It tells the DTP package to make the leading a percentage of the character size; 120 percent is common as a default and would yield the 12 points in our example. All the layout packages we reviewed let you select the overall leading as an absolute number. Figure 1 shows some text with the point size measurements marked.

While leading sets the amount of vertical space for a line, *tracking* sets the amount of horizontal space. PageMaker 4.0, for instance, offers five tracks: very loose, loose, normal, tight, and very tight (see figure 2). With loose tracking, characters are spread out more; tight tracking squeezes characters together. Ventura Publisher is more limited, offering only two levels of tracking. PageMaker 3.01, on the other hand, doesn't have tracking.

DesignStudio gives you three tracks, but it also lets you select tracking values for each of the three from a tracking graph. By moving points on a curve, you pick the tracking values in *ems*. An em is defined as a space equal to the width of the character's point size. A 10-point character would define an em to be 10 points. Traditional typesetting adjusts character spacing in fractions of an em; a 2-em space is half of an em. Similarly, 3-em, 4-em, and 5-em spaces are one-third, one-fourth, and one-fifth of an em, respectively. All the layout packages we reviewed allow you to control this intercharacter spacing manually. Using a variation of the Control-space bar combination or the arrow keys, you can insert fractional em spacing; pressing Control-Backspace removes fractional em spacing, a sort of anti-em.

Quark XPress gives you full control, accepting a numeric entry for tracking as well as allowing edits to a font's tracking graph. Photo 2 shows Quark's tracking controls. For each font style, you can bring up a graph that lets you set the tracking, in percentage, for every type size. It's more control than most people will be able to use, but if you're trying to do fancy things with type, all that power will leave you feeling a little giddy.

Some pairs of letters look especially awkward next to each other unless they are moved closer together. *Kerning* is an adjustment made to specific characters to account for their shape. DesignStudio and Quark XPress allow editing of a font's kerning table. You can change the values of selected letter pairs or add new pairs to the kerning tables. DesignStudio adds an extra perk by letting you magnify automatic kerning. You can select a percentage value to be applied to the default kerning values. For example, a value of 100 percent would accept the exact value specified in the kerning table,

continued

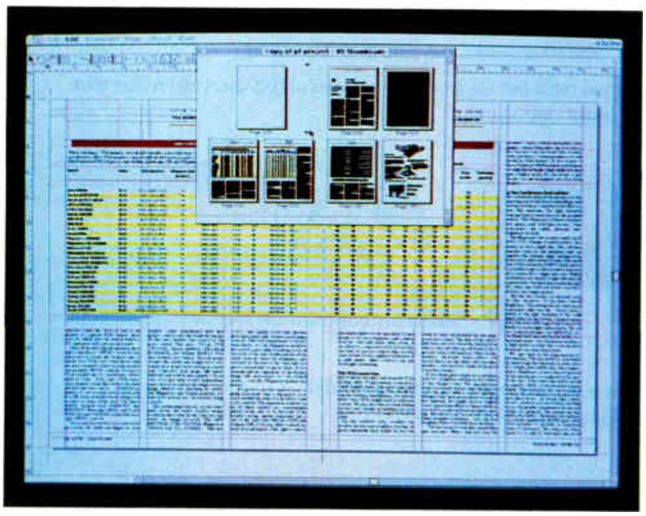


Photo 1: *With DesignStudio's thumbnail views, you can preview the overall design of a document as well as delete, insert, and arrange pages.*

LAYOUT AND TYPOGRAPHY

Table 1: *High-end DTP packages give you tight control over the way your type looks and how it flows across the page (● = yes; ○ = no; N/A = not applicable).*

	Aldus PageMaker 3.01 (PC)	Aldus PageMaker 4.0 (Mac)	Frame Technology FrameMaker 2.1 (Mac)	Interleaf Publisher 3.0 (PC)	Letraset DesignStudio 1.01 (Mac)	Quark XPress 2.12 (Mac)	Ventura Publisher 3.0 (PC)
Price	$795	$795	$995	$995	$795	$795	$795
Configuration requirements	2 MB, Windows 3.0	1 MB RAM	Mac SE, 2 MB RAM	386, 2 MB RAM, 15 MB disk space, EGA, PostScript printer	System 6.0.3, 1 MB RAM	Mac with 2 MB RAM	640K RAM, MS-DOS 2.1 or higher
Page layout							
Configurable ruler lines	●	●	●	○	●	●	●
Show cursor position on ruler	●	●	●	N/A	●	●	●
Report cursor coordinates	○	○	●	○	○	●	○
Guidelines	●	●	○	○	●	●	○
Grid overlay	○	○	●	●	●	○	●
Configurable grid	○	○	●	●	●	○	●
Master pages	●	●	●	○	●	●	○
Multiple master pages	○	○	●	N/A	○	○	○
Turn master page on or off	●	●	●	N/A	●	○	○
Pasteboard	●	●	○	○	●	○	○
Tool palette	●	●	●	●	●	●	○
Style catalog on-screen	●	●	●	●	○	○	●
File catalog on-screen	○	○	●	○	○	○	●
Typography							
Font-size range (points)	4-127	4-650	4-400	6-72	Up to 327	2-500	1-254
Half-point sizes	●	●	●	○	●	●	●
Quarter-point sizes	○	●	●	○	●	●	○
Tenth-point sizes	○	●	●	○	●	○	○
Kerning precision	No manual control	0.01 em	0.1 em	○	0.001 em	0.1 em	0.01 em
Edit kerning tables	○	○	○	○	●	●	○
Tracking control (no. of levels)	1	5	Entered as %	○	3	Unlimited	2
Edit tracking graphs	○	○	○	○	●	●	○
Adjustable leading (increments)	1 point	0.1 point	0.001 point	0.01% of point size	0.01 point	0.001 point	0.01 point
Subscripts	●	●	●	●	○	●	●
Superscripts	●	●	●	●	○	●	●
Small caps	●	●	○	○	●	●	●
Shift baseline	●	●	○	○	0.01 point	0.01 point	0.01 point
Column balancing	○	○	○	●	○	○	●
Vertical justification	○	○	●	●	●	○	●
Widow/orphan control	○	●	●	●	○	●	●
Text editing							
Search and replace	○	●	●	●	●	●	○
Search and replace fonts	○	●	●	○	●	○	○
Spelling checker	○	●	●	●	●	●	○
ASCII markup language	○	○	●	●	○	○	○
Automatic text flow	●	●	●	●	○	●	●
Views							
50%	●	●	●	○	●	●	●
200%	●	●	●	○	●	●	●
400%	●	●	●	○	○	○	○
800%	○	○	●	○	○	○	○
User-specified	○	○	●	○	○	○	○
Edit facing pages	●	●	●	○	●	●	●
Thumbnails	○	○	●	○	●	○	○
Printing							
Scale	●	●	●	○	●	●	○
Tiling	●	●	○	○	●	●	○
Print crop marks	●	●	●	○	●	●	●
Spot color overlays	●	●	●	○	●	●	●
Print to EPS file	●	●	○	Regular file	●	●	●
Precise control							
Manually enter coordinates of frames/objects	○	○	●	○	●	●	●
Move objects incrementally with cursor keys	○	○	●	○	●	●	○
Numeric entry for tab stops	○	●	●	●	●	●	●
Align objects	Manual	Manual	●	●	●	○	○

while a higher value would move all kerning pairs closer together.

A Matter of Styles

Given all these diverse typographic controls, you could spend hours adjusting the text styles in your publication. This is where paragraph tags and style sheets come in. Once you have established the formatting for a particular paragraph, you can assign a name, or "tag," to that format. From then on, you simply assign that tag to a paragraph, and it takes on the format associated with the tag. A style sheet is a collection of tags found in the document. Style sheets can be saved on disk and recalled into other documents. Paragraph tags and style sheets give you a lot of flexibility and save gobs of time.

Ventura Publisher excels at style sheets. It stores a catalog of paragraph tags in a style sheet that contains page-layout information, auto-numbering, chapter typography, and footnote settings. Ventura assigns a tag to every paragraph in the publication. This takes some getting used to at first. Before you fiddle with the formatting of a block of text, you should make sure to assign a tag to the text you are working on. Otherwise, the text will default to the "body text" tag, and your formatting changes will affect all paragraphs with the default tag. Other programs—PageMaker, for instance—will let you enter text without assigning a tag to it.

With PageMaker's Next Style option, you can designate a style to follow the current one. For example, take a look at the style of this article. Each subhead is followed by a flush-left paragraph (i.e., with no indent). The second paragraph following a subhead is then indented. This setup calls for three paragraph tags. Using the Next Style option, you could define the subhead tag and specify the following tag as "first paragraph." The first paragraph tag could then call on "body text" as its next style. In this way,

continued

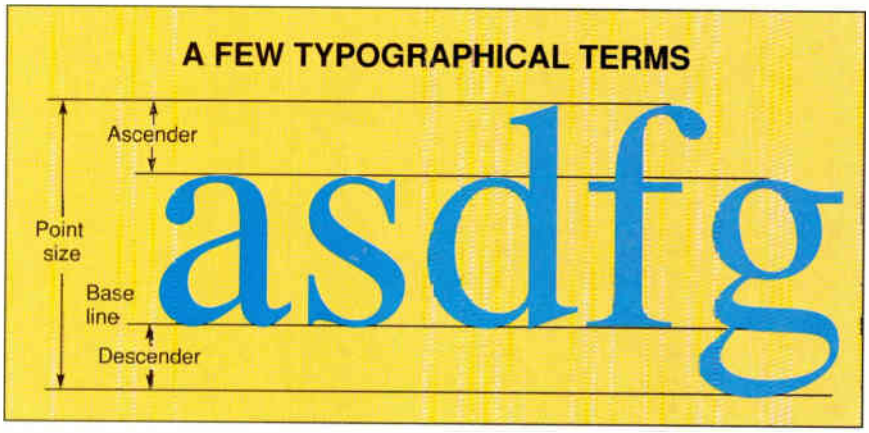


Figure 1: *A font's point size is measured from ascender to descender. Traditional leading specifies the space between one line's descender and the next line's ascender. However, these DTP packages measure leading from ascender to ascender. All the packages allow you to shift the text baseline for custom subscripts and other effects.*

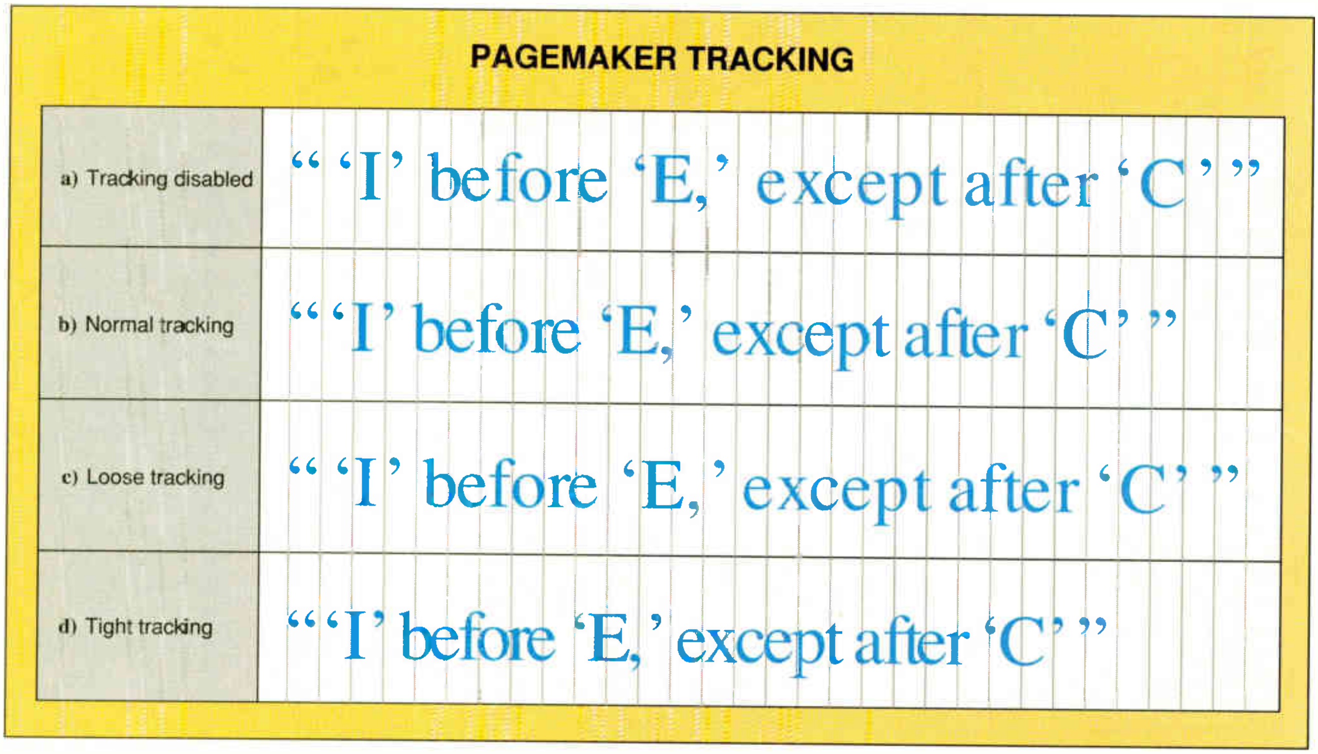
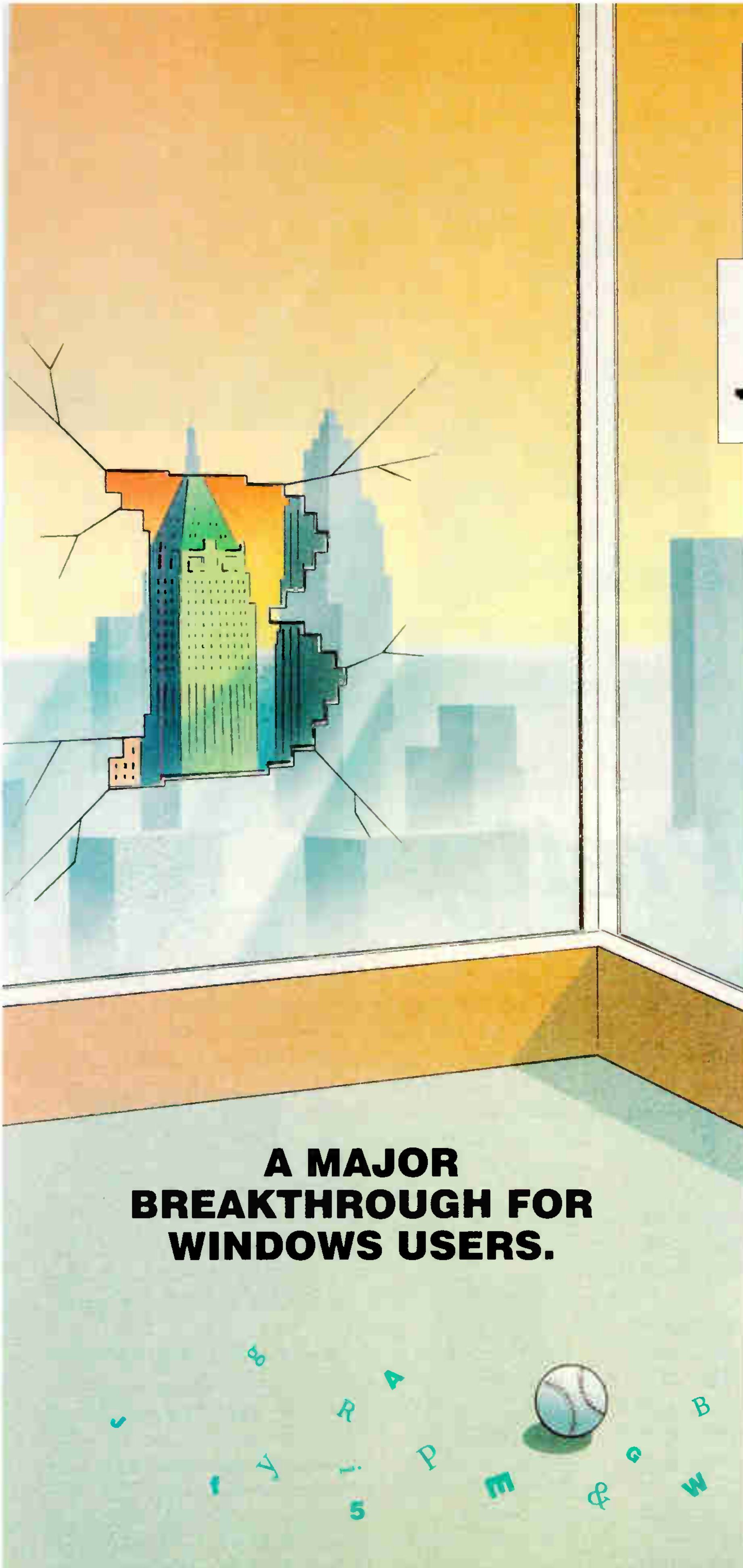


Figure 2: *Tracking controls the horizontal spacing of your text. Loose tracking spreads the text out; tight tracking squeezes it together. PageMaker offers five levels of tracking; Ventura Publisher, two; and DesignStudio, three. Quark XPress offers flexible numeric control over tracking.*



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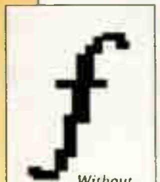

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Positive pressure, filtration	Yes	No	No
Operation at 55°C/131°F	Yes	No	No
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Maximum expansion slots available	14	5	5
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Toll-free support number	Yes	No	No
Regional sales support	Yes	No	No
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you need only apply the subhead tag, and the rest of the paragraphs following the tag are formatted automatically.

Watching Your H's and J's

Professional publishing systems contain sophisticated algorithms for hyphenation and justification (H&J) of text. With some of these DTP packages, you'd be hard-pressed to tell the micros from the minis.

An H&J algorithm will employ several different strategies for achieving good-looking justified text. All the programs have basic hyphenation controls. These include limiting the number of successive lines that can end with a hyphen, as well as specifying the smallest word that can be hyphenated and the minimum number of letters allowed before and after a hyphen.

Of course, DTP developers could take the lazy way out and hyphenate everything, but rarely is hyphenation the most desirable method. These programs will normally attempt other options before resorting to hyphenation.

Advanced DTP programs will adjust the space between words and characters within specified limits. You specify the spacing you prefer, as well as the minimum and the maximum that you want to allow. The H&J algorithm will begin to increase or decrease the space between words within those limits. Normally, an algorithm will attempt word spacing before resorting to intercharacter spacing. PageMaker and Ventura Publisher will override spacing limits if necessary but can highlight "loose" lines if you like.

DesignStudio gives you a choice between "standard" and "professional" justification. Standard justification is less picky about avoiding a hyphen, refusing to adjust intercharacter spacing whatsoever. The professional option lets you specify minimum and maximum values for word and character spacing.

High-end DTP produces professional results even if you choose not to justify your text. Unjustified text is called "ragged." Word processing software normally does not have any algorithms for managing ragged text; words simply fall where they fall. Ideally, you want every line to be a different length from the adjacent ones, and all the layout packages we reviewed except PageMaker provide that capability. Only Quark XPress lets you configure the "ragged zone." For instance, if you enter a value of 90 percent, every other line of text will be set to a line length that is 90 percent of the default line length.

All the programs except Ventura Publisher let you configure a "hyphenation zone" for ragged text. When the last word in a line of text exceeds the line length, the program will check the hyphenation zone. If the previous word falls within the hyphenation zone, the last word will wrap to the following line. If the previous word falls outside of the zone, the last word on the line will be hyphenated, if possible.

For that professional look, the lines should also be justified vertically. Vertical justification ensures that the last lines of each column across the page line up correctly.

Text Editing: The Word Processor's Domain

As we pointed out earlier, DTP software merges the outputs of your word processor and your illustration package. They do not claim to be text editors. PageMaker 3.01 and Ventura Publisher are especially lame when it comes to editing text.

Ventura, to its credit, maintains a two-way link that keeps the publication's text files updated. The text file on disk retains Ventura's paragraph tags. With this scheme, you can use your favorite text editor to complete any serious text-editing chores and remain confident that your Ventura publication will retain its formatting. The text-editing limitations in PageMaker 3.01 are more serious because it lacks this link. Once a document is laid out and formatted in PageMaker, you are practically forced to use the program for text editing.

The Macintosh products inherit the basic text-editing capabilities that Mac products always seem to have: cutting, copying, and pasting of WYSIWYG text. PageMaker 4.0 builds on version 3.01 by adding the Story Editor. This integrated editor abandons WYSIWYG mode and brings up a selected text story in a separate window. You won't see your formats, but the paragraph tags are listed in the left margin. In the Story Editor, you won't have to wait for the screen to update, or for text to wrap around an object. And you no longer have to read squinty WYSIWYG text when you make changes.

Aldus has filled another gap by adding a spelling checker to PageMaker 4.0. Quark XPress, FrameMaker, Interleaf Publisher, and DesignStudio also include spelling checkers. PageMaker 3.01 and Ventura Publisher leave spelling checking to your word processor. With PageMaker 3.01, that means you have to completely proof your text before placing it in the publication. Once it's been placed, it's much harder to find your typos, and PageMaker won't offer you any help.

The two PC products that we reviewed, PageMaker 3.01 and Ventura Publisher, also lack search-and-replace facilities. All the Mac products now perform search and replace. In most, you can search for not only text, but specified fonts, sizes, type styles, and paragraph styles as well.

Adding Graphics

A professional-looking document is more than just a pretty typeface. It also requires graphics, and your layout package should provide some facility to generate its own and also import graphics from other sources. PageMaker, DesignStudio, and Quark XPress are all meant to put together elements from different sources. They all handle a good number of formats (see table 2). Generally, you select the element from a list of files and

continued

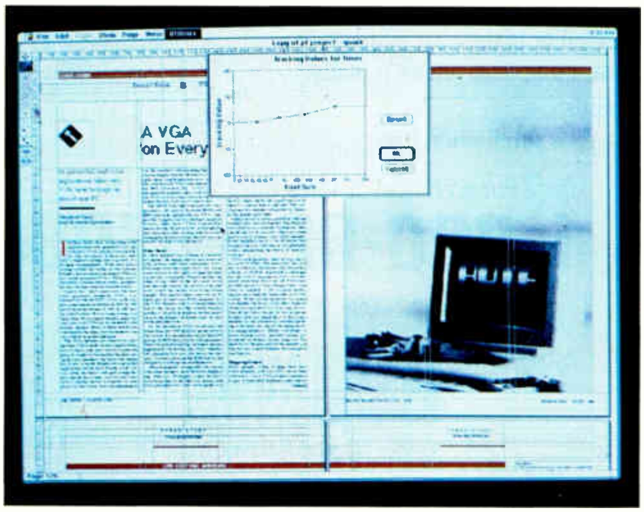

Photo 2: *Quark XPress goes a step further with tracking control by allowing you to edit its tracking graphs. The y-axis specifies the space between characters, while the x-axis specifies font size.*

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DOCUMENT CONTROL

Table 2: *All the reviewed DTP packages provide varying degrees of document control and file support (● = yes; ○ = no).*

	Aldus PageMaker 3.01 (PC)	Aldus PageMaker 4.0 (Mac)	Frame Technology FrameMaker 2.1	Interleaf Publisher 3.0	Letraset DesignStudio 1.01	Quark XPress 2.12	Ventura Publisher 3.0
Document control							
Two-way link to text file	○	○	○	○	○	●	●
Revision tracking	○	○	○	○	○	○	○
Change bars	○	○	●	●	○	○	○
Multiple files open	○	○	●	●	○	○	○
Document specifications							
Maximum pages	128	999	Unlimited	Unlimited	200	100	Unlimited
Custom page sizes (inches)	To 17 by 22	To 17 by 22	To 48 by 48	To 35 by 35	To 99 by 99	To 48 by 48	To 18 by 24
Double-sided	●	●	●	○	○	●	○
Mix portrait and landscape pages	○	○	●	○	○	○	○
Reorder pages	○	○	○	●	●	●	○
Long documents							
Automatic index generation	○	●	●	●	○	○	●
Automatic TOC generation	○	●	●	●	○	○	●
Cross-references automatically updated	○	○	●	●	●	○	●
Index of figures	○	○	●	●	○	○	●
Network support							
Simultaneous users	●	●	○	○	○	○	●
Lock files	●	●	●	●	○	○	●
Read-only	●	●	○	○	○	○	●
Lock elements (e.g., frames and objects)	○	○	○	○	○	○	○
Tabling	○	●	●	○	○	○	●
Equation editing	○	○	●	●	○	○	●
File formats							
Microsoft Word	●	●	●	○	●	●	●
XyWrite	●	●	○	○	○	○	●
WordPerfect	●	●	○	○	●	●	●
MacWrite	○	●	4.5 & 5.0	○	●	●	○
Write Now	○	●	○	○	●	●	○
EPS	●	●	●	●	●	●	●
TIFF	●	●	●	●	●	●	●
PICT	○	●	●	○	●	●	●
Sun Raster	●	●	●	●	○	●	●
HPGL	●	○	○	●	○	○	●
WMF	●	○	○	○	○	○	●
PCX	○	○	○	○	○	○	●
GEM	○	●	○	○	○	○	●
MacDraw	○	●	○	●	○	●	○
MacPaint	●	●	●	●	○	●	●
RTF	●	●	○	●	○	○	○
DCA	●	○	○	●	○	○	●
DBF	●	○	○	○	○	○	○
SYLK	○	○	○	○	○	○	○

either plop it onto the page directly (as with PageMaker) or stick it into a predefined frame (as with Ventura Publisher, Quark XPress, and DesignStudio). Interleaf Publisher and FrameMaker also handle foreign graphics formats, but that's not where they're at their best.

All the packages that we reviewed provide some kind of drawing capabilities (see table 3). Common elements include rectangles, lines, and circles, with varied amounts of fill and bordering capabilities. What we found disappointing was that neither PageMaker nor Ventura Publisher provides a Group function. DesignStudio and Quark XPress allow you to select a group of elements and glue them together so they become referenced as one element. By doing that, you will ensure the alignment between them, and simpler elements are much easier to handle. PageMaker 3.01 does not have a Group function, but we hope that version 4.0 will add it.

High-end DTP should also offer flexible tools for wrapping text around a graph. Quark XPress and DesignStudio share the best approach. The text can automatically wrap around an irregular shape within a frame. With PageMaker, you must click and drag the graphic's borders to form the desired wraparound shape (see photo 3). Ventura Publisher will only allow text to wrap around a rectangular frame. When we created our

continued

GRAPHICS

Table 3: *Although all the DTP packages provide some kind of drawing capability, they differ in the ways they let you manipulate graphics (● = yes; ○ = no).*

	Aldus PageMaker 3.01 (PC)	Aldus PageMaker 4.0 (Mac)	Frame Technology FrameMaker 2.1	Interleaf Publisher 3.0	Letraset DesignStudio 1.01	Quark XPress 2.12	Ventura Publisher 3.0
Graphics manipulation							
Flow text around graphics	●	●	Manual	○	●	●	●
Run around irregular shape	●	●	Manual	○	●	●	○
Text repel	○	○	Manual	○	●	●	●
Anchor graphics to text	○	●	●	●	○	○	●
Anchor graphics to position on page	○	●	●	○	●	●	●
Suppress display of graphics	○	●	●	○	●	○	●
Automatically scale graphic to fit frame	●	●	●	●	○	○	●
Manually scale graphic	●	●	●	●	●	●	●
Cropping	●	●	●	●	●	●	●
Contrast control	●	●	○	●	●	●	○
Halftone screening	●	●	○	○	●	●	●
Custom screening	●	●	○	○	●	●	●
Customized screening angle	●	●	○	○	●	●	●
Dithering controls	○	○	○	●	●	●	○
Negative	●	●	○	●	●	●	○
Drawing							
Rectangles	●	●	●	●	●	○	●
Circles	●	●	●	●	●	○	●
Polygons	○	○	●	●	●	○	○
Constrained lines	●	●	●	○	●	●	●
Other shapes	○	○	●	●	●	○	○
Free-form drawing	○	○	● (freehand curves)	●	○	○	○
Special effects							
Rotate text	○	90-degree increments	90-degree increments	●	0.1-degree increments	○	90-degree increments
Rotate graphics	○	○	90-degree increments	●	0.1-degree increments	○	○
Flip graphics	○	○	●	●	●	○	○
Pour text into shapes	Manual	Manual	○	○	●	○	○
Shapes for graphical frames	○	●	○	○	●	●	○
Step and repeat	○	●	○	●	●	●	○
Repeat frame across pages	○	○	○	○	○	○	●
Gravity	●	●	●	●	○	○	○
Condense/expand text	○	●	○	○	●	○	○
Color							
Spot colors	●	●	●	○	●	●	●
Process	○	●	○	○	●	●	○
Pantone	○	●	○	○	●	●	○
Charting functions	○	○	○	●	○	○	○

ad with Ventura, we were forced to insert several manual carriage returns to create the effect we were after (see photo 4).

The document publishing software takes a slightly different tack with graphics generation. The intended audience is writers who are probably not artists and don't need full drawing tools. Still, they are technical people, and they need the ability to create the kinds of technical illustrations that you usually see in journals and books.

The drawing tools in FrameMaker and Interleaf Publisher are very similar (see photo 5). You create a frame and place rectangles, circles, and other elements within it. Unlike the simplistic tools in the layout packages, these tools have *gravity*, which makes objects stick together. An experienced artist could use a sophisticated drawing tool and ensure that two lines touch or that a line is perfectly tangent to a circle. The Gravity and Snap features in FrameMaker and Interleaf Publisher make it easy for a nonartist to achieve the same results. You wouldn't want to draw the Mona Lisa with these tools, but many DTP users couldn't draw the Mona Lisa with any package.

Bells and Whistles

These packages add some unexpected features to make your layout work less tedious. Our project called for a drop cap (the big character leading off the first paragraph of an article). With most of the DTP packages, we had to set up a separate text block for the drop cap. But Ventura Publisher lets you select the first paragraph and assign a drop cap to it. You can then set the first character's font properties and specify how many lines the character should span vertically. Ventura uses the same technique for adding text bullets.

Another extremely useful function is called *step and repeat*. You can select an object and repeat it several times in one operation. You can also configure the

continued

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step, or amount of space, between each repetition. We used this feature when highlighting lines of the project's features table. We drew a box around the first line of the table and shaded it. We then selected the box, specified the number of times to repeat it (i.e., the number of lines to be shaded), and set the step to twice the leading of the table's lines. With a click of the mouse, the program dutifully copied the shaded box to every other line of the table. With PageMaker 3.01 and Ventura Publisher, we had to cut and paste the old-fashioned way.

All the programs except PageMaker 3.01 and Quark XPress support text rotation to some degree. Depending on your application, this capability may be a perk or a necessity. Ventura Publisher and PageMaker 4.0 allow text rotation in 90-degree increments. DesignStudio supports rotation to any angle in tenths of a degree. Quark XPress 3.0 will have a rotation tool that supports rotation to any angle in thousandths of a degree.

The Long and Short of It

One criticism that was leveled at earlier DTP products was that they couldn't handle long documents well. PageMaker 1.0 and 2.0 were particularly lacking in this area. Ventura Publisher was always better because of its multichapter approach and its auto-linking of files to the published document. Now that FrameMaker and Interleaf Publisher are available on both Macintoshs and PCs, the page-layout packages positively pale in comparison.

With DTP appearing on seemingly every desk in businesses of all sizes, document management is a real issue. On projects of more than a few pages in length, it's a common practice to have one or more writers handling the text, an artist drawing the illustrations, and a design artist assembling the pieces together in the page-layout package. While that may be an efficient way to handle the work flow, updating the finished document can be a nightmare.

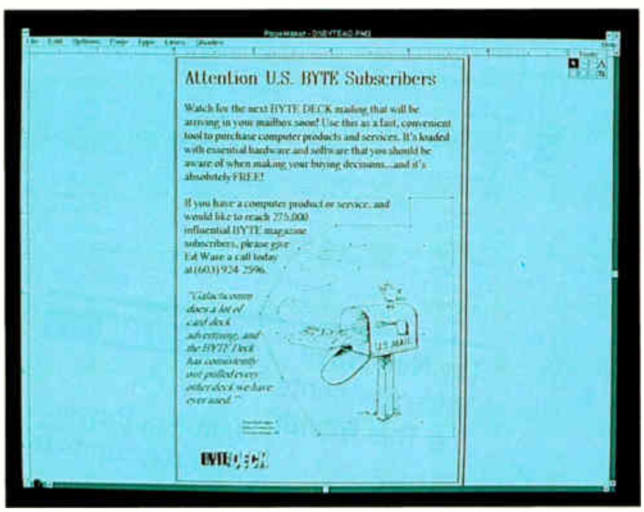

Photo 3: *For flexible text wrap, PageMaker lets you pull in the boundaries around a graphical object. You can click on the boundary to create a handle and then drag the handle around with the mouse. Quark XPress and DesignStudio automatically wrap around an image.*

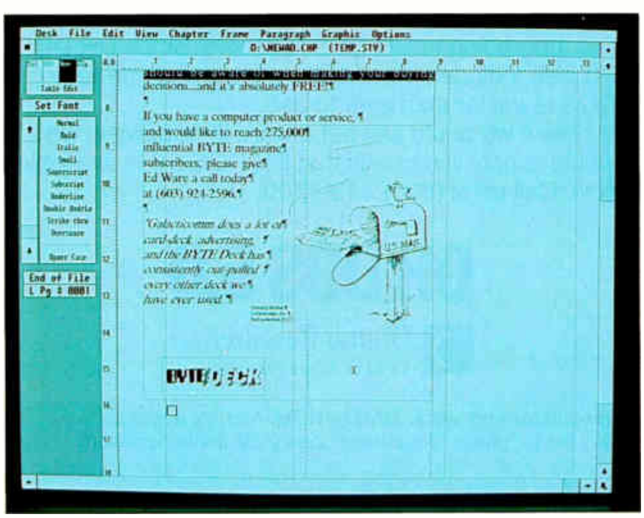

Photo 4: *Ventura Publisher's frames are less flexible. You can wrap around a frame's boundaries, but not around the graphical image within. To achieve a suitable wrap, we had to insert numerous carriage returns.*

Some layout packages, like Ventura Publisher, keep the text in the original word processor files and simply reference it when needed. This approach simplifies the update process because it allows a writer to make revisions to the text while the page designer makes more global style revisions.

Quark XPress, PageMaker 3.01, and DesignStudio handle text very differently. These packages read the text from the word processor file and incorporate it directly into the layout software's data file. The disadvantage in a shared work environment is obvious: Only one person can work with the file at a time, and that person must be familiar with the page-layout software. What's worse is that if someone makes changes to the external file, the changes won't be reflected in the final document unless that text is reimported into the page-layout software.

PageMaker 4.0 addresses this last problem by adding a Link facility to track the status of the original file. When active, PageMaker's Links will alert you that the original file has changed since the PageMaker file was last opened. You then choose whether to reimport the text, with the understanding that if you do, any finished formatting you may have added to the text will be lost.

One way around this lies in the network itself. On most networks, when you open a file, no one else on the network can open that same file. It's important to make sure that everyone in your workgroup uses the editing facility in the layout software and loads the file directly from the network. That way, the network file server will deny access to anyone else who tries to load the document, thereby ensuring that no one will clobber your changes. Of course, that also means that everyone else will have to twiddle their thumbs while you are making your changes, but isn't that better than having to redo them?

In a shared workgroup, Ventura Publisher's approach is the most workable of those of the general layout packages. With Ventura, you place the original file in position, and Ventura interprets the word processor's format to the best of its ability. If you make any changes to the text while in Ventura, Ventura adds these to the original file in the form of bracketed comments or native formatting commands. Later, if you need to make revisions to the text, your word processor will show you the formatting changes that have been applied in Ventura. Simply work around them when you make your edits, and they'll come right back

continued

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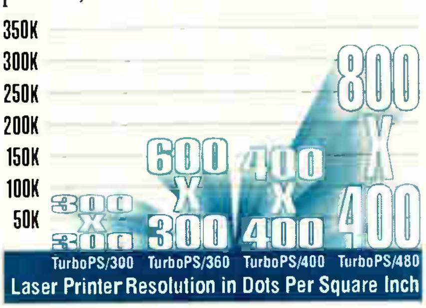
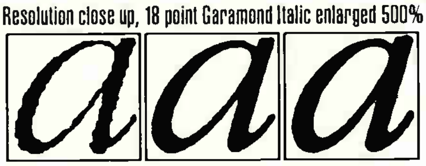


Resolution close up, 18 point Garamond Italic enlarged 500%



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With a fully compatible network like TOPS, Novell, or AppleShare, any of the files used in your publication could be stored in public network volumes, making shared access that much easier. One common—and, in fact, dangerous—practice is for people to use the network facility to pass the files around, but copy the files to their local hard disks before using them.

The danger here is that most networks have no provision for locking the files in that situation, and there is nothing to keep two people from working on copies of the same file. A person may make changes, not knowing that a copy has already been worked on, and inadvertently wipe out changes made by someone else. While networks can be a godsend to a workgroup producing a large publication, it's critical that checks and balances be added to make sure mishaps like this don't happen.

Book 'Em, Danno

Aldus has beefed up PageMaker considerably with the ability to put 999 pages in a document and link multiple documents together in a "book." For most people, document publishing is definitely the right way to produce long documents, particularly if these documents have fairly rigid formatting.

Document publishing has another advantage: last-minute changes. With either FrameMaker or Interleaf Publisher, you are working directly in the final document, with the formatting set onscreen. You see how the finished publication will look without having to reflow the text into your layout package. This can be a big time saver and can eliminate the need for your production department to get involved. The document writers and editors do their own production, in a manner of speaking.

FrameMaker and Interleaf Publisher are both blessed with a host of features that you would want when working on a lengthy document. In fact, the tables illustrate how close these two packages are in raw features. The table of contents and index features will let you tag a text element as belonging to one of these two sections. The software automatically tracks the element and creates the table of contents and index for you. In all fairness, PageMaker and Ventura Publisher provide a similar capability, but it's a somewhat more manual process.

Interleaf will be taking book production a step further in Publisher 5.0 with the introduction of its "active document" technology. Active documents can be thought of as related to hypertext, but with a twist. Active documents have the facility to behave differently under different circumstances. Interleaf 5.0 will allow you to flag portions of a document to know things about themselves. For instance, a document can check to see what access level an editor has on the network and provide access to different parts of the document. The results of a database access can be merged so that a document can automatically search a database, make formatting changes based on the result, and then bring up the final result in the WYSIWYG editor.

This is powerful stuff, and in some applications it may make printing your document unnecessary. The downside is that it won't be available until late this year for the Unix environment, and not until 1991 for the PC.

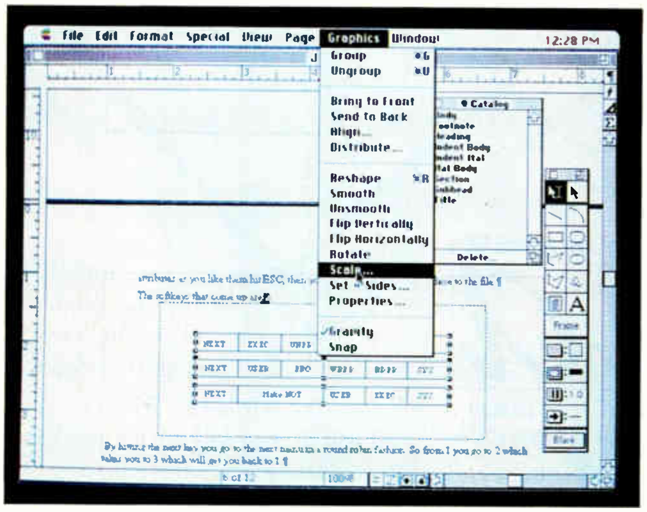


Photo 5: *FrameMaker's drawing tools and palette. The Tool menu selection includes rectangles (with or without rounded corners), polygons, circles, and freehand curves. The pull-down menus also include a Group selection for combining multiple objects into one.*

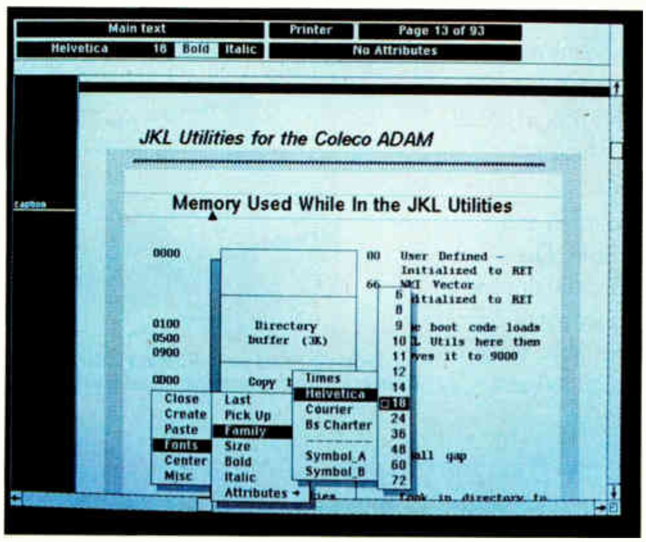


Photo 6: *Interleaf's daughter-menus. With a two-button mouse, the left button selects an object, and the right button brings up a system menu. The menu appears where the mouse pointer is onscreen, automatically selecting relevant choices. In most cases, the correct choice is automatically highlighted.*

The Right Type

Until there are service bureaus in space, you can't do DTP in a vacuum. It's important to have the ability to share DTP files with other software and to transmit finished documents for final output. For the most part, DTP software does its output in PostScript. PC software can also do a good job on the Hewlett-Packard LaserJet, but most high-end stuff is formatted in PostScript.

What most users typically do is generate proof copy on a black-and-white 300-dot-per-inch PostScript printer. We did our testing with both an Apple LaserWriter IINT and an HP LaserJet III with a PostScript cartridge. Both did a fine job of giving us the output we wanted. For serious output, 300 dpi isn't enough, so many people capture the PostScript output to a file and ship that file off to a service bureau. These bureaus use 1200- or 2400-dpi PostScript typesetters to produce the kind of quality that you see here in the pages of BYTE.

File compatibility is another issue.

continued

COMPANY INFORMATION

Aldus Corp.
(PageMaker 3.01 and 4.0)
411 First Ave. S
Seattle, WA 98104
(206) 622-5500
Inquiry 1060.

Frame Technology Corp.
(FrameMaker 2.1)
1010 Rincon Cir.
San Jose, CA 95131
(408) 433-3311
Inquiry 1061.

Interleaf, Inc.
(Publisher 3.0)
Ten Canal Park
Cambridge, MA 02141
(617) 577-9800
Inquiry 1062.

Letraset Graphic Design Software
(DesignStudio 1.01)
40 Eisenhower Dr.
Paramus, NJ 07653
(800) 343-8973
(201) 845-6100
Inquiry 1063.

Quark, Inc.
(Quark XPress 2.12)
300 South Jackson St., Suite 100
Denver, CO 80209
(303) 934-2211
Inquiry 1064.

Ventura Publishing Co.
(Ventura Publisher 3.0)
15175 Innovation Dr.
San Diego, CA 92128
(800) 822-8221
Inquiry 1065.

None of these page-layout packages can read output from any of the others. If you're planning on sharing files with another DTP workstation, make sure that you're using the same software.

The platform need not be the same, however, as a few of these packages run on multiple platforms. FrameMaker runs on the Mac, in addition to a number of Unix workstations. Interleaf Publisher is available for both Unix and DOS, although the DOS version may not be able to properly handle a file from the Unix version. The Unix package is in version 4.0, which has some features not present in the DOS version. PageMaker runs on both the PC (under Windows 3.0) and the Mac. To move files from one platform to the other, you need to have version 3.0 on both platforms; PageMaker 4.0 on the Mac won't read PC PageMaker 3.0 files, and PC PageMaker 4.0 is not yet available.

FrameMaker and Interleaf Publisher give you one more added goody—they can output their files into proprietary programming language formats. The nice thing about this capability is that you can have a database or some other software preformat your data into this language and have the document automatically formatted as it's read in.

Ready for the Big Time?

Here at BYTE, there's some serious talk going on about producing the magazine by DTP. In fact, our designers already lay out the Short Takes section with it. For the most part, the conversion went fairly smoothly. The whole process requires much more discipline because DTP lacks thorough document control, so you'll have to face that issue. The most obvious way to do this is to give your designer a private directory on the network and send all the finished pieces of an article to the directory. Other members of the workgroup must fully relinquish control of their stuff once they've handed it to the page designer. That's where the discipline comes in.

You've got to be especially careful when the document heads back through the work flow for changes. Producing the Short Takes section is manageable because of its size. As you add more writers, editors, section heads, illustrators, and designers, the DTP limitations become that much more pronounced.

Using DTP takes a change of mind-set. You've got a lot more flexibility when you move the design process to the desktop, and that power can be abused. You can't get too carried away with the ability to make last-minute changes. You've got to treat your DTP station as seriously as you would treat high-end typesetting equipment. If you can devise an effective plan for document control, we believe the DTP packages are strong enough, functionally and typographically, to become the preferred tool of the professional designer and typesetter.

You'll also want the biggest monitor you can find, because there's a lot of information on-screen. That presents another problem: Constantly moving to the top of the screen to get the menus gets tiresome quickly.

Among the page-layout programs, Ventura Publisher gets the highest marks for document control. Its two-way document link and network operation set it apart. Unfortunately, we found Ventura weaker as a layout tool. Its lack of a pasteboard, guidelines, and flexible text-wrapping made it difficult to work with.

For pure flexibility, you can't beat PageMaker. It frees you from the sometimes confining concept of frames. We found it easier to accomplish our project with PageMaker, especially when we were working with page spreads. You give up some important features, however, like step and repeat, full rotation of objects, and extra typographic precision. You'll want the Story Editor and improved typographic features of PageMaker 4.0, so run it on a Mac or wait until it's available on the PC.

Quark XPress and DesignStudio deliver more numeric control. You can specify precisely where to place a frame. You also get step and repeat and text rotation to any degree. Only if you need this level of control should you rule out PageMaker.

Of the document publishers, FrameMaker and Interleaf Publisher are both excellent, although FrameMaker is probably a bit more flexible. Publisher uses a complex series of daughter-menus to tame big screens (see photo 6); FrameMaker uses keyboard commands. Of the two packages, we preferred FrameMaker's solution, although Publisher's menu structure grows on you. Also, we found Publisher's drawing package to be easier for the novice. Choosing between the two is a matter of working style.

Is unused rubber cement recyclable? Unfortunately, it's not, and that's too bad, because you're going to want to move to DTP. Your desktop computer can now do most of what used to require a room full of typesetting equipment and bottles of glue. And don't feel too bad about taking your business away from the local typesetting house—there's a good chance that they're looking at DTP as well. If not, maybe you can give them all those knives and rubber cement you'll no longer be needing. ■

Stanford Diehl and Howard Eglowstein are BYTE Lab testing editors/engineers. You can contact them on BIX as "sdiehl" and "heglowstein," respectively.


if You Put it Together.
25MHz
Comparison
Product Tests

SYSTEM

Mark L. Van Name and Bill Catchings

REVIEW

486 EISA Machines: A Slow Start in the Fast Lane

The Extended Industry Standard Architecture bus's biggest claim to fame is its promise of better performance than you can get with the 16-bit AT bus. We reviewed three high-performance systems that attempt to make good on this claim. The Compaq Deskpro 486/25, the Tangent Model 425, and the Tandon 486/25 couple the EISA bus with Intel's 25-MHz i486 CPU. While all indeed deliver impressive performance, only one realizes even a part of EISA's promise.

The Compaq 486/25 Model 650 evaluation unit arrived loaded for bear. It included a 25-MHz i486 CPU, a socket for a Weitek WTL4167 math coprocessor, 8 megabytes of 80-nanosecond RAM, a 128K-byte 25-ns static RAM (SRAM) cache, 5¼-inch and 3½-inch floppy disk drives, an 18-millisecond full-height 650-MB Imprimis Technology ESDI hard disk drive, a 15-MHz ESDI disk drive controller, a 150-/250-MB tape drive, a 2400-bps internal modem, a serial port, a parallel port, a mouse port, a 300-watt power supply, a 101-key IBM Enhanced-style keyboard, a 14-inch Compaq Advanced Graphics color monitor, an Advanced Graphics 1024 board, an Advanced Graphics memory board, and MS-DOS 3.31. This system lists for an amazing $29,387.

Tangent Computer sent a more moderately equipped system. Its Model 425 included a Mylex motherboard with a 25-MHz i486 CPU and a socket for a Weitek WTL4167 math coprocessor, 8 MB of 80-ns RAM, a 128K-byte 25-ns SRAM cache, a Mylex EISA floppy and SCSI hard disk drive controller with a 4-MB on-board cache, a 17-ms 5¼-inch 105-MB Quantum SCSI hard disk drive, high-capacity 5¼-inch and 3½-inch floppy disk drives, a Video Seven VGA 1024i board with 512K bytes of RAM, an NEC MultiSync 3D monitor, two serial ports, a parallel port, a game port, a 250-W power supply, a Key Tronic IBM Enhanced-style 101-key keyboard, and MS-DOS 4.01. This configuration will run you $8790.

The Tandon 486/25 Model 300 evaluation unit had a larger hard disk drive than the Tangent Model 425, but only one floppy disk drive. Our system also included a 25-MHz i486 CPU, a socket for a Weitek WTL4167 math coprocessor, 16 MB of 100-ns RAM, a 64K-byte 20-ns memory cache, a 5¼-inch 330-MB Maxtor SCSI hard disk drive with an average access time of 16 ms, a 16-bit Adaptec SCSI hard disk drive controller, a 16-bit Paradise VGA card, two serial ports, a parallel port, a 190-W power supply, a 101-key IBM Enhanced-style keyboard, MS-DOS 4.01, Microsoft Windows 3.0, a mouse, and a 14-inch Tandon VGA color monitor. The total price for this configuration is $10,059.

To compare the prices of these systems fairly, we calculated what the cost of each would be with a 5¼-inch 1.2-MB floppy disk drive, a 300-MB hard disk drive, 8 MB of RAM, a VGA monitor, and MS-DOS. The Compaq 486/25 was still far and away the most expensive of the bunch at $20,316. A similar Tandon 486/25 runs $8899, while a comparable Tangent Model 425, which includes a 4-MB disk cache, lists for $9740. With the money you would need to buy the Compaq at list price, you could buy both of the other systems and still have enough money left over ($1677) to purchase a 386SX clone!

Speed Freaks

All that money definitely buys you performance: These systems are all screamers. Their BYTE application benchmark indexes range from 37.7 to 63.4—not a slouch in the bunch. The big winner is the Tangent Model 425, with the Compaq 486/25 in the middle and the Tandon 486/25 bringing up the rear.

Most of this wide spread in application performance stems from the machines' different disk subsystems. The Tangent Model 425's caching EISA disk drive controller gave it a whopping 10.11 on BYTE's low-level disk test, where the Compaq 486/25 scored 3.75 and the Tandon 486/25 achieved a relatively low 2.31.

Tandon explained its system's low disk result by noting that the Tandon 486/25 uses a 16-bit SCSI controller that adds an overhead of 5 ms per disk access. The company claims that this delay is far more expensive on DOS, which blocks requests while waiting for disk sectors, than it is on an operating system such as Unix, which queues such requests and continues working.

BYTE's Unix Filesystem Throughput benchmarks (which are not shown in the Unix benchmarks graph) support Tandon's claim. On those tests, the performance gap between the Tandon machine and the other systems, while still large, is much smaller than on the DOS tests.

Both Compaq and Tandon offer options that improve disk drive performance. Compaq's optional EISA Intelligent Drive Array controller and hard disk drives, while having only a small on-board cache, should yield improved disk performance. The IDA drives, which Compaq developed for the Systempro, come in pairs of 210-MB drives.

Compaq's Deskpro 486/25 offers the highest video performance of the group.

Two such pairs will fit into a special area in the Compaq 486/25, for a total of 840 MB of disk space. Likewise, Tandon claims that by the time this review sees print, it will be offering an optional EISA caching disk drive controller with performance much like that of the Tangent's controller.

The Tandon 486/25 also suffers from a lethargic VGA board; its video index of 1.99 indicates that it operates at a fraction of the speed of the Compaq and Tangent machines. However, the Tandon 486/25 compensates somewhat for its poor disk and video marks with a slight edge in BYTE's DOS CPU tests.

Tangent's caching EISA disk drive controller gives the Model 425 a clear performance advantage.

Awaiting Add-ins

All three of the review systems ran our software compatibility suite of over two dozen common applications without a hitch. We were unable to test them, however, with any EISA add-in cards; few such cards are available as we write this review, and many of the vendors of the cards that are available were reluctant to let us test their cards on "uncertified systems."

Following the introduction of each new generation of processors is a period of a year or so when support chips for that processor are not yet available. During that time, vendors rely on their own designs and use fewer off-the-shelf application-specific integrated circuits. These early 486 entrants follow that trend. Their motherboards all measure about 12 by 14 inches, a bit large by today's standards. All three have lots of discrete logic, with Intel's EISA ASICs supplying the EISA logic. The systems differ widely, however, in just which functions are on those motherboards and which are on add-in cards.

The Compaq 486/25's motherboard includes the circuitry necessary to support a VGA monitor, its I/O ports, the floppy disk drives, and Intelligent Drive Electronics (IDE) hard disk drives. Its

continued

The Tandon 486/25 is the low-price leader, but its disk and video performance could be better.

Compaq Deskpro 486/25 Model 650

Company
Compaq Computer Corp.
20555 SH 249
Houston, TX 77070
(800) 231-0900
(713) 370-0670

Components (as reviewed)
Processor: 25-MHz Intel i486; socket for 25-MHz Weitek WTL4167
Memory: 8 MB of SIMM-mounted RAM; 128K bytes of cache RAM
Mass storage: 5¼-inch 1.2-MB Canon floppy disk drive; 3½-inch 1.44-MB Citizen floppy disk drive; Wangtek 150-/250-MB cartridge tape drive; 650-MB Imprimis ESDI hard disk drive; Compaq ESDI controller
Display: Compaq Advanced Graphics 1024 board; Advanced Graphics memory board; Advanced Graphics color monitor
Keyboard: 101-key IBM Enhanced AT layout
I/O interfaces: Serial port; parallel port; mouse port; 2400-bps modem; seven 32-bit EISA expansion slots

Price
$29,387

Inquiry 1076.

Tangent Model 425

Company
Tangent Computer, Inc.
197 Airport Blvd.
Burlingame, CA 94010
(800) 223-6677
(415) 342-9388

Components (as reviewed)
Processor: 25-MHz Intel i486; socket for 25-MHz Weitek WTL4167
Memory: 8 MB of SIMM-mounted RAM; 128K bytes of cache RAM
Mass storage: 5¼-inch 1.2-MB Teac floppy disk drive; 3½-inch 1.44-MB Teac floppy disk drive; Mylex floppy and SCSI hard disk drive controller with 4-MB cache; 105-MB Quantum SCSI hard disk drive
Display: Video Seven 16-bit VGA 1024i board with 512K bytes of RAM; NEC MultiSync 3D monitor
Keyboard: 101-key IBM Enhanced AT layout
I/O interfaces: Two serial ports; parallel port; game port; six 32-bit EISA expansion slots; one 16-bit ISA slot; one 8-bit ISA slot

Price
$8790

Inquiry 1078.

Tandon 486/25 Model 300

Company
Tandon Corp.
405 Science Dr.
Moorpark, CA 93021
(800) 800-8810

Components (as reviewed)
Processor: 25-MHz Intel i486; socket for 25-MHz Weitek WTL4167
Memory: 16 MB of SIMM-mounted RAM; 64K bytes of cache RAM
Mass storage: 5¼-inch 1.2-MB Epson floppy disk drive; 330-MB SCSI Maxtor hard disk drive; Adaptec 16-bit SCSI hard disk drive controller
Display: Paradise 16-bit VGA card; Tandon VGA color monitor
Keyboard: 101-key modified IBM Enhanced AT layout
I/O interfaces: Two serial ports; parallel port; six 32-bit EISA expansion slots; two 16-bit ISA expansion slots

Price
$10,059

Inquiry 1077.

memory is on a separate board that connects to the motherboard via a proprietary slot. The memory board includes 4 MB of 80-ns DRAM, a large number of memory-support chips, and six "pockets" for expansion RAM. Each such pocket can hold a 2-MB, 8-MB, or 32-MB daughterboard, for an amazing maximum RAM capacity of 100 MB.

The design of the Tandon 486/25's motherboard is similar to that of the Compaq's. Its motherboard contains support circuitry for the I/O ports, floppy disk drives, and IDE hard disk drives. The memory is on a card that fits into a proprietary expansion slot; it holds up to 64 MB of memory in 16 single in-line memory module sockets. Each SIMM can contain 100-ns chips in 256K-bit, 1-megabit, or 4-Mb sizes.

Tangent's Mylex motherboard is unlike the others. This board has room for eight SIMMs, which you must install in groups of four. Each SIMM can contain 80-ns-rated 256K-bit, 1-Mb, or 4-Mb chips, for a system maximum of 32 MB. The motherboard also relegates the I/O and disk support circuitry to other cards.

All three of the boards we tested were clearly early designs. Compaq's board was the cleanest, with only one patch wire visible. Each of the other two motherboards had more than 20 visible wires.

Ready to Grow

All three systems have similar expansion capacities. The Tandon 486/25 has six EISA and two 16-bit ISA slots. Five of the EISA slots and a half-length ISA slot were empty in the review system. The Tangent Model 425 also has six EISA and two ISA (one 16-bit and one 8-bit) slots. Five of the EISA slots were empty in our system. The Compaq 486/25 has seven EISA slots, six of which were empty in the review unit.

The review systems differ widely in just which functions are on the motherboards and which are on add-in cards.

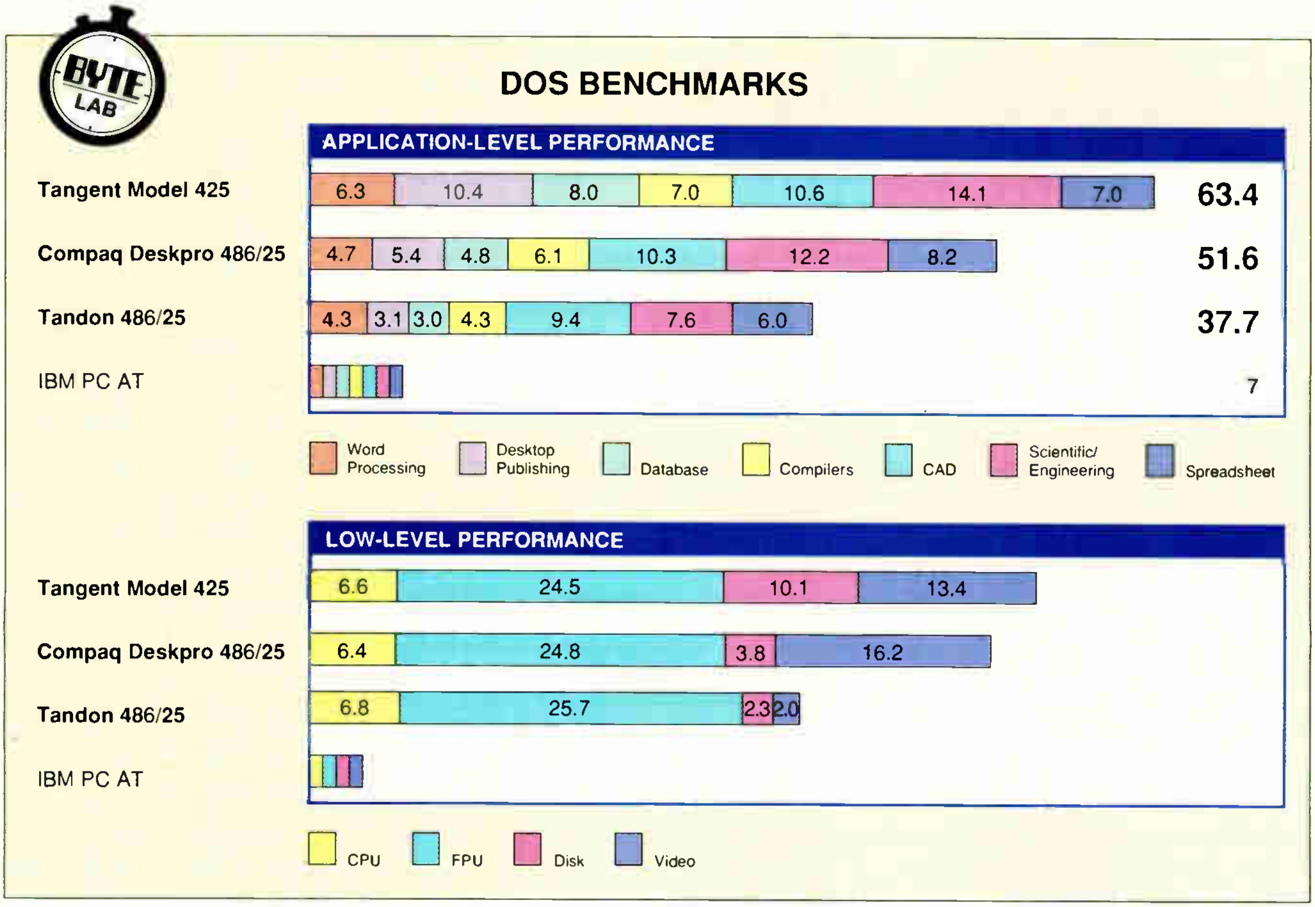
On the disk front, the Tandon 486/25 has five half-height 5¼-inch drive bays. The Tangent Model 425 has even more room, with six half-height 5¼-inch and two half-height 3½-inch drive bays. The Compaq 486/25 has one full-height and three half-height 5¼-inch drive bays, plus room for two IDA drive pairs.

Support Channels

All three vendors provide one-year limited warranties. Compaq, however, requires you to get service from the reseller who sold you the system. Tandon and Tangent provide on-site service for one year.

The three vendors also differ in how much they help you get started. Compaq

continued



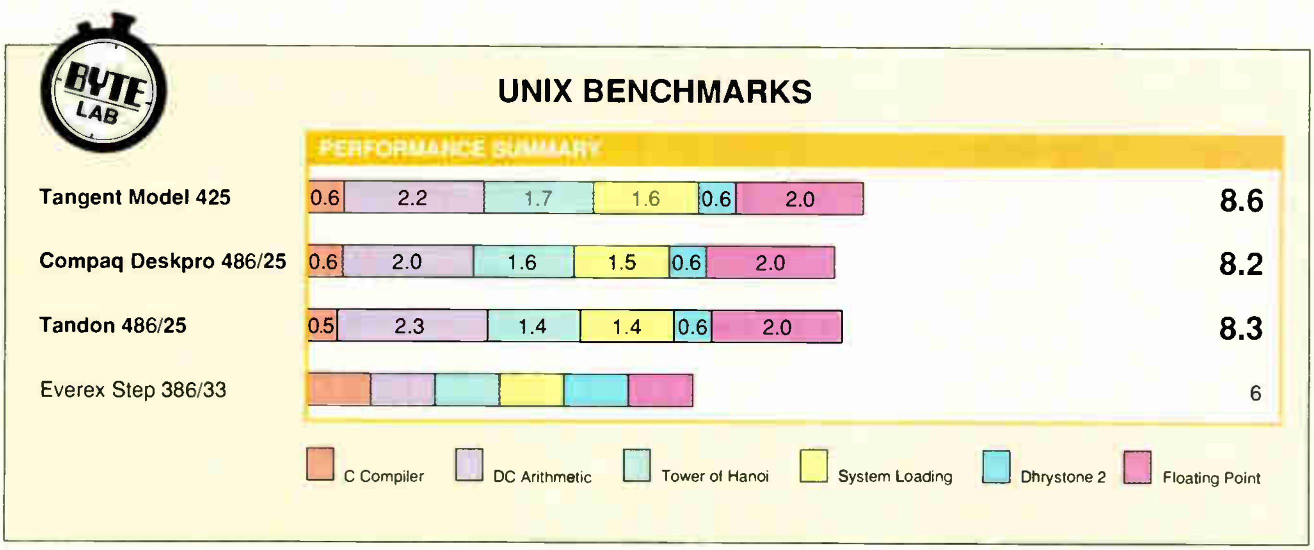
CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
Tangent Model 425	0.68	20076.5
Compaq 486/25	0.67	19880.0
Tandon 486/25	0.70	20746.7
IBM PC AT	0.02	2317.9

For application and low-level benchmarks, results are indexed and show relative performance; for each individual index, an 8-MHz IBM PC AT running MS-DOS 3.30 = 1. For all benchmarks, higher numbers indicate better performance.

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level; the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs: Word processing: WordPerfect 5.0; Desktop Publishing: Aldus PageMaker 3.0; Database: Borland Paradox 3.0 and Ashton-Tate dBASE IV; Compilers: Microsoft C 5.1 and Turbo Pascal 5.5; CAD: AutoCAD release 10 and Generic CADD level 3 1.1.5; Scientific/Engineering: Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet: Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1.

The BYTE Lab introduced version 2.0 of the DOS benchmarks in the August issue (see "BYTE's New Benchmarks: New Looks, New Numbers"). Benchmark results for machines reviewed under previous versions aren't directly comparable. To obtain a copy of the benchmarks, join the listings area of the byte.bmarks conference on BIX or contact BYTE directly.



Note: The graph above summarizes the results of the Unix benchmarks (version 2.6). All results are indexed to show relative performance; for all tests, an Everex Step 386/33 running Xenix 2.3.1 = 1. The cumulative index is formed by summing the indexed performance results for the tests. Comprehensive results are available by contacting BYTE.

leaves the job to you or your reseller, although the firm's Fastart installation utility is the best one that we've seen. Tandon goes a step further and installs MS-DOS on your hard disk. Tangent does the best job of the group by far: The firm will install your choice of DOS, OS/2, Unix, or NetWare, and it will even install a LAN adapter and confirm that the operating system can communicate with that card.

Why EISA?

With all three systems, the first question you must answer is whether you want or need the EISA bus. EISA's 32-bit bus and bus-master capability give it the potential to improve the performance of such peripherals as disks and network adapters. EISA adapters are, however, still relatively rare; the only 32-bit EISA card in any of these machines was a Mylex caching disk drive controller. That controller gave the Tangent the best disk performance of the group by far, but how much of that performance is attributable to the 4-MB cache and how much to EISA is unclear.

If you buy an EISA system today, you are betting on its potential; few EISA boards are yet available. Still, if the price difference between an ISA and an EISA system isn't too high, we'd recommend going with EISA, especially if you're planning to run a multiuser operating system such as Unix or NetWare.

But you're certainly paying an enormous premium for EISA with the Compaq 486/25. For that price, you get the usual Compaq quality and ruggedness, but relatively moderate performance. The EISA machines from Tandon and Tangent are more reasonably priced. The Tandon 486/25 has the lowest price, but it also has the poorest disk and video results. However, should Tandon bundle the 486/25 with the promised EISA caching disk drive controller and a better VGA board, it could be a formidable machine.

The Tangent Model 425 offers the best performance of the group at a reasonable price. Although Tangent is hardly a household name, the system's combination of relatively low price and high performance, along with the one year of onsite service and the superb installation support, make it our pick of the group. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

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TANGENT COMPUTER

Personal Workstation GREAT PERFORMERS PW Proving Ground August 1990

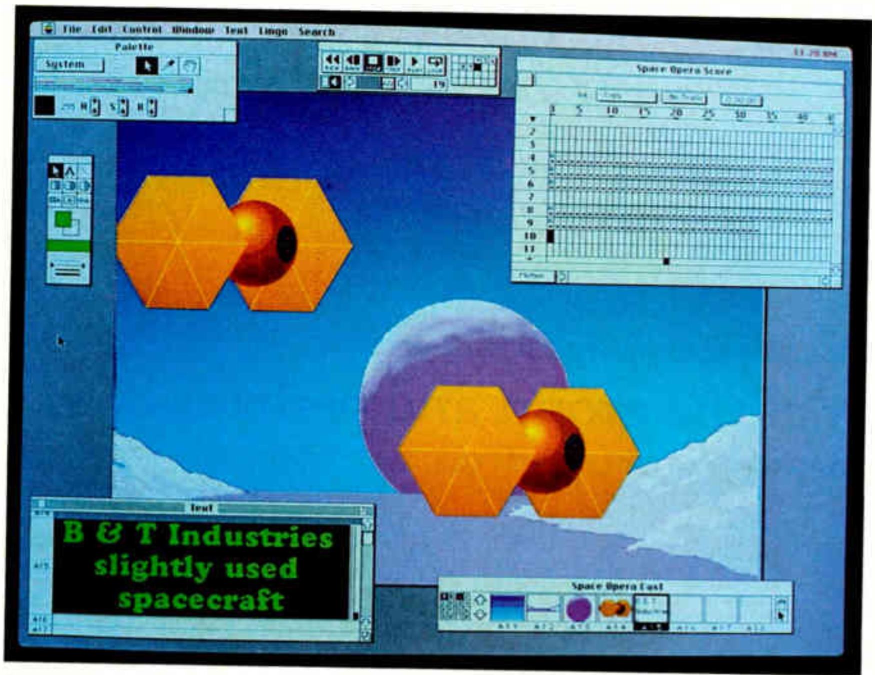
Tangent Computer, Inc., 197 Airport Blvd., Burlingame, CA 94010.

Circle 285 on Reader Service Card

Tom Thompson

REVIEW

Director Takes Charge of Mac Multimedia



Director 2.0 as seen from within the Studio module. The Score, Text, Cast, and Palette windows control what appears within the Stage window, which displays the animation in the rearmost window.

With all the hype surrounding multimedia, you commonly hear of Macintoshes splicing together live video, music, and intricate animations to create mind-boggling presentations. But in reality, these presentations often rely on exotic video-input equipment and custom software that are unavailable to the average Mac user.

But MacroMind's new Director 2.0 continues in the direction set by earlier versions of the package, that of a software tool that makes multimedia practical and affordable for most Mac users. At $695, the software costs less than some 24-bit color boards for the Mac II. Yet Director excels at helping you combine various sounds, scanned images, computer graphics, and text in precisely controlled sequences to express your ideas.

Businesspeople can quickly learn to use Director for presentations that don't require a lot of rocket science or expensive peripherals. The same package lets professional artists exercise the precise control required for sophisticated animations. While you will obtain best results using the color and performance of a Mac II-family computer, Director also works on the Mac Plus, Portable, and SE. Furthermore, Director goes easy on memory. You need just 1 megabyte of RAM for the 68000-based Macs; the Macs that use color require 2 MB. As usual, your mileage can vary: Complex presentations that use lots of graphics, long-duration sound tracks, or 24-bit color images require more memory.

The Sequel

Director traces its history back to the 1985 introduction of VideoWorks, an application that allowed you to produce animated image and sound sequences called *movies*. Over time, MacroMind added interactive functions and color support. Director became VideoWorks' successor, with version 2.0 adding a HyperTalk-style script language called Lingo that builds interactive controls such as screen menus and buttons. Director processes user events with these controls and steers the movie's frame sequences as determined by Lingo. The new Director also adds support for compact disk audio (via Apple's SCSI CD-ROM unit), certain Pioneer and Sony videodisk players (via a serial port), and videotape units.

Director consists of two distinct modules: Overview and Studio. Overview keeps multimedia operations at a high level. Many people will use it to quickly generate business presentations that require simple animation with charts or text and some sounds and scene transitions, such as dissolve and wipe-to-left.

The clever use of icons and only three windows keep work in Overview simple. You drag icons into an Overview window to assemble your presentation. The icons prompt you for either an image file (in MacPaint, PICT, or Glue format), a "canned" sequence file (movies that Director produces), or sound files. Other icons set time delays, create animated text displays, or produce transitions.

The Studio module supports the user working with complex images who needs the fine control unavailable in Overview. In Studio, you work with the components of a movie at the lower level, which allows the exact positioning of objects and motion-sound synchronization required in an advanced presentation.

Studio builds on the play/movie paradigm that was first used in VideoWorks. The Stage is a window where all the animation appears. The Studio's cast is analogous to actors in a play. Cast members can be scanned images, bit-mapped drawings, sounds, buttons, or text, all organized in a Cast window. Not all of the cast has to be on-stage at one time, and some of them can serve as the backdrop. A spreadsheet-style Score window controls your sounds and determines where and when things happen on the stage. It also directs which of the cast members appear in front of the others. A pop-up Ink menu on the Score determines if cast members appear transparent, opaque, or as a matte.

The Studio has many windows: Overview's three windows, plus Text, Tool (used to make buttons and other interactive screen controls), Comment (used to add notes), Paint (a fully featured, built-in color paint program that lets you edit cast members), Palette (to modify the color palette of cast members), Message (used to test out scripts), and Tweak (used to position cast members with 1-pixel accuracy). If this seems like too much to deal with, Director offers context-sensitive on-line help windows.

You can easily produce animations by dragging a cast member about the Stage from one position to another and then

continued

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Other manufacturers with their simple-minded direct-mapped cache architectures were obsessed with churning out the best benchmark numbers. We, however, were not convinced DOS and Power Meter 1.3 is any example of a typical real life application (registering at 8.003 MIPS, we are not too shabby either). With Two-Way Set Associative Cache capability, our 386 is also more attuned to run the emerging multi-tasking operating systems like OS/2® and UNIX™, where modular code sizes (of less than 32K) and frequent code-switching are the norms. Worrying about compatibility? Both IBM® and COMPAQ® endorsed the same INTEL® 82385 Cache Controller. Furthermore, we enhanced it with page-mode and interleaved memory in the event of a cache miss. It is the closest to a true 0-wait-state implementation on the market.

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Director Takes Charge of Mac Multimedia

Director 2.0

Company
MacroMind, Inc.
410 Townsend St., Suite 408
San Francisco, CA 94107
(415) 442-0200

Hardware Needed
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Software Needed
System 6.0.2 or higher; MacroMind Accelerator for real-time animation

Price
$695

Inquiry 979.

using the In-Between item in the Score menu to produce smooth movement between positions. Note that this is not real "tweening," where, if the size and shape of a cast member change, the application fills in reshaped images. However, you can carefully stretch or shrink a cast member between short intervals on the Score to produce the illusion of an object coming into the foreground or receding into the distance. Cycling through the color palette on certain cast members produces a shimmering effect that mimicks animated movement.

Road Test

I tried Director on a Mac IIfx with 4 MB of RAM running an Apple 8•24 Display board, a Mac IIci with 4 MB of RAM running a SuperMac Spectrum/24 Series III board, and a Mac Plus with 2 MB of RAM. Director easily configured itself for each system's screen size and QuickDraw environment. For example, on the Mac IIfx, I used the built-in paint editor to construct color casts, while on the Mac Plus, the paint editor worked in black and white.

The Overview was so easy to use that I created a decent presentation without looking at the manuals. However, the tutorial files provided with Director are of great help to the novice. The Studio was a bit harder to learn, and the on-line help was definitely an asset here. But in several hours, I produced a simple movie that used drawings imported from SuperPaint 2.0 and PixelPaint Professional, sounds digitized using Farallon's MacRecorder, and a scanned color image made on a Sharp JX-100 scanner.

Nor did it take long for me to create an interactive demonstration that presented different scanned images and sounds based on clicking buttons on the screen. Lingo uses easy, English-language commands such as `go to frame 30`. But to master its intricacies, you will need to crack the manuals. As the movie executes, a "playback head" in the Score window indicates where Director is in the movie, which helps with debugging Lingo scripts. Again, the tutorials on both the disk and manuals are helpful. While Director can work in a 24-bit color environment, you'll need more than 5 MB of memory to pull it off: On the IIfx, Director complained that it was running out of memory when I tried to add several 24-bit-deep cast members to the Score.

Even on a Mac IIfx, movie playback was slow, no matter what rate I set. The Mac Plus ran at about the same speed as the IIfx (still slow), because it has fewer bits to push about on a small black-and-white screen. High-speed animation requires MacroMind's Accelerator, a separate software product that costs $195. During execution, Director takes every visible object and recalculates its position, assembling each screen frame by frame. This lets you modify the movie on the fly. The Accelerator stores only the differences between each screen. The trade-off is that accelerated files can balloon in size from hundreds of kilobytes to over a megabyte. However, you'll see a considerable boost in performance; even on a Mac Plus, objects rocketed across the screen. Unless you expect to store your movies on videotape for playback, plan on shelling out the cash for the Accelerator.

Multimedia for All

Director 2.0 is a solid product. The Overview module allows businesspeople to create excellent presentations easily, while the powerful Studio module lets professionals produce sophisticated animation projects. Director also supports several peripherals for advanced multimedia projects. Its reach will extend to other platforms perhaps as early as this fall. MacroMind is developing a player that will display movies on a PC running Windows 3.0. Note that this program will only play movies; you'll still need a Mac to create them.

With Director, Mac multimedia has finally come of age. It will dispel a lot of the hype surrounding multimedia by allowing lots of people to produce graphical presentations and to do it well. ■

Tom Thompson is a BYTE senior technical editor at large. You can reach him on BIX as "tom_thompson."

386 and 486 Windows users:

DOS Lives. Despite what you may have read.

Insufficient memory to run application;

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When Windows 3.0 says there's not enough room to run your DOS programs, it's just trying to tell you it needs QEMM 5.1.

Windows 3.0 may have been a big step forward for some programs.

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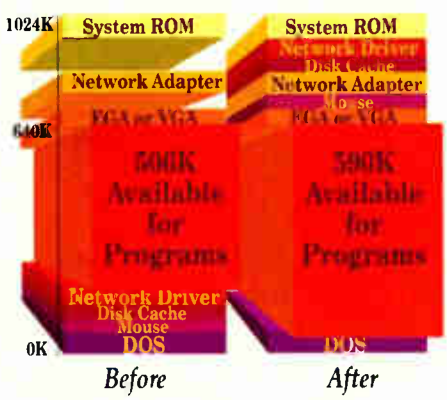

Unused memory is like hidden gold in your PC. QEMM finds it and makes it available.

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And it can run DOS programs and DOS-extended programs i.e., 1-2-3 Release 3, side-by-side.

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QEMM-386 System Requirements: 80386-based PCs and PS/2s and PCs with 80386 add-in boards. Operating system: PC DOS 2.0-4.0, MS DOS 2.0-3.3, Windows 3.0. Conventional memory requirement 1.5K.
DESQview System Requirements: IBM Personal Computer and 100% compatibles (with 8086, 8088, 80286, or 80386 processors) with monochrome or color display; IBM Personal System/2 • Memory: 640K recommended; for DESQview itself 0-145K • Expanded Memory (Optional): expanded memory boards compatible with the Intel AboveBoard, enhanced expanded memory boards compatible with the AST RAMpage; EMS 4.0 expanded memory boards • Disk: two diskette drives or one diskette drive and a hard disk • Graphics Card (Optional): Hercules, IBM Color/Graphics (CGA), IBM Enhanced Graphics (EGA), IBM PS/2 Advanced Graphics (VGA) • Mouse (Optional): Mouse Systems, Microsoft and compatibles • Modem for Auto-Dialer (Optional): Hayes or compatible • Operating System: PC-DOS 2.0-4.0; MS-DOS 2.0-3.3 • Software: Most PC-DOS and MS-DOS programs; programs specific to Microsoft Windows 1.03-2.1, GEM 1.1-3.0, IBM TopView 1.1 • Media: DESQview is available on either 5-1/4" or 3-1/2" floppy diskette.

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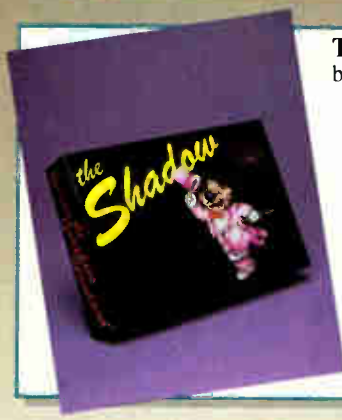

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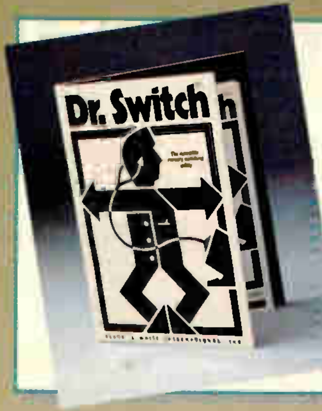

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(Developer 2-User) LIST: $595 **PS** Price: $569

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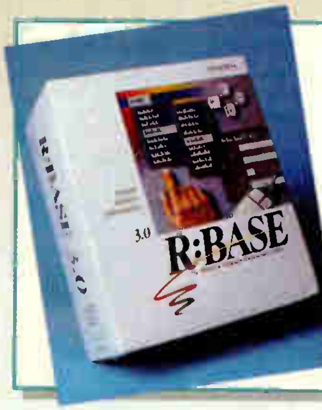

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by Microrim

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by Brightbill-Roberts

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Object/1
by mdbs, Inc.

Object/1 is more than just another application development tool. It's designed specifically for graphical environments like Presentation Manager and Windows 3.0 to provide a comprehensive development environment. It features a Forms Painter which allows you to build and edit graphical forms which link to a variety of back-end database servers. Object/1 is a rich object-oriented programming tool which has more than 250 classes and 3000 methods.

LIST: $995 **PS** Price: **$895**

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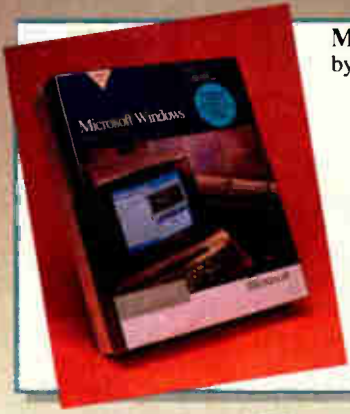

MS Windows 3.0
by Microsoft Corp.

Microsoft Windows 3.0 transforms your one character-based application to a graphically oriented, multi-application environment for DOS. Simultaneously works with all the programs and files you need, breaking the 640K memory barrier. Device independent. Drop down menus, dialog boxes, and icons for intuitive interfaces. Move data between tasks or applications. Automatically determines operating mode from hardware configuration.

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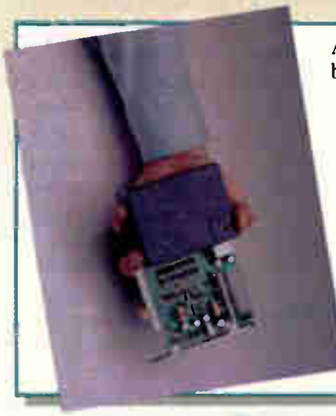

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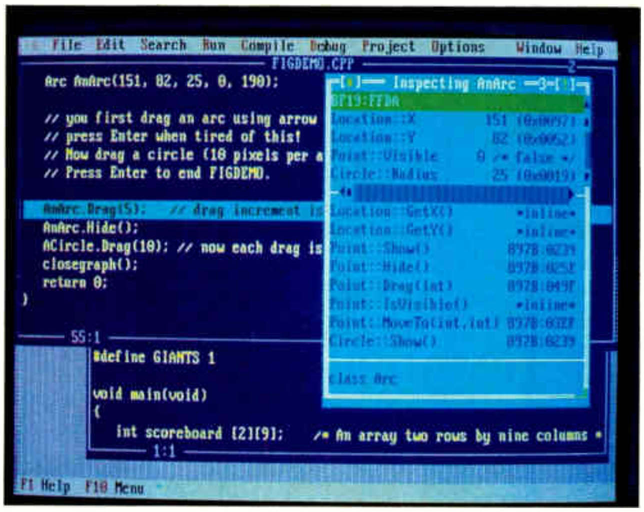
REVIEW

Object-Oriented C That Goes VROOMM



Borland's Turbo C++ features a revamped Integrated Development Environment.

Like it or not, we are probably all going to be programming in an object-oriented programming language real soon. That shouldn't surprise you; good programmers have been using OOP techniques for years, even when they did not have OOP languages to back them up.

When AT&T integrated a set of OOP extensions into the C language, C++ was born. It's been well received, but C remains the language of choice for commercial development. Why? Even though C++ has been around for some time now, the number and quality of support tools have lagged far behind the language itself. It's one thing to produce a large project using an OOP language; it's quite another to debug it.

In Good Company

In introducing Turbo C++, Borland is following a bit behind its main competitor, Zortech (see the review "C++, Plus," July BYTE). Both products are *true* compilers, as opposed to AT&T's own implementation of C++, which merely translates the code to C. They also include C++ debuggers and a variety of programming tools. From there, the two products diverge.

Turbo C++ Professional, the package reviewed here, is as complete a development system as you could hope for. This aggressively priced set combines Turbo C++, Turbo Assembler, Turbo Debugger (with C++-specific capabilities), and Turbo Profiler. Borland has also added a host of software tools including `make`, `grep`, and Microsoft-compatible `link` and `lib`. The cherry on top is an updated version of the famous Borland Integrated Development Environment (IDE).

Before you break that seal, though, you'd better see how much room you have on your disk. Turbo C++ Professional takes about 9 megabytes if you do a full install: that is, install the libraries for all memory models, uncompress the examples, and take all the on-line documentation and tutorials. The installation utility lets you select the pieces you want and put them where you want them.

The installation went smoothly, except for one hitch: Each module has its own installation program, so I had to type `install` four times. I also had to answer a lot of duplicate questions every time. I had expected a bit more integration from folks touting an IDE.

The IDEs Have It

I have to say that I was never a big fan of Turbo C. The compiler was pretty good, but the user interface felt almost amateurish. In contrast, I wouldn't mind living in the new IDE. The multiple file capability, combined with overlapping windows and good mouse support, provides the type of work environment you might expect from Windows or a high-powered Unix workstation.

Pull-down menus (with attached hot keys) give instant access to the various tools, while dialog boxes handle configuration settings and interactive tasks such as searches. You can customize the system menu with user-specific options. The on-line help is standard, and it has a hypertext style that lets you click on highlighted words to get more detail.

Getting programs edited and compiled through the IDE is a cinch. It remembers the files you were working on during the last session and what windows they were in—just the sort of thing that makes it easier to get up to speed in the morning. The IDE also includes a built-in version of `make` called the Project Manager. You give the Project Manager a list of source files and compiler options; when you do a build from the IDE, the Project Manager figures out dependencies among the files and does the minimum amount of compilation needed to update your program. You can move from one project to another simply by picking a name from a list. The IDE saves the current session and sets up the new one. A version of `make` is included for the stand-alone compiler as well.

Of Compilers and Power Tools

As with Turbo C, Borland includes both a stand-alone (command-line) compiler and one that is part of the IDE. Both are ANSI C and AT&T C++ 2.0 compliant. Old-style (Kernighan and Ritchie) behavior is available through either IDE menus or command-line switches.

Both of the Turbo compilers are rock-solid implementations of the C++ standard, with the traditional Borland added value (e.g., in-line assembly language). I

continued

Turbo C++ Professional 1.0

Company
Borland International, Inc.
1800 Green Hills Rd.
Scotts Valley, CA 95066
(408) 438-8400

Hardware Needed
IBM PC, XT, AT, PS/2, or compatible with at least 512K bytes of memory (640K bytes for the integrated environment)

Software Needed
DOS 2.0 or higher

Price
Turbo C++ Professional 1.0: $299.95
Turbo C++ 1.0: $199.95

Inquiry 976.

maintain a library of code known to bedevil AT&T's `cfront` and the Free Software Foundation's (GNU) g++ C++-to-C translators. Turbo C++ compiled everything flawlessly, and the resulting code was correct every time. When I put Zortech to the same test, I got the correct results, but I had to tweak some of the code to get it to compile. Turbo C++ (unlike Zortech) also uses the new AT&T `iostreams` library, but it includes support for the old (C++ 1.2) `streams` library as well, to make migration to the new version easier.

Debugging strictly from the IDE is about the same as Borland's past efforts, except that the jazzed-up interface makes it easier to move between coding and debugging tasks. If you need more debugging power, you can invoke the stand-alone Turbo Debugger 2.0, which goes far beyond this (and most traditional debuggers) by providing support for *reverse execution*. Reverse execution lets you step backward through the code, undoing the effect of each instruction as you back over it. Of course, the stand-alone version also has full support for debugging TSR programs and device drivers, processes on other PCs, 286 protected-mode code, and virtual memory mode processes on 386 machines. Naturally, it recognizes 386 and i486 instruction sets. It's a true source-level debugger, working not only with Borland compilers, but with any compiler that can produce a .MAP file.

When working with C++ programs, the debugger adds a class/object inspector that lets you traverse the parents and children of your C++ classes. There is also a hierarchical view, showing graphically the tree of objects and classes. It's possible to be fancier than this in supporting the examination of C++ objects, but the Turbo Debugger OOP extensions are sufficient.

A program that doesn't crash and doesn't produce bogus results can still be buggy if it's slow. The Turbo Profiler lets you move into your code with a microscope and a stopwatch, precisely timing the duration of any block of code, even a single statement. Runnable from either the IDE or the command line, the Profiler lets you mark areas in your source code for measurement. Then it runs your program and totals the time spent in each selected area, as well as the number of times each area is executed (the hit count). In addition, the Profiler can record the callers of a routine, collect data on file I/O, and monitor keyboard, printer, and other interrupt activities.

You can accumulate data over several runs and save it for use in a later session. The timing and hit count data are displayed along with bar graphs to show relative times and counts. The display formats are selectable via menus from the IDE, and you can merge the data with your source code for printing.

Is all this useful? I've had days when I would have gladly paid twice the price of the entire Professional package for this jewel alone. I once spent two days trying to hand-optimize a search module, because I thought I could do a better job than the book I copied it from. I dug out the old disks and loaded the source code into the IDE. Within minutes, the Profiler showed me that the code from the book was already optimized. I wouldn't have wasted two days if I'd had the Profiler earlier.

Even the most elegant high-level code occasionally falls short when speed is the key demand, and handcrafted assembly language is frequently the means of choice to get that boost. Borland's Turbo Assembler 2.0 can give you that speed, with newly added support for the 386/i486 instruction sets, plus a new command-line option that enables multipass assembling for resolution of forward references and pass-dependent constructs. Borland claims that Turbo Assembler is Microsoft Macro Assembler–compatible all the way back to MASM 4.0, something that even Microsoft can't claim about later releases of its own product. I checked it out on some old device driver code that was written for MASM 4.0, and Turbo Assembler handled it with ease.

Noise from Under the Hood

Turbo C++ makes use of Borland's Virtual Run-time Object-Oriented Memory Manager (VROOMM). This is an updated version of the old overlay scheme you may remember from the days when 128K bytes was a fat system. Now that even 640K bytes is tight, VROOMM uses disk swap space, expanded memory, or extended memory to permit programs larger than the available space to run. Portions of the code are swapped in and out of the main DOS memory region as needed. (The entire Turbo C++ Professional suite of programs was built with VROOMM.) With VROOMM, you can put a large but rarely used piece of code into a separate module, knowing that it won't get loaded until it actually gets called.

Overlays have been around for a long time, but they have been a royal pain to code, especially for a large project. VROOMM will save you from all that. For example, I have a disk management program written in C++ that uses a configuration file to set defaults for things like window sizes and data formats. It has a forms-type editor module that you can use to edit the configuration file, but it seemed too large to incorporate as part of the main program. Until now, I have been using it as a separate executable file. Enter VROOMM. Simply by using the -Y option to compile the main module, and the -Yo option to compile the editor module, I was able to create a single .EXE file that does not load the editor code until the configure function is called. Now I can reconfigure my disk manager on the fly.

One of the few shortcomings of Turbo C++ is that it offers no support for either Microsoft Windows or OS/2. Zortech should have no trouble holding its own, for a while at least, because it includes support for these important environments. Borland is said to be working feverishly on Windows and OS/2 support for C++.

The release of Borland's Turbo C++ Professional, with its robust, tool-laden working environment, means that PC programmers can at last take full advantage of OOP techniques without giving up the power and familiarity of C, even Turbo C, itself. In all, I am impressed. Borland has put together a package well suited to the professional developer, at a price that may blow the lid off the OOP PC market. ■

Steve Spicer is a principal engineer for Technology Concepts, Inc., in Sudbury, Massachusetts, where he uses C++ to create telecommunications network management products. He can be reached on BIX c/o "editors."

ZORTECH C++ DEVELOPER'S EDITION V2.1

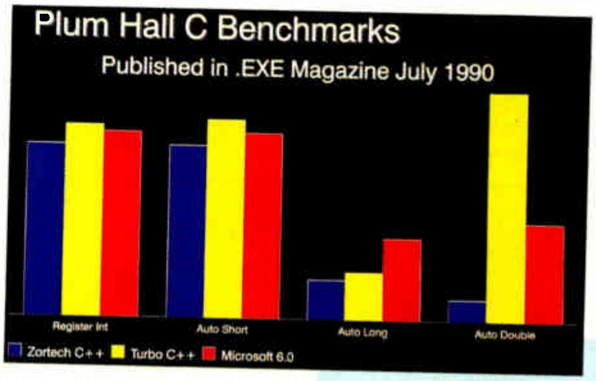
Multi - Platform

MS-DOS • WINDOWS • OS/2 • DOS 386 • UNIX 386

MS-DOS

Zortech's industrial strength compiler provides all the benefits of C++, but with the speed and code size you would expect from the best C compilers.

The quality of the original Zortech C++ implementation together with the continuous improvement achieved since its launch in June 1988 produces fabulous benchmarks. Just look how far it's ahead of the nearest competitor.



Zortech C++ provides state of the art, USEFUL features, most of which are added in direct response to customer requests.

You can effortlessly cruise through the DOS 640K barrier using Zortech's Virtual Code Manager (VCM™). This allows you to develop applications up to 4MB in size whilst in real mode, without changing your C/C++ source code. Zortech's much acclaimed 'handle pointers' provide an elegant solution to processing EMS memory.

Zortech C++ also uses the Rational Systems™ DOS Extenders allowing you to easily compile and debug really large programs, even large MS-Windows 3.0 applications. If you want to purchase a Rational Systems license for your own applications, your Zortech code is Plug & Go.

Zortech's new C++ Workbench provides a cross platform development environment for C++. It has really useful features including powerful source and grep browsers, to look at your handiwork.

In response to hundreds of requests, MS-Windows 2.1 support was added into the base DOS C++ Compiler in version 2.0. Now with Zortech C++ V2.1 development of C++ applications for Windows 3.0 is a reality not a promise.

Along with the C++ compiler comes a top quality ANSI C compiler. In fact, after reviewing 14 C/C++ compilers in its May 1990 issue, Computer Language editor J. D. Hilderbrant said:

"The pressure to name an overall winner in the compiler sweepstakes is nearly overwhelming...it's an easy choice. We pick Zortech!"

Thousands of our customers had existing C code they wanted to recompile, so we made it simple. In the words of BYTE Magazine:

"I fed a Microsoft C specific version of the Micro-EMACS editor source to Zortech's compiler, and less than one hour later, I had a new (and smaller) program."

Our C++ Debugger, which understands C and Assembler too, is CodeView™ compatible, but that's where the similarities end. This feature packed tool can examine your program from 19 viewpoints and uses overlapping windows with full mouse support, icons and dialog boxes.

Debugging large programs is no problem with our DOS Extender, Virtual and Remote debugger versions. Quite simply, there's no better C++ debugger to use and no better C++ to debug.

Our C++ Tools package is the most comprehensive set available. All 25 class libraries are extensively documented and come with the full source code.

The Zortech C++ Developer's Edition V2.1 includes C and C++ Compilers, C++ Debugger, C++ Tools and the FULL Library Source Code (excluding Flash Graphics). That's right, you don't have to pay hundreds of dollars extra for source code - it's in the box!

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The OS/2 Developer's Edition now provides a C++ Compiler and source level Debugger designed for C++. In the words of OS/2 Magazine:

"Zortech C++ serves as a direct replacement for the Microsoft C Compiler in developing applications, allowing programmers to use object-oriented techniques in OS/2 development."

The OS/2 Developer's Edition also includes C++ Tools, Flash Graphics and C++ Workbench for OS/2 together with the standard DOS Developer's Edition.

Upgrades for existing OS/2 Compiler Option owners now available. Please call for details.

UNIX 386 NEW

Not a day passes at Zortech HQ without numerous requests for a UNIX version of Zortech C++. Now, DOS and OS/2 developer's can reach new markets by easily moving their code to SCO UNIX 386 and binary compatibles.

The Zortech C++ V2.1 UNIX 386 Compiler generates the same tight, fast code that Zortech's DOS and OS/2 users have come to expect. UNIX specific versions of Flash Graphics and the C++ Workbench are also provided.

In line with the traditional Zortech Policy, owners of the Zortech C++ V2.1 UNIX 386 Compiler will be able to inexpensively upgrade to the forthcoming Zortech C++ V2.1 UNIX 386 Developer's Edition.

DOS 386 NEW

Now, with the 386 you can address up to 4 Gigabytes of memory. Why spend so much money on 386 hardware and not use software which will take advantage of it?

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MS-DOS developers can now build true 32 bit C and C++ applications for 386 processors using Zortech's powerful 386 development system. The Zortech C++ V2.1 Developer's Edition for DOS 386, contains 32 bit versions of the C and C++ Compiler, Flash Graphics library, C++ Debugger and full standard library source code together with all the familiar features provided with the standard DOS Developer's Edition.

Using Phar Lapp's much acclaimed 386/DOS Extender Technology, you can build applications which access 4 Gigabytes of linearly addressable memory. Your applications will also be Plug & Go for use with Phar Lapp's 386 DOS Extender which may be purchased seperately.

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Zortech's C++ Video Course is all the training material you need to move a team of good C programmers into the world of C++. Many corporations have already done just this.

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C++ at Work '90

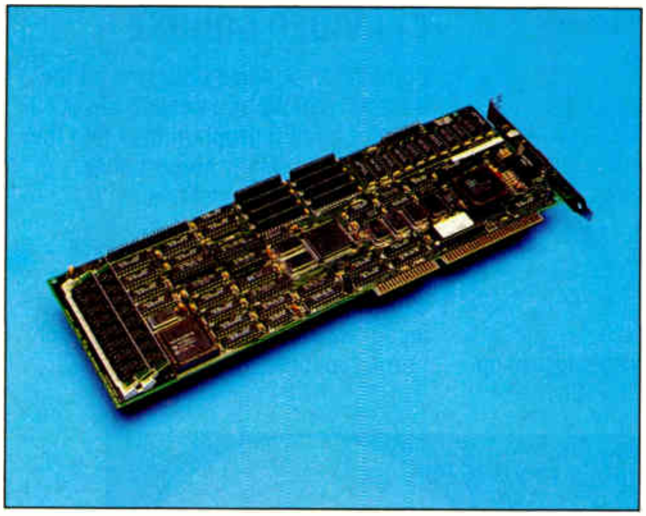
The new Zortech C++ platforms will be officially released in New Jersey during C++ at Work '90 Sept 24-26, 1990.

Circle 320 on Reader Service Card

Greg Loveria

REVIEW

Pumping Pixels: Hercules Flexes Its Muscles in 24-bit Color



A 60-MHz TMS34010 graphics processor on the Hercules Graphics Station card accelerates TIGA-VGA throughput in resolutions of up to 1024 by 768 pixels by 8 bits. With the Art Dept. option, the card offers 24-bit color on standard VGA monitors.

Hercules Graphics Station

BYTE LAB

Company
Hercules Computer Technology, Inc.
921 Parker St.
Berkeley, CA 94710
(415) 540-6000

Hardware Needed
386 or 486 IBM AT or compatible with one free 16-bit slot and 640K bytes of RAM; standard VGA monitor or multiscanning monitor capable of 1024- by 768-pixel resolution; monochrome/text display card and TTL monochrome monitor for running optional Art Dept. software

Price
As reviewed (with 2 MB of DRAM and Lumena software): $3995
Base model (board only, with 1 MB of RAM): $1024

Inquiry 1075.

Hercules, the name that's synonymous with monochrome graphics, has added a new twist to color desktop imaging. Its Graphics Station card uses the Texas Instruments Graphics Architecture to accelerate VGA display throughput and support TIGA-VGA resolutions of up to 1024 by 768 pixels by 8 bits. But the true appeal of this card is its 24-bit color display capabilities on standard VGA monitors. Imaging professionals who want 24-bit color may spend $2000 to $3000 for raster-graphics adapters. At $1024, the HGS takes a large chunk out of this high-end graphics expense.

Working in conjunction with Hercules, Time Arts has ported its graphic arts program, Lumena 16, to work directly on the HGS to utilize its 24-bit color output. Before its conversion to the HGS, Lumena required expensive raster-graphics boards. The software/board bundle, called Hercules Art Dept., sells for $3995. At press time, Art Dept. was the only way to implement 24-bit color on the Hercules card.

60-MHz Power

The HGS is a 16-bit Industry Standard Architecture graphics adapter; it supports all IBM VGA modes from 320- by 200-pixel CGA through 1024- by 768-pixel 8514/A emulation. Hercules provides TIGA software drivers for both AutoCAD release 10 and Windows/286 (the company plans to release Windows 3.0 drivers this fall).

A Texas Instruments TMS34010 graphics-processor chip operating at 60 MHz powers the board. The chip's 32-bit architecture handles the large block moves of continuously addressable memory needed for graphics-intensive applications. The base configuration comes with 1 megabyte of video RAM; I tested the 2-MB DRAM unit ($1495), which Hercules recommends for boosting Art Dept. and AutoCAD performance.

The card installed easily in a full-size 16-bit slot. No jumpers needed repositioning. Once in place, the HGS becomes the primary display adapter and uses the standard VGA 15-pin D-shell connection. If your system has on-board VGA, you must disable the VGA circuitry for the card to function properly.

I tested the HGS on an Associates Computer Supply 25-MHz 386 tower system with 640K bytes of base memory and 8 MB of RAM. I connected a Relisys RE-5155 multiscanning monitor for testing resolutions of from 640 by 480 pixels to 800 by 600 pixels, and a Relisys RE-1520 auto-switching monitor for 1024- by 768-pixel interlaced and noninterlaced resolutions.

A README file on the utilities disk supplements the precise manual with information about application-specific TIGA drivers. The installation program, STATION, displays a point-and-shoot main menu. During installation, the program creates an .STA file, which determines and sets the TIGA default screen and color bit resolutions for an application. The manual tells you to reboot so that screen resolution changes take effect. I generated a variety of .STA files to change resolutions that I invoked from the DOS prompt as `STATION [filename] .STA`. This saved me time by ensuring that the resolution changes took effect without rebooting the system.

AutoCAD Support

AutoCAD release 10 performed well, with a noticeable increase in speed. I loaded VW.DWG, a wire-frame drawing of a Volkswagen Beetle, in 21.34 seconds in the 8-bit, 256-color mode with 1024- by 768-pixel resolution. Regeneration of the drawing took only 8.91 seconds. Redraw was virtually instantaneous.

All resolutions from 640 by 480 pixels by 256 colors to 1024 by 768 pixels by 256 colors (noninterlaced) performed well. However, 1024- by 768-pixel by 256-color interlaced mode sent AutoCAD's bottom command line and top pull-down menus off the viewing screen. Even when I used the sizing knob to manually reduce the vertical screen size, the menus remained unusable.

Windows on the Fly

As I expected, both Corel Draw and PageMaker files and documents running under Windows/286 look great at 1024 by 768 pixels by 8 bits. Because of the

continued

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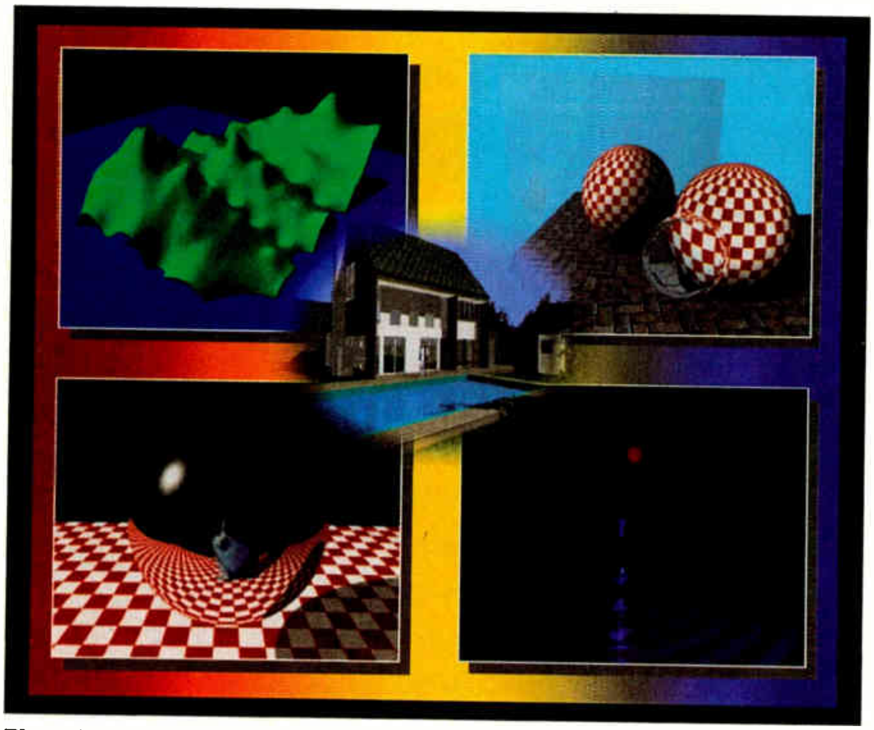

Photo 1: *I created this composite 512- by 482-pixel by 24-bit image using a standard VGA monitor and Hercules Art Dept. bundled with the HGS card. Each image began as a wire-frame AutoCAD model; Big-D by Graphics Software was then used to ray-trace and render the AutoCAD DXF files. I rescaled the resulting TARGA files to 320 by 200 pixels and placed them over a 24-bit color background gradation. Finally, I vignetted the center image using the Art Dept.'s elliptical edge-fade command. (Original images and Big-D images courtesy of Butch Balingit/Digitech & Graphics Software, Inc.; file-to-slide conversion courtesy of Image Center)*

256 colors that are available in all resolutions, gray scaling, TIFs, bit maps, and Corel Draw's Pantone colors looked superb.

Also, the HGS recorded more than a 25 percent increase in speed versus a standard Super VGA board when I opened large graphics-intensive .CDR files, such as Corel Draw's Pantone Color Process Chart. My standard Super VGA board was a Willow Peripherals VGA-TV board with 512K bytes of memory using Windows/286 at 640- by 480-pixel resolution by 16 colors. With that board, COLORBAR.CDR took 13.53 seconds to open and 10.74 seconds to show the file's color preview. With the HGS card's TIGA environment set at 640 by 480 pixels by 256 colors, COLORBAR.CDR took 12.24 seconds to open, and the color preview appeared in 8.26 seconds. Opening COLORBAR.CDR with TIGA-VGA set at 1024 by 768 pixels by 256 colors in noninterlaced mode took 10.05 seconds. The color preview took 7.35 seconds to display, unexpectedly faster than in both lower resolutions.

GIF Vexations

I encountered problems, however, using the HGS as my primary display adapter. Standard applications, such as WordPerfect 5.0 and XTreePro Gold, work fine without setting a TIGA resolution environment, but this was not the case when viewing GIFs (graphics interchange files). I use an excellent shareware program, VPIC, to view GIF and TARGA images. VPIC would display GIFs only if I changed to a 640- by 480-pixel by 16-color mode. Modes higher than 16 colors locked up the system. Hercules says that it has contacted VPIC's author about incorporating TIGA-GIF display into the program. The lockup also occurred with other GIF viewers, such as CSHOW and VGIF.

From a Hercules BBS, I downloaded GSGIF.ZIP, which does allow GIF display under the TIGA environment from the DOS prompt in a full 256 colors at up to 1024 by 768 pixels. I also used a shareware program from Synergistic, called GCP42.ZIP, under the TIGA-Windows environment to view GIFs. GCP42 worked in all TIGA-Windows resolutions at 256 colors. The file has been uploaded to both BIX and Hercules's technical-support BBS for downloading.

24-bit Artwork

Hercules gears the Art Dept. bundle to graphic design and layout artists. The program provides artists with an impressive set of over 250 drawing tools. In 512- by 480-pixel resolution by 24-bit color mode, gradation and continuous color tones are absolutely stunning (see photo 1).

The software requires an additional nine-pin D-shell TTL monochrome monitor and monotext board configuration to function and display program menus. I tested both Relisys monitors as the main displays in the above mode.

The Art Dept. software provides a form of two-dimensional cell animation and high-quality font generation. Supported graphics I/O devices include many popular scanners, digitizers, and color printers, including those from Howtek, Panasonic, and Sharp.

Although I was impressed with the Art Dept. software's ability to load and display TARGA files in 24-bit resolution, this particular feature mellowed my enthusiasm for the HGS's capabilities. At present, the Art Dept. software is the only way to utilize the card's 24-bit color display. In addition, even though Hercules advertises it, the card does not yet support 640- by 480-pixel by 16-bit color (that's 32,000-plus colors). And unlike a raster-graphics adapter, the HGS has no video-capture capabilities. Again, the Art Dept. software and a scanner must be purchased to import image data. I would also like to see more documentation included in the manual discussing overall TIGA theory, and added GIF display support.

But as with most TIGA boards, the HGS's support of 8-bit color and its increased speed in both AutoCAD and Windows/286 impressed me. Also, this card may have it over other TIGA adapters, based on the commitment I saw from Hercules and Time Arts to support and implement future 16-/24-bit color modes and applications. As these implementations become a reality, it's nice to know that you'll have TIGA plus 16-/24-bit display capabilities on-board at no extra charge. ■

Greg Loveria is a computer graphics and desktop publishing consultant, animator, and technical writer in Binghamton, New York. He can be reached on BIX c/o "editors."

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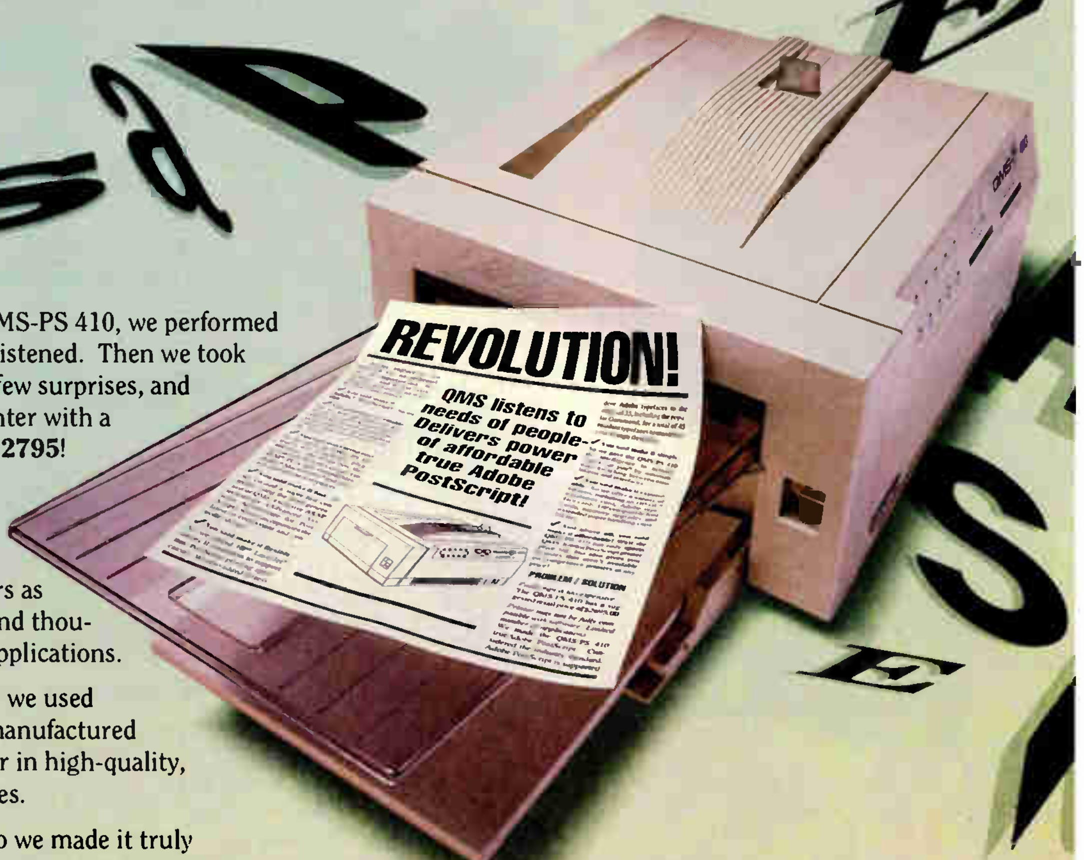

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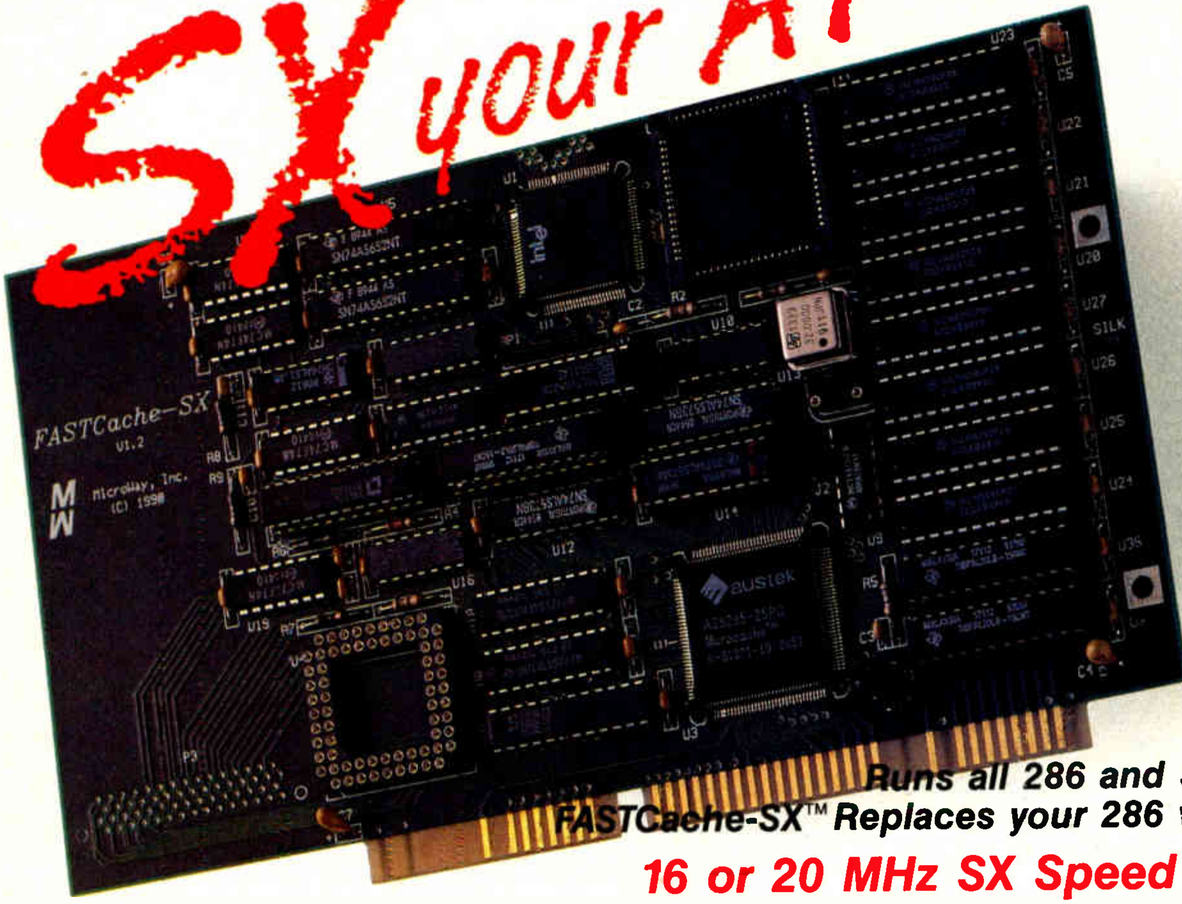

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George Bond

REVIEW

The SX Turns 20

New-generation 20-MHz 386SX PCs have arrived, and they are pushing Intel's SX architecture further onto the 386DX's turf. That the 386DX-20 is likely to follow the 386DX-16 into obscurity is more the result of good marketing than advancing technology. But the SX's 16-bit internal data path, a handicap for Unix and OS/2 users, is perfectly adequate for the MS-DOS environment—and the price is certainly right.

I reviewed three new systems built around the 386SX-20: the Club TX-320-SX-14, the Compaq Deskpro 386s/20, and the Micro Express ME 386SX/20. These machines are easy to distinguish from one another: Pricing and construction quality vary, and BYTE's MS-DOS benchmarks produced some surprising results.

Up-Front Differences

All three machines use baby AT cases with indicator lights, switches and drive bays on the front panel, and I/O ports on the back. The Club also has a speaker switch—a nice touch if you hate machines that beep at you. The Micro Express has a turbo button up front, and the Compaq floppy disk drives have two-color read/write status LEDs. As usual, the Compaq has no reset button: You'll have to use the standard three-finger salute (Ctrl-Alt-Del).

The Compaq review unit came fully loaded: a 20-MHz 386SX with a 4K-byte set-associative static RAM (SRAM) cache, 16 megabytes of 80-nanosecond RAM, an 80387SX math coprocessor, two 3½-inch 120-MB 17-millisecond Conner Peripherals Intelligent Drive Electronics (IDE) hard disk drives, high-density 3½-inch and 5¼-inch floppy disk drives, a 150-/250-MB cartridge tape drive, an internal 2400-bps modem, Compaq DOS 3.3, an on-board 16-bit VGA controller, and a Compaq color analog VGA monitor. The list price for all this is an astounding $17,883.

Compaq's basic machine lists for far less. It includes 2 MB of RAM and a 3½-inch 1.44-MB floppy disk drive for $3299. The closest Compaq configuration to the Club and Micro Express sells for $6197 and includes 2 MB of RAM; an 80387SX math coprocessor; serial, parallel, and mouse ports (one each); a high-density 3½-inch floppy disk drive; a 60-MB 17-ms Conner Peripherals IDE hard disk drive; an on-board 16-bit VGA video controller; and a Compaq color analog VGA monitor.

Included with the Micro Express were 2 MB of 80-ns RAM; an 80387SX math coprocessor; two serial ports; one parallel port; a high-density 5¼-inch floppy disk drive; a 3½-inch 42-MB 21-ms Quantum IDE hard disk drive; a Pixel Engineering 16-bit VGA card with 512K bytes of RAM; and an NEC MultiSync 2A color analog VGA monitor for $2449. Micro Express also sells a stripped-down version with 1 MB of RAM, two serial ports, one parallel port, and one floppy disk drive for $999.

In its basic configuration, the Club TX-320-SX-14 includes 1 MB of 100-ns RAM, a 64K-byte SRAM cache, a 5¼-inch 1.2-MB floppy disk drive, and an Everex MFM floppy/hard disk drive controller for $1295. My review system included 4 MB of RAM; an 80387SX math coprocessor; one serial and one parallel port; a high-density 5¼-inch floppy disk drive; a 3½-inch 44-MB 28-ms Toshiba hard disk drive; an Everex VGA card with 256K bytes of RAM; MS-DOS 3.3; and a Club American 14-inch multifrequency VGA color monitor for $2584.

The Micro Express and the Club, heavily discounted mail-order machines, sell for a fraction of the Compaq's list price. Even a hefty 30 percent dealer discount would bring a comparable Compaq to just over $4000.

Inside Job

To get at the Club's motherboard and disk drives, you remove five screws at the rear and slide the case off the chassis. The chassis and cover are heavier and better finished than most of the clones I've seen. The internal layout is standard: drive bays in the right front quadrant, a 200-watt power supply in the right rear section, and expansion slots taking up the rest. Club has jammed the Everex floppy/hard disk drive controller, cable, and disk drives inside in a manner that's typical for a baby AT clone.

The Club supports a maximum of 8 MB of RAM—all on-board—using 1-MB single in-line memory modules (SIMMs). The motherboard looks solidly built; it uses mostly surface-mount components. It has one 8-bit and seven 16-bit expansion slots. Three of the 16-

continued

The Club TX-320-SX-14 includes a 64K-byte SRAM cache.

The Deskpro 386s/20 is fast, well constructed, and expensive.

The ME 386SX/20 didn't need a processor cache to post top CPU scores.

Club TX-320-SX-14

Company
Club American Technologies, Inc.
3401 West Warren Ave.
Fremont, CA 94539
(415) 683-6566

Components (as reviewed)
Processor: 20-MHz 386SX; 20-MHz 80387SX math coprocessor
Memory: 4 MB of RAM in 1-MB SIMMs; 64K-byte SRAM cache
Mass storage: 5¼-inch 1.2-MB floppy disk drive; 3½-inch 44-MB Toshiba MFM hard disk drive
Display: Everex Viewpoint VGA controller; Club American 14-inch multifrequency VGA color monitor
Keyboard: 101-key IBM Enhanced
I/O interfaces: One serial port; one parallel port; one 8-bit and seven 16-bit expansion slots

Price
$2584

Inquiry 1079.

Compaq Deskpro 386s/20

Company
Compaq Computer Corp.
P.O. Box 692000
Houston, TX 77269
(713) 370-0670

Components (as reviewed)
Processor: 20-MHz 386SX; 20-MHz 80387SX math coprocessor
Memory: 16 MB of RAM in 1-MB SIMMs; 4K-byte SRAM CPU cache
Mass storage: 5¼-inch 1.2-MB floppy disk drive; 3½-inch 1.44-MB floppy disk drive; two 3½-inch 120-MB Conner Peripherals IDE hard disk drives; 150-/250-MB tape drive
Display: Integrated 16-bit VGA controller; 14-inch color analog VGA monitor
Keyboard: 101-key IBM Enhanced
I/O interfaces: Two serial ports; one parallel port; one mouse port; four 16-bit expansion slots

Price
$17,883

Inquiry 1080.

ME 386SX/20

Company
Micro Express
1801 Carnegie Ave.
Santa Ana, CA 92705
(714) 852-1225

Components (as reviewed)
Processor: 20-MHz 386SX; 20-MHz 80387SX math coprocessor
Memory: 2 MB of RAM in 256K-byte DIPs
Mass storage: 5¼-inch 1.2-MB floppy disk drive; 42-MB Quantum ProDrive IDE hard disk drive
Display: Pixel Engineering Ultimate VGA-16 card; NEC MultiSync 2A color analog VGA monitor
Keyboard: 101-key IBM Enhanced
I/O interfaces: Two serial ports; one parallel port; three 8-/32-bit and five 16-bit expansion slots

Price
$2449

Inquiry 1081.

bit slots were occupied in the review machine.

I found two worrisome problems when I opened the Club's case. The video card's mounting bracket wasn't screwed to the case, and the hard disk drive controller cable was only half seated on the controller card connector. Neither of these is a horrible problem, but I worry about quality control that lets such conditions slip by. My only other complaint about the machine is that its cooling fan is noisy.

The Compaq Deskpro 386s/20, like every Compaq computer I've used, is first-class in most ways (including, of course, the price). It is built like the proverbial tank. Everything has a quality feel and works smoothly, with one exception: the standard Deskpro case cover. To remove the cover, you unscrew three large thumbscrews with your fingers and lift it off the chassis. Very easy. Alas, it's difficult to align the cover properly when replacing it, and you must exert a fair amount of force to get it into position.

The interior is fairly open. The power supply runs along the length of the right side of the case, and the expansion slots have the left third of the case to themselves. The one-third-height hard disk drives sit horizontally at the back of the case between the power supply and expansion slots and swing up to allow access. The area between the hard disk drives and the drives mounted in the three front bays is crowded with cables. All in all, it's an efficient design and should make routine maintenance and expansion easy.

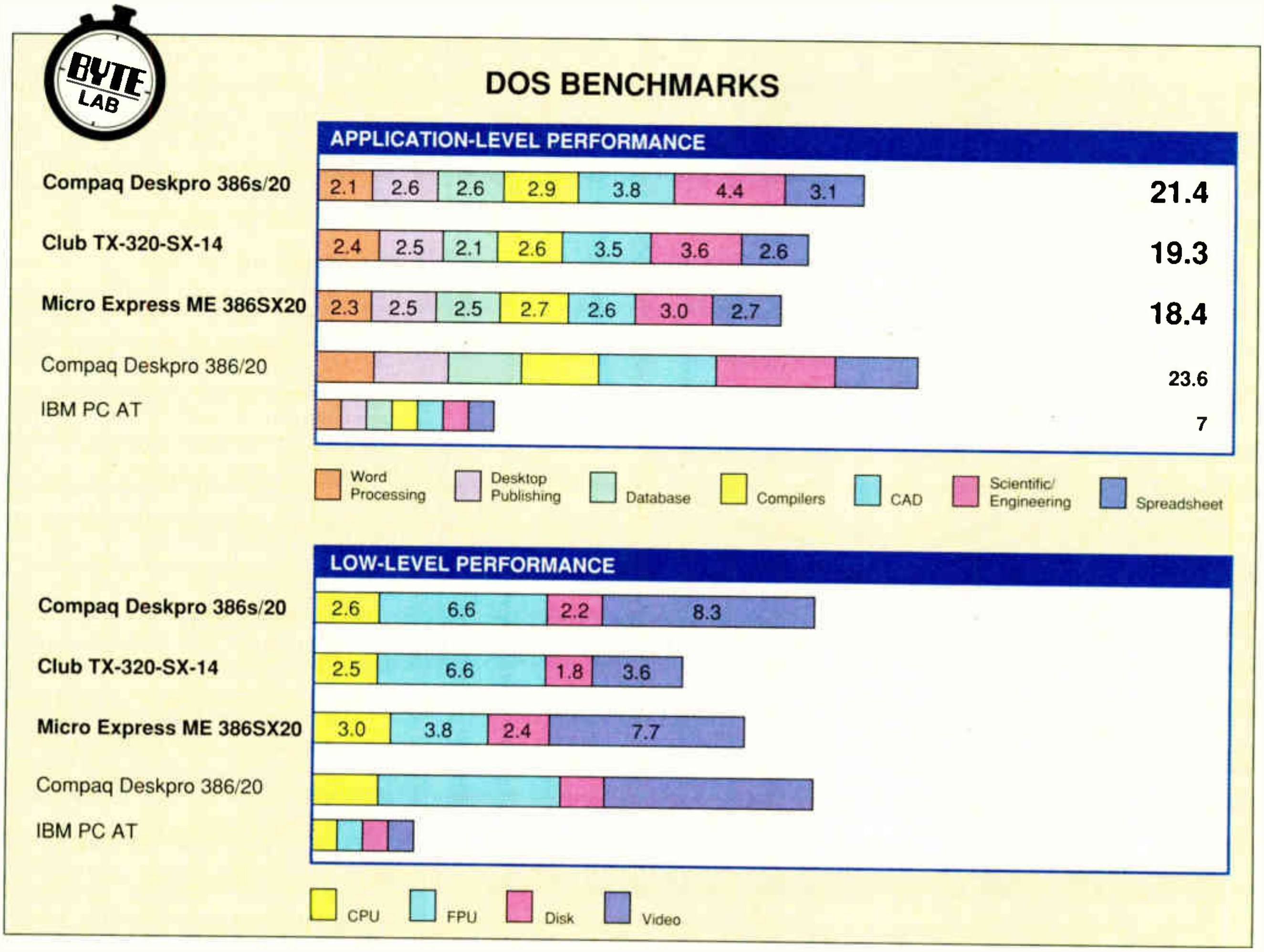
The Compaq motherboard appears to be as solid and strongly made as the case. It uses mostly surface-mount components and accepts up to 16 MB of RAM mounted in special SIMM modules. Compaq has integrated the serial ports, parallel port, mouse port, a very fast video controller, and an IDE interface on the motherboard. This left my system's four 16-bit expansion slots available for the internal modem and tape drive controller. Still, having only four available slots may be a limitation for some users. And even with only four expansion cards in place, you're probably running at the edge of the 140-W power supply's ability. Most machines in this class use 200-W or heavier supplies.

The Compaq Deskpro 386s/20 is first-class in most ways (including, of course, the price).

The 101-key Enhanced keyboard is wonderful. The touch is firm, and it's heavy enough not to slide around on your desk, yet light enough to use on your lap. I would prefer a Selectric-style L-shaped Enter key instead of the standard, skinny AT key, however.

As with the Compaq, the Micro Express had case problems. Misaligned screw holes on my review machine made the cover difficult to remove and replace. The general interior layout of the Micro Express is standard, except that it provides 3½-inch vertical drive bays on either side of the two 5¼-inch horizontally mounted drive bays. Overall, it's reasonably open. But installing or removing a drive in the rightmost 3½-inch bay is tricky.

The motherboard itself appears to be sturdy. It uses surface-mount technology for most parts, but it supports only 2 MB of RAM on the motherboard. You can install an additional 8 MB of 1-MB SIMM RAM using a $149 expansion card. Of



CONVENTIONAL BENCHMARKS

	LINPACK (single) (MFLOPS)	Dhrystones (Dhry./sec.)
Compaq 386s/20	0.16	7938.5
Club TX-320-SX-14	0.16	8056.1
ME 386SX/20	0.08	6549.1
Compaq 386/20	0.17	8449.7
IBM PC AT	0.02	2317.9

For application and low-level benchmarks, results are indexed and show relative performance; for each individual index, an 8-MHz IBM PC AT running MS-DOS 3.30 = 1. For all benchmarks, higher numbers indicate better performance.

The BYTE low-level benchmark suite identifies performance differences between machines at the hardware level; the application benchmarks evaluate real-world performance by running a standard test suite using commercially available applications. Application indexes include tests using the following programs: Word processing: WordPerfect 5.0; Desktop Publishing: Aldus PageMaker 3.0; Database: Borland Paradox 3.0 and Ashton-Tate dBASE IV; Compilers: Microsoft C 5.1 and Turbo Pascal 5.5; CAD: AutoCAD release 10 and Generic CADD level 3 1.1.5; Scientific/Engineering: Stata release 2, MathCAD 2.5, and PC-Matlab 3.5f; and Spreadsheet: Lotus 1-2-3 release 3.0 and Microsoft Excel 2.1.

The BYTE Lab introduced version 2.0 of the DOS benchmarks in the August issue (see "BYTE's New Benchmarks: New Looks, New Numbers"). Benchmark results for machines reviewed under previous versions aren't directly comparable. To obtain a copy of the benchmarks, join the listings area of the byte.bmarks conference on BIX or contact BYTE directly.

the system's eight expansion slots, one 8-/32-bit slot and four 16-bit slots are open.

What the Micro Express lacks in construction quality, it makes up for with its 15-month "depot service" warranty. The company pays freight both ways for the first four months. After that, you pay shipping to the factory. Club American offers a more standard 12-month warranty in which you must pay shipping one way. Compaq's 12-month warranty requires returning the machine to your dealer. Compaq doesn't offer on-line technical support. Club American and Micro Express's help lines aren't toll-free, and I had to wait for a return call, but both returned my call within 2 hours and were able to answer my questions quickly.

A Mixed Performance

The BYTE benchmark results for the Club and Micro Express were inconsistent. The Micro Express outpaced both the Compaq and the Club in overall CPU performance, but it turned in a poor showing on the low-level FPU tests. Fast memory moves account for the Micro Express's high CPU index. On the other CPU tests—Sieve, Sort, and integer math—performance was about on a par with the Club and the Compaq.

The Club rivaled the Compaq's CPU and FPU results, but it lagged behind both of its competitors on the low-level disk and video tests. The Compaq turned in the best performance overall. It had the fastest video subsystem and turned in the highest application index score of the SX-class machines that BYTE has tested to date.

On the compatibility front, all three computers ran an assortment of popular

continued

applications with no problems, including Quattro Pro, XyWrite III Plus, Microsoft Excel 2.1, WordPerfect 5.0, Paradox 3.0, Microsoft Windows 3.0, Lotus 1-2-3 release 3.0, Aldus PageMaker 3.0, Qmodem 4.0, and Crosstalk for Windows. And they all supported my Logitech Bus Mouse.

Pick of the Litter

Compared with the older-technology 16-MHz 386SX machines, these 20-MHz SX computers aren't always faster. Several 16-MHz SX machines that BYTE has tested offer CPU performances that are comparable to those of the Compaq and the Club; Micro Express's 16-MHz SX machine, while slower in the low-level CPU tests, offers virtually identical performance to the 20-MHz ME in the BYTE application benchmark suite (see "386SX PCs: Heirs to the Low End," August BYTE).

On average, however, these machines are 10 percent to 15 percent faster than their 16-MHz cousins, and 10 percent to 15 percent more expensive. They pose a serious challenge to systems using the more expensive 386DX-20 processor, such as the Compaq Deskpro 386/20—all three machines rivaled it in terms of raw CPU power.

If you're thinking of buying an SX machine, the SX-20's extra performance may be worth the premium, particularly if you will be running Windows 3.0 applications.

Of the three machines I reviewed, the Compaq is clearly the best-made and gave the best overall performance. But even users who can afford the Compaq may balk at the price gulf that separates it from the Club and the Micro Express.

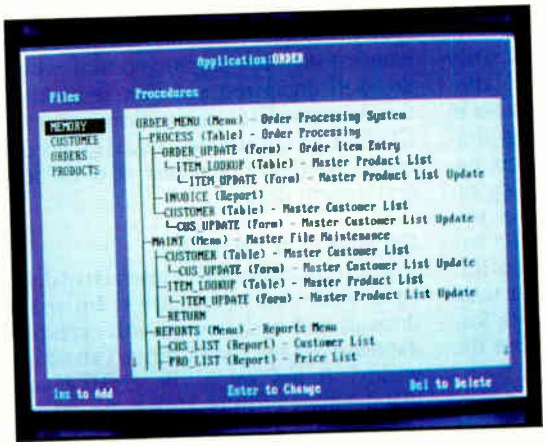
The Micro Express turned in blazingly fast CPU and video performances, but if you need FPU power, you can forget about this machine. On balance, the Club is the best machine in the group; its construction quality doesn't approach the Compaq's, but it surpasses that of the Micro Express. It's relatively inexpensive. And slow times in the low-level hard disk and video tests didn't stop the Club from posting a second-place finish in the application benchmarks. Faster hard disk and video components would make this machine tough to beat. ■

George Bond is a consultant in communications—electronic, traditional print, and person-to-person. He has more than 20 years' editorial and management experience with major information companies and is cofounder of BIX. You can reach him on BIX as "gbond."

George A. Stewart

REVIEW

A Database Developer That's Different from the Rest



The base menu of Clarion's Designer utility shows the structure of the application. To view a particular procedure or file in greater detail, you highlight it and press Return.

I want to make one thing clear: Clarion is *not* just another souped-up DBMS to join the pack along with dBASE III and IV, Paradox, R:base, DataEase, and the rest. Instead, it is a true applications development system with features that set it apart from the traditional DBMS group. For example, it includes a rich, general-purpose language with enhancements for database operations, a programmer's editor, and a high-level applications prototyping utility that generates working code. It also has an integrated environment that minimizes the need to use repetitive, arcane commands, yet it retains the flexibility that often goes with command-oriented systems.

With that list of features, Clarion is a large system, requiring 4.5 megabytes of hard disk space for installation. That space is used for Clarion's four work areas: design and edit; compile, process, and debug; file creation and maintenance; and support utilities.

A base menu simplifies the process of selecting among these various elements. The base menu remembers your last actions and uses that information when you start a new operation, to reduce the need for tedious entry of filenames. This context is preserved even when you quit Clarion and return later.

Painless Programming

The Designer utility is the most unusual aspect of Clarion. The program accepts your application specifications in terms of files and procedures and prompts you for needed information. Eventually, it produces data structures and Clarion source code to produce entry screens, reports, menus, and to-do computations.

For many business applications, like mailing-list maintenance and order entry/inventory/invoicing, Designer's end product may be sufficient. Even without further customization, Designer produces programs that are far from rudimentary. For example, when designing a screen-entry form, you can create a field that activates a lookup table or a list of choices to help the end user in filling in the form. You can also create help screens that are displayed when the end user makes an error, presses the Help key, or begins entering data into a field. You can create conditional fields that are activated only when certain other values are entered elsewhere on the screen.

In other cases, Designer's output serves as a first approximation or perhaps just a skeleton of what you want to accomplish. It has still saved you a lot of time, simply by creating the data structures, screens and reports, source code modules, and connecting logic between all these elements. You finish the work using the Editor to program directly in Clarion source code.

Designer starts with a model that serves as the skeleton for your application. Clarion includes one called STANDARD.MDL, but you can create your own models as well. The standard model application lets you put together procedures including reports, help menus, option menus, tables (scrollable lists of records in a file), forms (for entering and modifying data), and others (custom procedures to be filled in using the Editor; other procedures can also be binary files created using C or some other high-level language).

One of Clarion's niftiest features, available in the Designer and in the Editor, is the Screen Formatter. This program lets you create WYSIWYG screens and reports with virtually no canned flavor: You can produce exactly the screen you want using paint modes for filling in background, track modes for setting up rules, boxes, and borders, and field commands for specifying whether a field is from a file, computed, or from a lookup table, and how it will be formatted. On exiting the formatter, Clarion generates the often voluminous screen structure, variable declaration, and procedure code corresponding to the screen or report that you sketched out on the computer screen.

The output of Designer is Clarion source code that you can modify directly using the Editor. Once the source code is finished, you compile the code to produce a pseudocode that the run-time processor executes interpretively. During this phase of program development, you can set breakpoints, watch variables, jump to specific program lines, and use other debugging techniques.

After you complete the testing and debugging phase, you produce a standalone program by using the utility called Translator. Translator produces a single, self-sufficient executable file or, if you so specify, an executable file and a run-time library file. The latter approach saves space if several applications are on the same system; the various applications can share the common routines.

The Clarion Language

The Clarion language combines structured programming with intuitive shortcuts (e.g., automatic type conversions) that keep programs smaller than they otherwise might be. Programs are organized into declaration and code sections. The main program may contain a map declaration listing internal and external code (e.g., procedures, routines, and functions) used by the main program. You can declare code sections as part of overlay structures to limit the memory requirements of an application.

There are five data types: string (fixed length, 1 to 255 bytes), byte (1-byte unsigned integer), decimal (packed decimal value, 1 to 15 digits, up to 8 bytes long), short integers (2-byte signed), and long integer (4-byte signed).

You can store times and dates as long integers and then display them in various conventional formats using a picture

continued

Clarion Professional Developer

Company
Clarion Software
150 East Sample Rd.
Pompano Beach, FL 33064
(800) 354-5444
(305) 785-4555

Hardware Needed
IBM PC, XT, AT, PS/2, or compatible with 512K bytes of RAM and a hard disk drive with 4.5 MB free

Software Needed
DOS 2.0 or higher

Price
$845

Inquiry 980.

function. Variables can be placed in arrays with up to four dimensions. You can group and treat variables as a unit by means of a Group declaration. You can compare grouped variables and clear, dimension, and otherwise reference them by a single group name.

Conversion between data types is automatic, so, for instance, given string variables `city` and `state` and long integer variable `zip`, you can combine and assign the three variables to another string variable `address` with the single assignment statement `address=city & state & zip`. Clarion automatically converts the long integer to a string of digits.

Structured executable statements include `case of...orof...else`, `if...then...else`, and conditional and unconditional `loop`. File structure statements include `record` declarations for specifying the fields that comprise a record, `index` and `key` for declaring index and key fields, and `owner` and `encrypt` for file security. File attributes assigned when a file is accessed include `create`, allowing a nonexistent file to be created; `protect`, which prevents a file from being changed; and `reclaim`, which specifies that add and append operations write new records into the position last deleted. For keyed and indexed files, `dup` allows for duplicate keys (otherwise rejected); `nocase` makes key or index values case-insensitive; and `opt` suppresses null keys.

Clarion has many features to support transaction processing, which allows file operations to be undone by reversing the effects of the operations. This makes it well suited to accounting and other serious applications where data integrity is essential. `Logout` initiates logging for a transaction. The logout file contains a copy of every changed record in its prechanged form. `Rollback` permits restoration of changed records, and `commit` terminates transaction processing.

Several statements give you control over the balance between data integrity and file-processing speed. `Cache` allocates virtual memory for keeping keys in memory, speeding file processing dramatically. (In the performance test described below, caching the file key reduced processing time from 4 minutes, 52 seconds to 50 seconds.) `Buffer` lets you control the size of the record buffer, using all available memory if you wish (but increasing the amount of data lost should a power failure occur before the buffer is written to disk).

For network operations, Clarion provides a share statement that opens a file and marks it shared; `lock` and `unlock`, which prevent or allow file access by other workstations; and `hold` and `release`, which prevent or allow access to a particular record by other workstations.

How Fast?

To get a rough measure of Clarion's file access performance, I created a 1000-record database consisting of five string fields and two long integer fields. The data was keyed on one of the string fields. I then wrote Clarion and dBASE III Plus 1.1 programs to read and display each record in key sequence. I ran the tests on a 286 Dell System 200 that had 640K bytes of RAM, a 20-MB hard disk drive, and MS-DOS 3.10.

dBASE III took 1 minute, 46 seconds to complete the file review. Clarion took just 50 seconds. Reviewing the file in (unkeyed) physical record order took 1 minute, 12 seconds in dBASE III and 25 seconds in Clarion.

Learning to Play the Clarion

A comprehensive set of software tutorials, written in the Clarion language, lets you get the feel of the system, although slowly. A slim volume, called Getting Started, guides you through a series of projects with the Designer, Editor, and Compiler. This book will really help you understand and appreciate the Designer. After that, there's a comb-bound book of Annotated Examples, ranging from a "Hello, World" miniprogram to an invoice program allowing an unlimited number of items per invoice to a slot machine simulation complete with sound effects and graphics. Studying the annotated listings while running these programs gives you a subtler understanding of how to put the Clarion language to work. There are 17 annotated programs in all, not including a sample language extension module written in assembly.

For the rest of the story, you have two massive volumes, the Utilities Guide (500-plus pages) and the Language Reference (380-plus pages), both of which are well organized and thorough. Last, the Help key, F1, is active throughout the Clarion environment, usually giving context-sensitive help that is often several screens deep.

Excellence or Overkill?

If you are accustomed to interactive database work—ad hoc queries, browsing through and updating records, creating databases on the fly—Clarion can be unwieldy. It has some file creation and maintenance utilities: Filer, for changing data files to match changes made in the programs that access the data; Converter, for converting both ways between Clarion and BASIC, DIF, dBASE II, and dBASE III; Sorter for sorting and merging data files; and Scanner for viewing data files in a spreadsheet format.

However, these utilities won't let you call up a record based on a search key or list a set of records matching a record filter. Such tasks require you to create at least a minimal application using Designer or Editor. The Clarion language, however, lets you design general-purpose programs to accomplish such tasks.

For those who don't want to program extensively in Clarion but do like the idea of creating applications without the need for programming, Clarion Software offers the Personal Developer for $199. The program comes with eight ready-to-use or -customize applications: order entry, sales tracking, inventory system, membership list maintenance, publications cataloging, telephone directory, classroom grading system, and interoffice memowriter. Applications produced under Personal Developer are upwardly compatible with Professional Developer.

At $845, Clarion Professional Developer is significantly more expensive than the typical $500 DBMS, and it could indeed be overkill for a person who simply doesn't want to take the trouble to create reusable applications. However, for professional developers and others who want sophisticated database applications, Clarion should be able to earn its keep. ■

George A. Stewart is a former BYTE technical editor who lives in Hancock, New Hampshire. You can reach him on BIX c/o "editors."

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MF-5221	30 to 80kHz	0.31	1280 × 1280
MF-5321 (A.R.Panel)	30 to 80kHz	0.31	1280 × 1280
MF-5421 (A.R.Panel)	30 to 80kHz	0.26	1600 × 1280

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IDEK Europe (W. Germany)
Neumannstrasse 38, 6000 Frankfurt a.M. 50, West Germany
Phone: (49) 69-521 922 Fax: (49) 69-521 927

IDEK North America
144 Centre Mountain View, CA 94041 U.S.A.
Phone: (1) 415-962-9410 Fax: (1) 415-962-9474

BIX Conference News—

***NetWare Tech Journal* Joins BIX**

■ Now you can read the text of *NetWare Technical Journal* on BIX. *NetWare Technical Journal* is a rich source of information and technical discussion about the network computing industry. Topics covered include programming, software/hardware integration, trends and recent developments in the industry. In addition to reading the text of this publication, you can also engage in discussions on BIX about an article's significance. (join netware.tech)

Object-Oriented Programming— The object of much discussion on BIX. BYTE readers interested in object-oriented programming will find the topic has many homes on BIX. The wide range of choices on BIX includes discussions for beginners, debates among pros, and software for an object-oriented preprocessor.

For OOP newcomers, there's the 'beginners' topic in the 'c.plus.plus' conference. (join c.plus.plus)

In the 'cobol' conference, some members of the CODASYL COBOL Committee's Object-Oriented COBOL Task Group are feverishly working on adding features to the COBOL language to make it an object-oriented language. (join cobol)

In the 'other.lang' listings area, you can download an object-oriented preprocessor to the Icon language. The file, called 'idol.arc', contains a full description of the Idol language, source code for the preprocessor (written in Idol) and the bootstrap to get the preprocessor going. (join other.lang)

In 'amiga.sw', an object-oriented inter-

BIX COMMUNITY CALENDAR OCTOBER 1990

face into the Amiga's Intuition is under scrutiny. Join Peter Cherna, of Intuition fame, and discuss this development. (join amiga.sw)

As an added plus, SAS Institute supports its C++ compiler in the new 'sas.c' conference. (join sas.c)

Object-oriented design and theory not specifically tied to any particular compiler is the subject of the 'ood' conference. (join ood)

Two new topics recently opened in the 'telecomm.pgms' conference also taking a look at OOP: 'multitask.tc' and 'objective.tc.' In the 'multitask.tc,' talk focuses on background operations and telecommunications. The 'objective.tc' topic strives to answer the question: Can we do better than the old glass Teletype interface? (join multitask.tc, and objective.tc)

■ **Other Conference News and Events**—Support for all Tandy computer products is available through the BIX Tandy conference. Among the many contributors in this conference is Mike Banks, author of the definitive book on Tandy's Deskmate software (and author of the Modem Reference Guide). Banks is a regular contributor, keeping you up-to-date on developments at Tandy. He also lends a hand to anyone wishing to use Deskmate more efficiently. (join tandy)

What's Ahead: LAN Times and Data Communications magazines will soon be joining BIX. International computer and technology news and reports from Europe and Japan will join the BIX Microbytes newswire.

BIX Exchange News

■ **Amiga Exchange**—Commentary on the new AmigaDOS operating system, 2.0, continues hot and heavy. Check out topic '2.0' in the 'amiga.user' conference. (join amiga.user)

Explore the internationalization initiative underway for 2.0 in the 'amiga.int' conference. (join amiga.int)

Learn all about the Amiga 3000 in the 'amiga.special' topic 'cover girl', including how to plug in expansion SCRAM, which is not as easy as it sounds. (join amiga.special)

IFF standards—always a hot issue—are discussed at length in the 'amiga.dev/iff conference. (join amiga.dev/iff)

IBM Exchange—Itching to build your own 33-MHz 80386? We'll tell you how to build one from scratch during October in the IBM Exchange.

We'll also be comparing Windows 3.0 vs. Desqview vs. OS/2, and telling how to program Windows applications.

The IBM Exchange is the place to learn the ins and outs of the new PC/DOS 5.0, and join in the debate over which drive is best—IDE, ESDI, SCSI, MFM or RLL.

For these topics and others, look in 'hot.topics' in the IBM Exchange. (join ibm.exchange)

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Object Lessons

Object-oriented computing is no longer simply the wave of the future—it's real, it's spreading, and it's here now. Once only the realm of technical papers and academia, object orientation has taken the software industry by storm. Everyone's doing it.

But that doesn't mean that everyone *should* be doing it. There are important lessons for the software industry within the object-oriented paradigm—lessons of modularity and reusability, lessons of paradigm consistency, and lessons about when *not* to use object orientation.

The dictionary defines an object lesson as "something that serves as a practical example of a principle or abstract idea." The goal of this State of the Art section is to provide you with practical examples of the abstract concept of object orientation—solid information that will help you choose, from a position of strength and knowledge, whether object orientation is the right paradigm for you.

One of the basic tenets of object-oriented computing is reusability—libraries of self-contained modules that you can reuse instead of reinventing the wheel every time you need it. In "There *Is* a Silver Bullet," Brad J. Cox shows how reusability in various contexts has come to define much of civilization, whereas the start-from-scratch attitude has become hopelessly archaic for a maturing industry. It's a fascinating article filled with surprising historical parallels.

Knowing the kinds of challenges you face can help you decide whether to undertake this change—and there *are* challenges. Object orientation is not a panacea, and a real handle on its pluses and minuses for your organization can help you determine whether it's worth the cost. In "Migration Patterns," Chuck Duff and Bob Howard examine the risks and rewards of migrating to objects. They also detail a stepped approach to migration so you don't have to plunge in without a life jacket.

One area that seems particularly confusing is the database area. Even the experts cannot agree on whether to use a relational database or an object-oriented one (or perhaps a hybrid of the two). In "Database Wars Revisited," Christopher M. Stone and David Hentchel compare relational and object-oriented databases—how they stack up against each other and what their respective strengths and weaknesses are.

We tend to think of this choice as a choice of programming styles. But it's much more. It's a choice of paradigm, a whole way of seeing things, and it extends far beyond the programming elements. In "Objects—Born and Bred," Elizabeth Gibson describes Object Behavior Analysis, an object-oriented approach to analysis, a first move toward a successful object-oriented system.

But is this the right time for you and your company to make the switch? Is object-oriented technology ready for you and your needs? Are you ready for it? In "Auld Lang Syne," Edward Yourdon discusses when object orientation is the right choice, when it's the wrong one, and when you should take it in stages.

Object lessons are not always fun. Sometimes they teach you things you didn't want to know. But when you look back at them, you're almost always glad they came along, because they prevented you from making future mistakes. There are many advantages to object-oriented technologies, but there are costs as well. Which side comes out on top? There is no easy answer. In the final analysis, the choice is—and has to be—yours.

—Jane Morrill Tazelaar
Senior Editor, State of the Art

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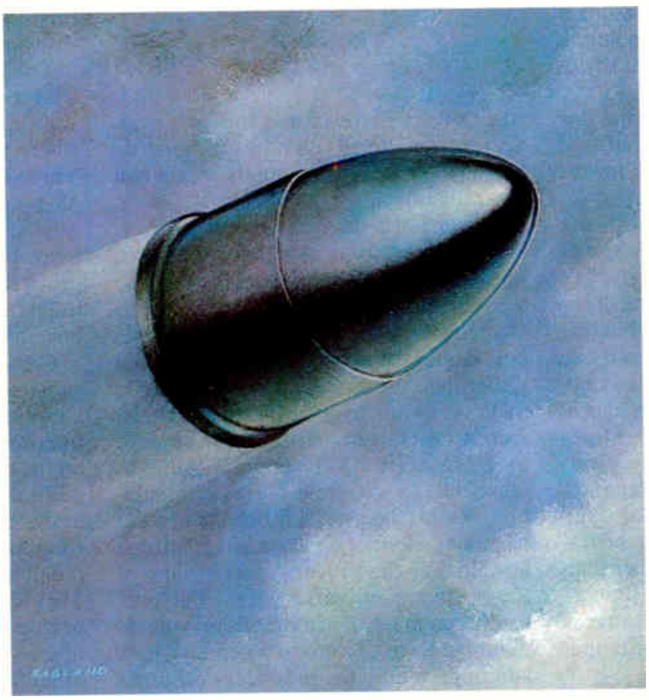
There *Is* a Silver Bullet

A software industrial revolution based on reusable and interchangeable parts will alter the software universe

Brad J. Cox

Of all the monsters that fill the nightmares of our folklore, none terrify more than werewolves, because they transform unexpectedly from the familiar into horrors. For these, one seeks bullets of silver that can magically lay them to rest. The familiar software project, at least as seen by the nontechnical manager, has something of this character; it is usually innocent and straightforward, but is capable of becoming a monster of missed schedules, blown budgets, and flawed products. So we hear desperate cries for a silver bullet—something to make software costs drop as rapidly as computer hardware costs do.
—Brooks (see reference 1)



Two centuries after its birth in the industrial revolution, the age of manufacturing has matured and is showing signs of decline. And a new age, the information age, is emerging, born of the phenomenal achievements that the age of manufacturing brought to transportation, communication, and computing.

By eliminating time and space as barriers, however, the very achievements that put us within reach of a truly global economy are burying us in irrelevant and useless data, in mountains of low-quality ore that must be laboriously refined for relevant information—the signal hidden in the noise. The critical resource for turning this raw data into useful information is computer software, as strategic a resource in the information age as petroleum is today.

More than 20 years ago, the NATO Software Engineering Conference of 1968 coined the term *software crisis* to indicate that software was already scarce, expensive, of insufficient quality, hard to schedule, and nearly impossible to manage.

For example, in *The Mythical Man-month*, one of the seminal works of these two decades, Fred Brooks observed that adding more people to a late software project only makes matters worse. And in "No Silver Bullet: Essence and Accidents of Software Engineering," he argues that the difficulties are inevitable, arising from software's inescapable essence—not from accident, but from some deficiency in how programmers build software today.

But if you view these same facts from a new perspective, a more optimistic conclusion emerges. The software crisis is not an immovable obstacle but an irresistible force—a vast economic incentive that will grow toward infinity as the global economy moves into the information age.

To turn Brooks' own metaphor in a new direction, there *is* a silver bullet. It is a tremendously powerful weapon,
continued

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propelled by vast economic forces that mere technical obstacles can resist only briefly. But as Brooks would agree, it is not a technology, a whiz-bang invention that will slay the software werewolf without effort on our part or vast side effects on our value systems and the balance of power between software producers and consumers.

The silver bullet is a *cultural* change rather than a technological change. It is a paradigm shift—a software industrial revolution based on reusable and interchangeable parts that will alter the software universe as surely as the industrial revolution changed manufacturing.

Object-Oriented Technologies

The term *object-oriented* keeps turning up. There are object-oriented environments, object-oriented applications, object-oriented databases, architectures, and user interfaces, and object-oriented specification, analysis, and design methods. And, of course, there are object-oriented programming languages, from conservative Ada to radical Smalltalk, with C++ and Objective-C somewhere in between. You may well wonder what, if anything, all these different technologies have in common. What does the adjective *object-oriented* really mean?

Who can say with certainty what *any* adjective means? No one is confused when an adjective such as *small* means entirely different things for cars, molecules, and galaxies. But in the software domain, words often cloud as much as they illuminate.

Object-oriented fails to distinguish between the low-level modularity/binding technologies of Ada and C++ and the higher-level ones of Smalltalk, and between these three languages and a hybrid environment like Objective-C. Moreover, purists summarily exclude ultra-high-level modularity/binding technologies like Fabrik or Metaphor (see reference 2) from the object-oriented domain because they are iconic rather than textual and because they do not support inheritance, forgetting that the same is true of things like tables and chairs that are indisputably "objects."

The confusion is understandable. The inhabitants of the software domain, from the simplest BASIC statement to a million-line application program, are as intangible as a ghost. And because programmers invent and build them all from first principles, everything in the software domain is unique and therefore unfamiliar, composed of modules and routines that have never been seen before and will never be seen again.

These component parts of the domain of software obey laws—promulgated by the programmers—that are specific to a unique instance. There are no general guidelines to bring order to the software domain. As Brooks put it, software is a world of werewolves and silver bullets. When all a programmer knows for certain is what he or she put there in the last few days, mystical belief will always win out over scientific reason. Thus, terms like *computer science* and *software engineering* remain oxymorons, tripping up those who don't recognize their inherent contradictions.

> *Everything in the software domain is unique, composed of modules and routines that have never been seen before and will never be seen again.*

To get a grip on *object-oriented* means coming to the realization that it is an end, not a means—an objective rather than the technologies for achieving it. It means changing how we view software, shifting our emphasis to the objects we build rather than the processes we use to build them. It means using all available tools, from COBOL to Smalltalk and beyond, to make software as tangible—and as amenable to common-sense manipulation—as are the everyday objects in a department store. *Object-oriented* means abandoning the process-centric view of the software universe where the programmer-machine interaction is paramount in favor of a product-centered paradigm driven by the producer-consumer relationship.

But since reverting to this broader meaning might confuse the terminology even further, I use a separate term, *software industrial revolution*, to mean what *object-oriented* has always meant to me: transforming programming from a solitary cut-to-fit craft, like the cottage industries of colonial America, into an organizational enterprise like manufacturing is today. It means *enabling* software consumers, making it possible to solve your own specialized software problems the same way that homeowners solve plumbing problems: by assembling solutions from a robust market in off-the-shelf, reusable subcomponents, which are in turn supplied by multiple lower-level echelons of producers.

The problem with the old paradigm is illustrated with a simple question. When building a house, would you consider buying a plumbing system built entirely from unique, customized parts?

Yet this is just what the software community, with its infatuation with process and the pursuit of perfection from first principles, expects programmers to do whenever they build software. This would be considered ludicrous in a mature domain such as plumbing, yet it is business as usual in software.

To illustrate further, contrast the enormous interest that is generated by advances in process-oriented technologies—for example, structured programming, object-oriented programming, CASE, and Cleanroom—with the woeful lack of interest in the development of a robust market of fine-grained reusable software components.

The key element of the software industrial revolution is the creation of such a standard-parts marketplace, a place where those who specialize in the problem to be solved can purchase low-level, pluggable software components to assemble into higher-level solutions. The assemblers, of course, have as little interest in the processes used to build the reusable components as plumbers have in how to manufacture thermostats.

Clearly, software products are not the same as tangible products like plumbing supplies, and the differences are not minor. However, I shall avoid dwelling on the differences and emphasize a compelling similarity. Except for small programs that a solitary programmer builds for personal use, both programming and plumbing are organizational activities. That is, both are engaged in by ordinary people with the common sense to organize as producers and consumers of each other's products rather than reinvent everything from first principles. The goal of the software industrial revolution in general, and object-oriented technologies in particular, is to bring common sense to bear on software.

The Copernican Revolution

Let us assume that crises are a necessary precondition for the emergence of novel theories, and next ask how scientists

continued

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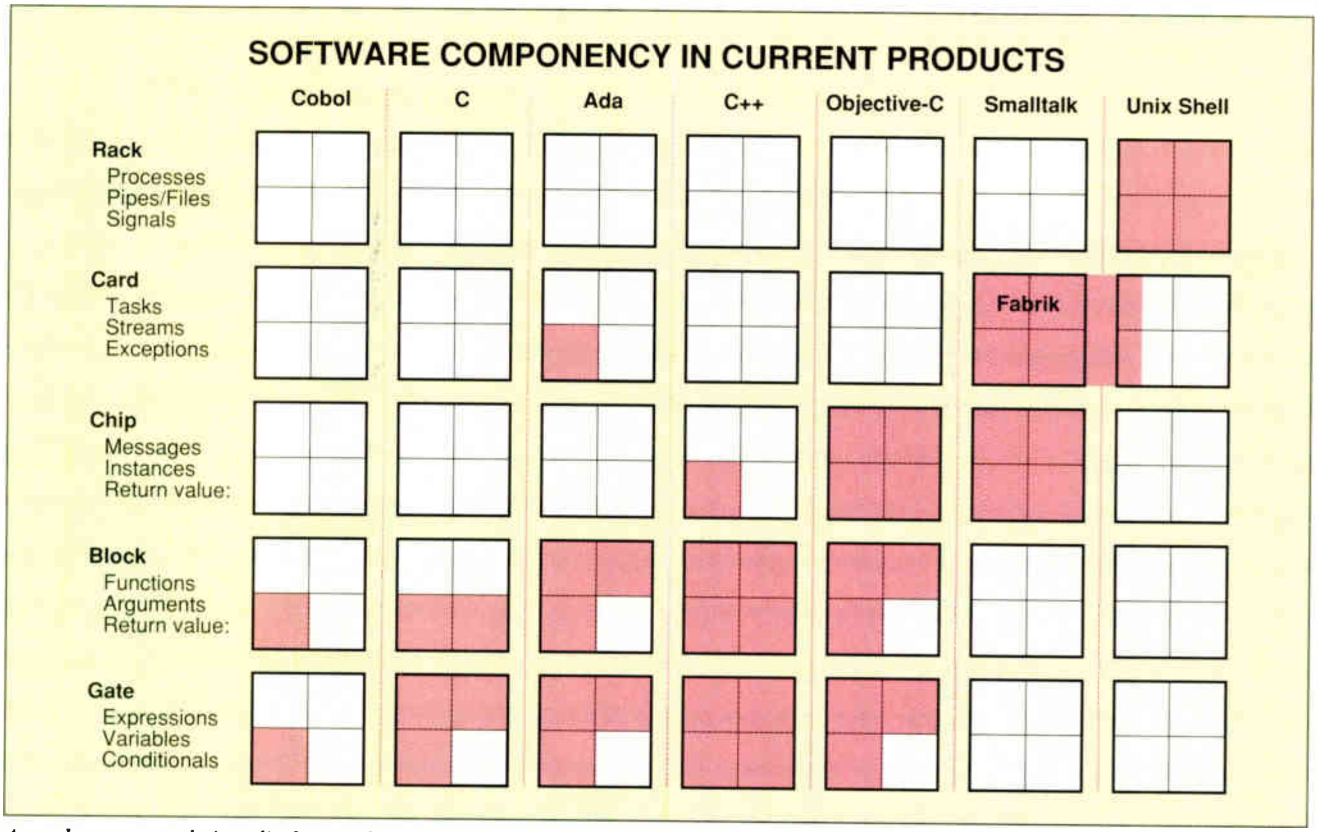

A product-centered view discloses relationships between languages that were not obvious from the traditional process-centered view. It implies a multilayered architecture of reusable, interchangeable software components analogous to the multilayered architecture of hardware engineering. It also implies that the critical path to escaping the software crisis does not involve discovering new modularity/binding technologies, but integrating those that are already known.

respond to their existence. Part of the answer, as obvious as it is important, can be discovered by noting first what scientists never do when confronted by even severe and prolonged anomalies. Though they may begin to lose faith and then to consider alternatives, they do not renounce the paradigm that has led them into crisis. They do not, that is, treat anomalies as counter-instances, though in the vocabulary of philosophy of science, that is what they are. The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature and with each other.

—Kuhn (see reference 3)

Aristotle's universe had the earth and mankind at the center, with the sun, moon, planets, and stars circling around on ethereal spheres. The second-century astronomer Ptolemy amended this model by adding *epicycles* to account for observed discrepancies in planetary motion. By the sixteenth century, 90 such epicycles were needed, and the resulting complexity created an astronomy crisis.

The Aristotelian cosmological model as extended by Ptolemy was once as entrenched and "obvious" as today's process-centered model of software development. Given any particular discrepancy, astronomers were invariably able to eliminate it by making some adjustment in Ptolemy's system of epicycles, just as programmers can usually overcome specific difficulties within today's software-development paradigm.

But like today's software engineers, the astronomers could never quite make Ptolemy's system conform to the best observations of planetary position and precession of the equinoxes. As increasingly precise observations poured in, it became apparent that astronomy's complexity was increasing more rapidly than its accuracy and that a discrepancy corrected in one place was likely to show up in another. The problem could not be confined to the astronomers and ignored by everyone else, because the Julian calendar, based on the Ptolemaic model, was several days wrong—a discrepancy that any believer could see from the behavior of the moon.

This was as serious a problem for that era as the software crisis is today, since missing a saint's day lessened a worshipper's chances of salvation. By the sixteenth century, the sense of crisis had developed to the point that you can well imagine an early astronomer, frustrated beyond limit with keeping Ptolemaic models up to date, venting his despair in an article titled "No Silver Bullet: Essence and Accidents of Astrophysics."

In 1514, the Pope asked Copernicus to look into calendar reform, and over the next half century, Copernicus, Galileo, Kepler, and others obliged by eliminating the astronomy crisis, once and for all. But their silver bullet was not what the church had in mind. It was not a new process, some whiz-bang computer or programming language for computing epicycles more efficiently. It was a cultural change, a paradigm shift, a "mere" shift in viewpoint as to whether the heavens rotate around the earth or the sun.

The consequences to all the beliefs, value systems, vested interests, and

continued

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power balances of that era were anything but minor. The astronomer's silver bullet removed mankind from its accustomed place at the center of the universe and placed us instead at the periphery, mere inhabitants of one of many planets circling around the sun.

The software industrial revolution involves a similar paradigm shift, with a similar assault on entrenched value systems, power structures, and sacred beliefs about the role of programmers in relation to consumers. It is also motivated by practical needs that an older paradigm has been unable to meet, resulting in a desperate feeling of crisis.

Just as the church's need for calendar reform escalated the astronomy crisis to where change became inevitable, the need for reliable software in the information age is escalating the software crisis to where a similar paradigm shift is no longer a question of whether, but of when and by whom.

The Industrial Revolution

It does not diminish the work of Whitney, Lee, and Hall to note the relentless support that came from the government, notably from Colonel Wadsworth and Colonel Bomford in the Ordnance Department and from John C. Calhoun in Congress. The development of the American system of interchangeable parts manufacture must be understood above all as the result of a decision by the United States War Department to have this kind of small arms whatever the cost.
—Hawke (see reference 4)

The cottage-industry approach to gunsmithing was in harmony with the realities of colonial America. It made sense to all parties, producers and consumers alike, to expend cheap labor as long as steel was imported at great cost from Europe. But as industrialization drove materials costs down and demand exceeded what the gunsmiths could produce, they began to experience pressure for change.

The same inexorable pressure is happening in software as the cost of computer hardware plummets and the demand for software exceeds our ability to supply it. As irresistible force meets immovable object, you experience the pressure as the software crisis: the awareness that software is too costly and of insufficient quality, and its development is nearly impossible to manage.

The software industrial revolution will occur, sometime, somewhere, whether programmers want it to or not, because it will be the software consumers who determine the outcome. It is only a question of when and by whom—whether the present software development community will be able to change its value system quickly enough to service the relentless pressure for change.

Contrary to what a casual understanding of the industrial revolution may suggest, it didn't happen overnight, and it didn't happen easily. In particular, the revolutionaries were not the cottage-industry gunsmiths; they actually seem to have played no role whatsoever, for or against. They stayed busy in their workshops and left it to their consumers to find another way.

The software industrial revolution will occur, sometime, somewhere, whether programmers want it to or not, because the consumers determine the outcome.

Judging from a letter written by Thomas Jefferson in 1785, it was actually he who found the solution in the workshop of a French inventor, Honoré Blanc. Key technical contributions were made by entrepreneurs (e.g., Eli Whitney, John Hall, and Roswell Lee) attracted from outside the traditional gunsmith community by incentives that the gunsmiths' consumers laid down to foster a new approach.

Those with the most to gain, and nothing to lose—the consumers—took control of their destiny by decisively wielding the behavioral modification tool of antiquity: money. They created an economic incentive for those vendors who would serve their interest (i.e., the ability to reuse, interchange, and repair parts) instead of the cottage-industry gunsmiths' interest in fine cut-to-fit craftsmanship.

Although it took consumers nearly 50 years to make their dream a reality, they moved the center of the manufacturing universe from the process to the product, with the consumers at the center and the producers circling around the periphery. Of course, the gunsmiths were "right" that interchangeable parts were far more expensive than cut-to-fit parts. But high-precision interchangeable parts ultimately proved to be the silver bullet for the manufacturing crisis: the paradigm shift that launched the age of manufacturing.

Reusable Software Components

A crucial test of a good paradigm is its ability to reveal simplifying structure to what previously seemed chaotic. Certainly, the software universe is chaotic today, with object-oriented technologies fighting traditional technologies, Ada fighting Smalltalk, C++ fighting Objective-C, and rapid prototyping fighting traditional methods, such as Milspec 2167 and Cleanroom.

Only one process must win and be adopted across an entire community, and each new contender must slug it out with older ones for the coveted title, "standard." Different levels of the producer-consumer hierarchy cannot seek specialized tools and reusable components for their specialized tasks, skills, and interests, but must fit themselves to the latest do-it-all panacea.

By focusing on the product rather than the process, a simpler pattern emerges, reminiscent of the distinct integration levels of hardware engineering (see the figure on page 212). On the card level, you can plug off-the-shelf cards to build custom hardware solutions without having to understand soldering irons and silicon chips. On the chip level, vendors can build cards from off-the-shelf chips without needing to understand the minute gate- and block-level details that *their* vendors must know to build silicon chips. Each modularity/binding technology encapsulates a level of complexity so that its consumer needn't know or care how components from a lower level were implemented, but only how to use them to solve the problem at hand.

Building software applications (rack-level modules) solely with tightly coupled technologies like subroutine libraries (block-level modules) is logically equivalent to wafer-scale integration, which is something that hardware engineering can barely accomplish to this day. Yet this is just what every software developer must do.

So, seven years ago, I cofounded The Stepstone Corp. to play a role analogous to that of silicon chip vendors by providing chip-level software components, or Software-ICs, to the system-building community. The goal was to create an enabling technology for a multilevel

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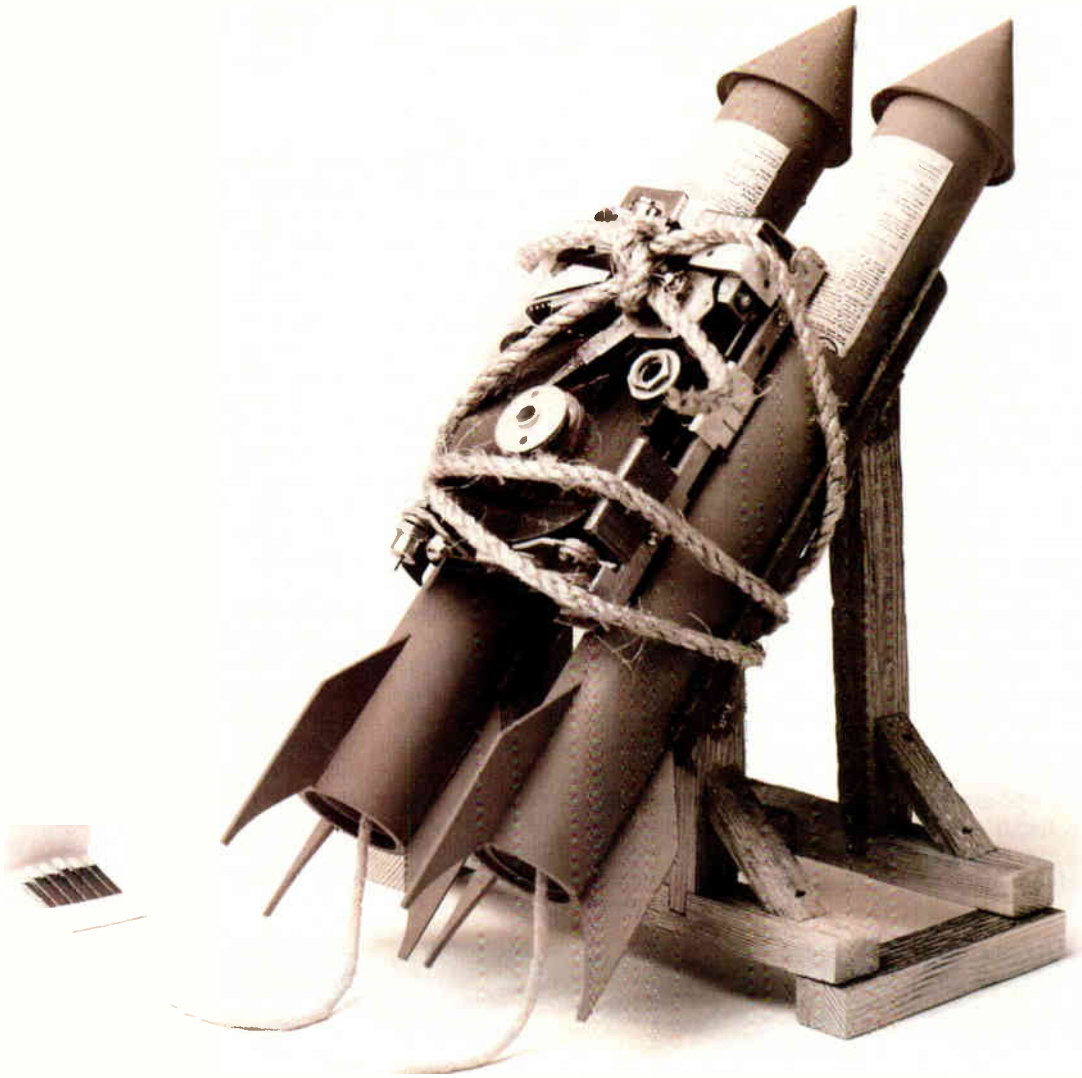

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marketplace in reusable software components. (It is called the Objective-C System-building Environment.)

Stepstone's experience amounts to a large-scale study of the reusable-software-components-marketplace strategy in action. With substantial Software-IC libraries now in the field and others on the way, the chip-level software-components-marketplace concept has been tried commercially and proven sound for an amazingly diverse range of customer applications.

However, this study has also revealed how difficult it still is, even with state-of-the-art object-oriented technologies, to design and build components that are both useful and genuinely reusable, to document their interfaces so that consumers can understand them, to port them to an unceasing torrent of new hardware platforms, to ensure that recent enhancements or ports haven't violated some preexisting interface, and to market them to a culture whose value system, like that of the colonial gunsmith, encourages building everything from first principles to avoid relying on somebody else's work.

A particularly discouraging example of this value system is that, in spite of the time and money invested in libraries and environmental tools like browsers, Objective-C continues to be thought of as a language to be compared with Ada and C++, rather than as the tiniest part of a much larger environment of ready-to-use software components and tools.

Another lesson of the last few years is that chip-level objects are only a beginning, not an end. The transition from how the machine forces programmers to think to how everyone expects tangible objects to behave is not a single step, but many, as shown in the figure. Just as there is no universal meaning for adjectives like *small* or *fast*, there is no single, narrow meaning for *object-oriented*.

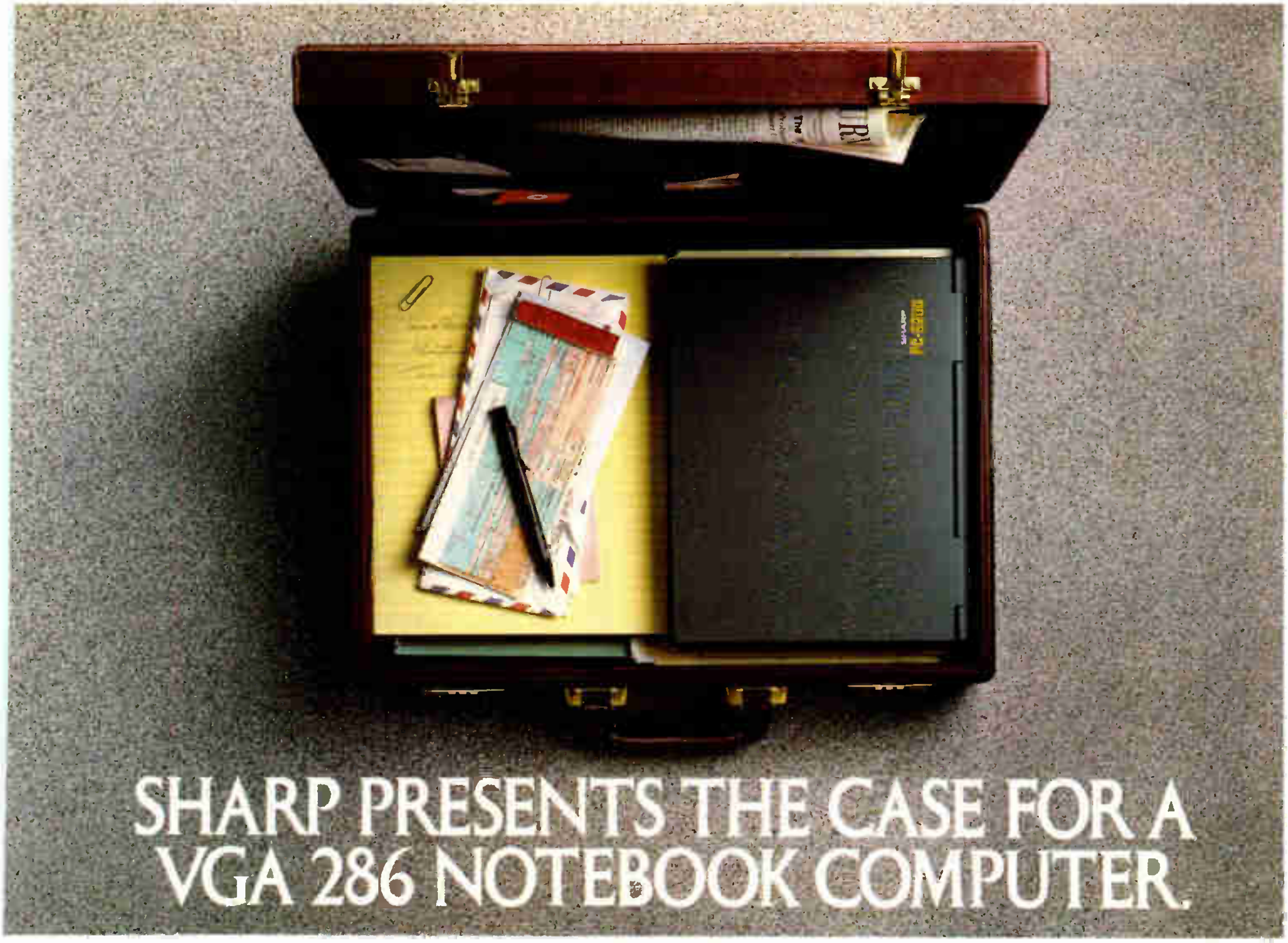
At the gate and block levels of the figure, *object-oriented* means encapsulation of data and little more. The dynamism of everyday objects has been relinquished in favor of machine-oriented virtues, such as computational efficiency and static type checking. At the intermediate (chip) level, objects also embrace the open-universe model of everyday experience where all possible interactions between the parts and the whole are not declared in advance, as opposed to the closed universe of early binding and compile-time type checking.

But on the scale of any large system, gate-, block-, and even chip-level objects are extremely small units of granularity: They are grains of sand where bricks are needed. Since even chip-level objects are as procedural as conventional expressions and subroutines, they are just as alien to nonprogrammers. Until invoked by passing them a thread of control, these objects are as inert as conventional data, quite unlike the objects of everyday experience.

What Next?

In the stampede to force the world's round, dynamic objects into square, static languages like Ada or C++, you must never forget that such low-level languages—and even higher-level environments like Objective-C and Smalltalk—are highly unlikely to be accepted by mainstream information-age workers. They are more likely to insist on nontextual, nonprocedural visual "languages"

continued



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that offer a higher-level kind of "object," a card-level object, of the sort that programmers know as coroutines, lightweight processes, or data-flow modules. Since these objects encapsulate a thread of control alongside whatever lower-level objects were used to build them, they admit a tangible user interface that is uniquely intuitive for nonprogrammers.

By definition, these systems are more fundamentally "object-oriented" than the procedural, single-threaded "object-oriented" languages of today. Like the tangible objects of everyday experience, card-level objects provide their own thread of control internally. They don't "communicate by messages"; they don't "support inheritance"; and their user interface is iconic, not textual.

By introducing these and probably many other architectural levels, where the modularity/binding technologies at each level are oriented to the skills and interests of a distinct constituency of the reusable-software-components market, the programmer shortage can be solved as the telephone-operator shortage was solved, by making every computer user a programmer. ■

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ACKNOWLEDGMENT

This article draws upon a longer, more detailed piece I wrote: "Planning the Software Industrial Revolution: The Impact of Object-Oriented Technologies," to be published in IEEE Software, *November 1990.*

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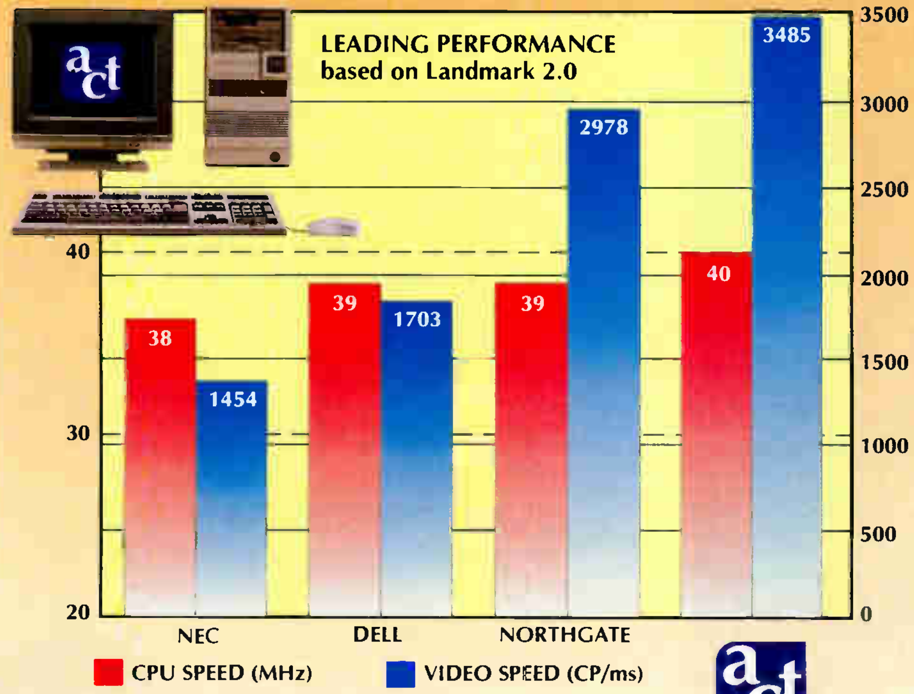

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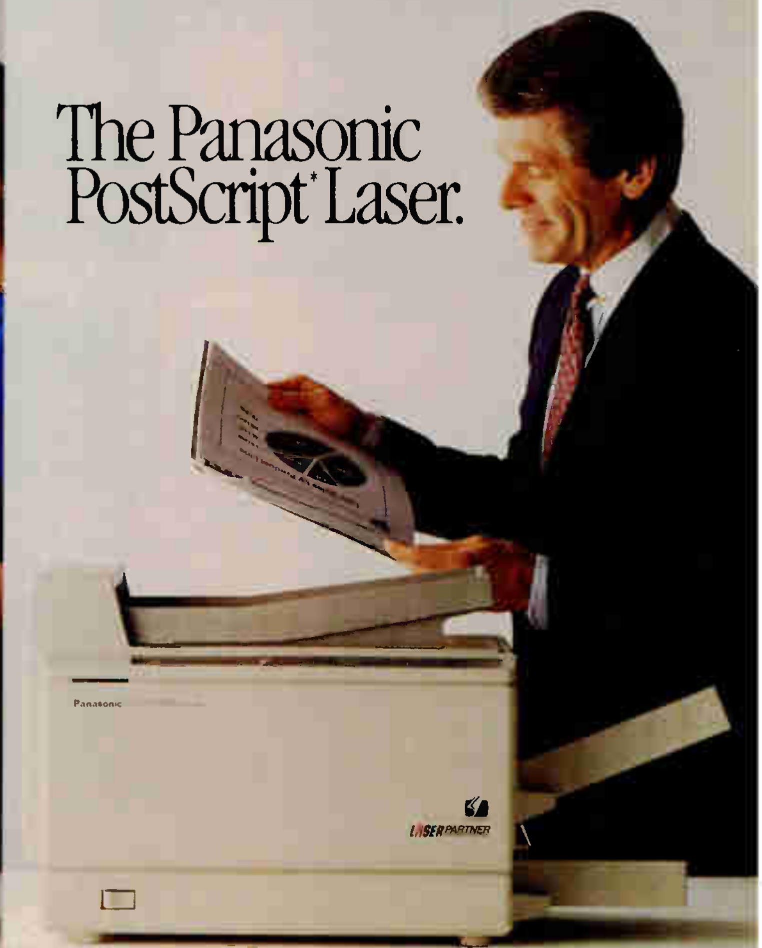

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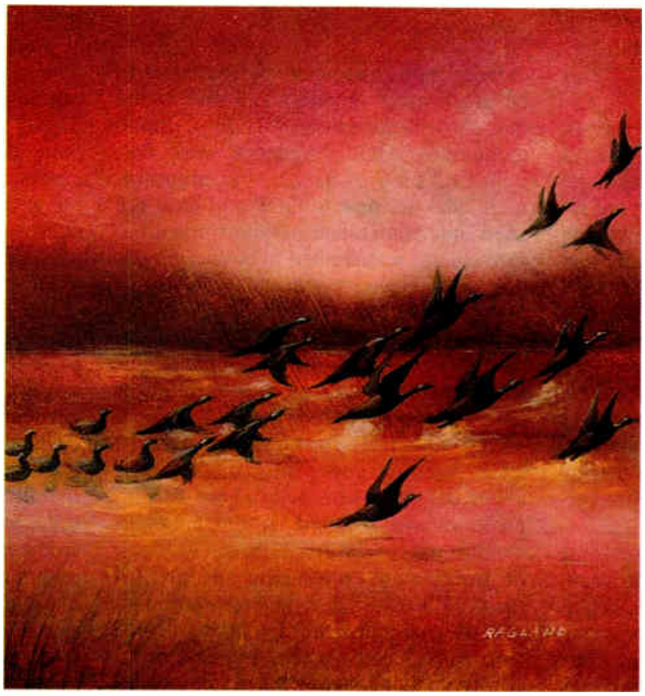
Migration Patterns

Moving to object-oriented technology is more involved than simply buying a compiler

Chuck Duff and Bob Howard



The software industry has never abandoned its quest for the silver bullet—a methodology or philosophy that with one shot would eliminate the problems endemic to software. Past candidates have included structured languages, structured analysis and design, fourth-generation languages, and AI. But software continues to be expensive and problematic. The latest candidate for the role of silver bullet is object-oriented programming (OOP).

Many people have rather naive views of the OOP terrain. They tend to fall into one of two schools of thought. The first is the "OOP is magic fairy dust" camp, which holds that OOP will make programming go away and reusable components appear, like alchemists' gold, from the unwieldy libraries that preceded them. The second is the "OOP is old wine in new bottles" camp, merely the latest round of marketing hype from an evil cabal of language vendors. While the latter view is more conservative and less prone to disaster, neither permits its adherents a chance to realize the real potential of OOP. A more realistic view of OOP proceeds from the following:

1. OOP does have benefits, but they are not free.
2. A commitment to OOP and reusable software requires significant organizational support.
3. Object-oriented techniques can and should be considered separate from object-oriented languages.
4. Organizations can minimize risk and turbulence by taking a staged approach in migrating to object-oriented technology.

Benefits Package

Object-oriented technology improves software systems because it facilitates better factoring of functionality and related data than do traditional structured-programming techniques. Using object-oriented techniques does not imply better design; you can easily find many bad procedural designs dressed up in object-oriented clothing. Rather, OOP languages add features that allow the efficient implementation of well-factored, minimally coupled systems.

In this sense, object-oriented technology is in step with many well-established principles of good software design. For example, Myers's Composite Structured Design promotes high module cohesion and low module coupling as broad benchmarks for system quality. OOP promotes high cohesion through inheritance and polymorphism, allowing more general, finer-grained code. It promotes loose coupling via encapsulation and dynamic binding, which insulate data and procedures from the rest of the system.

These characteristics improve the

continued

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long-term life and maintainability of object-oriented systems for the same reasons that they are considered advantageous in relation to structured programming: Systems that localize information and logic are simply less complex. There is no magic here, and no radical departure from accepted software wisdom. OOP is the next step in the evolution of structured programming.

Building highly reusable software components is a difficult undertaking. OOP improves code reuse by using less complex, loosely coupled, highly cohesive components. Even so, most people tend to underestimate how difficult it is to produce such high-quality designs, regardless of how you do it. The job is much easier with OOP, but it is still a considerable challenge.

The ability to produce reusable components opens up a new set of opportunities and problems in software development. Ideally, reusable components would replace much original development activity. These components would come from within a project, a company, or the world at large. This requires an archiving and repository technology and procedures that simply don't exist today.

Paying the Piper

Any business decision about whether or not to adopt OOP must weigh the costs of climbing the learning curve—language, programming model, class library; of incompatibilities between new and existing code; and of the need to develop an organizational infrastructure to support software reuse.

Marketing lore to the contrary, adopting an OOP language without making other investments will not significantly improve either the maintainability or reusability of your code. In the hands of well-trained, properly organized project teams, however, OOP will almost certainly provide benefits.

Most new technologies require some degree of retraining. For OOP, the learning involves obvious issues, such as language syntax, and deeper issues concerning the programming model and class library. Syntactic differences between OOP languages and traditional procedural languages come about because OOP languages need to support the notion of sending requests, or messages, to objects to perform some action.

For example, in some OOP languages, such as Smalltalk and C++, the syntax places the receiver of the message first, followed by the message name. Other OOP languages, such as Actor, use the opposite order, more closely following procedural function calls. Programmers can usually absorb a new syntax fairly quickly.

A Matter of Time

Of far more significance than syntactic changes, however, are changes to the underlying programming models. These are more fundamental and thus more challenging. They affect analysis, design, coding, and optimization.

In the future, corporate and intercorporate object repositories may offer a selection of thousands of classes for reuse.

Good object-oriented designs tend to be much more modular and distributed than those targeted for procedural implementations. OOP languages work best with this kind of design, but programmers who are new to OOP and have not used inheritance and polymorphism before are not accustomed to building modular, reusable components.

A reusable component must be written in a very general manner. Since most programming languages do not allow truly general code, most programmers haven't developed these skills.

The most time-consuming part of the OOP learning curve involves learning about the class libraries. These can include classes shipped by the language vendor, purchased from library vendors, or previously created by the project team. When you use object-oriented languages, the basic library may include several hundred classes. In the future, corporate and intercorporate object repositories may offer a selection of literally thousands of classes for reuse.

Hands-on instruction and intelligent code-browsing tools are the most effective ways of ensuring that programmers become familiar with the existing class libraries. When browsing tools are not available, you increase the likelihood of wasting time reinventing classes that are already available.

Another cost of migrating to OOP may come from the need to replace systems or libraries incompatible with the new OOP language. This cost can be burdensome enough to change your mind about using the new technology. Happily, most modern OOP languages can interface with existing systems and libraries implemented in procedural languages.

Organizing for OOP

There is a hidden cost that is sometimes overlooked as an organization migrates to a new technology: People are afraid of, and often resist, change. Programmers and technical people invest a tremendous amount of time and energy in developing their expertise. A radical change that may render their knowledge obsolete is often perceived as a threat. These feelings can have a definite effect on morale and productivity and, if not managed, add to the overall cost.

In many cases, this fear is due to a lack of understanding of how OOP works. You can greatly reduce these anxieties by showing that, given some knowledge of structured programming and design, OOP is an evolutionary rather than revolutionary step.

Much has been made of the ability of object orientation to foster the creation of reusable software components. Very little has been said about the cost of developing the methods and the corporate infrastructure to support this goal. All too many organizations have been lured by claims of instant reuse; unfortunately, it just isn't so.

Developing reusable components is *easier* in an OOP language, but not automatic. Organizations wishing to adopt these techniques must be prepared to change the development practices of project teams and the structure of systems development departments.

Within the project team, you can promote reuse by making several important tasks explicit. Time must be allocated to study existing classes to determine proper inheritance and reuse decisions. In our experience, project teams tend to work most efficiently when you separate the responsibility for building general-purpose components from the responsibility for reusing and customizing those classes in an application.

Thus, you can divide the members of a project team into two groups: builders and reusers. Time should be set aside for interaction between them. This will result in better inheritance and reuse decisions by the reusers, and additional ideas for new classes by the builders. Interaction at this level is essential to ensure that

continued

Objects in C

In an object-oriented implementation in C, we will define the data and functionality of graphical objects. You can use C's `struct` data type to define an object. First, you create a general shape class, followed by descendant classes `line` and `rectangle`. Drawing these shapes requires two steps. The first involves setting up the object's display attributes (e.g., color, style, and brush). The second step, which is not shown in the code, involves actually drawing the object.

Our first attempt at creating objects provides encapsulation, but no support for polymorphism or inheritance. We will add these facilities later. Thus, you can define a simple object type, such as shape, as consisting of two point objects: `origin` and `corner`.

```
typedef struct shape {
 POINT origin;
 POINT corner;
} SHAPE;
```

By placing the structure definition in a header file, `shape.h`, you can declare instances of the class in any module that includes it. Next, you need to define the class's behavior and ensure that there is no access to internal data from outside these methods. A class file, `shape.c`, would begin with the header and would contain every function that can operate on a shape object. Note that in your first implementation of the shape class, you need to hard-code the differences in the drawing behavior based on the object type. Thus, `line` objects will call the function `setLineTools`, and `rectangle` objects will call the function `setRectTools`.

```
include <shape.h>

/* Define methods for drawing and inverting
shape objects. Illustrates the use of
encapsulation. No support for polymorphism or
inheritance. */

void draw(self, display, type)
 void *self;
 SCREEN *display;
 int type;
{
 if visible(self)
 {
 if type == LINE
   setLineTools(self, display);
 else
 if type == RECT
   setRectTools(self, display);
 else
   error("invalid shape");
   drawShape(display, self);
 }
}
```

The parameter `self` represents the object to be drawn. The encapsulation provided by the class structure and functions lets you write fairly clean code, although it still has a distinctly procedural flavor. By adding support for polymorphism via messages, we will eliminate this code later.

SHAPE class's first descendant is LINE. The definition of a LINE structure includes the ancestral structure SHAPE. This construct simulates the inheritance of instance variables, but it is not automatic. A structure that defines the PEN class completes the definition.

```
typedef struct line {
 SHAPE shape;
 PEN pen;
} LINE;
```

The routine `line.c` begins with the definition of class structures, listed in inheritance order. You follow this, once again, with the associated functions. Then you implement the function `setLineTools`, which will be called from the generic `draw` function.

```
include <shape.h>
include <line.h>

void setLineTools(self, display)
 void *self;
 SCREEN *display;
{
 setPen(display, self->pen);
}
```

RECTANGLE class is implemented in the same fashion: first, the class definition in `rect.h`, and then the `include` statements and function definitions in `rect.c`.

```
typedef struct rect {
  SHAPE shape;
  PEN pen;
  BRUSH brush;
} RECTANGLE;

include <shape.h>
include <rect.h>

void setRectTools(self, display)
  void *self;
  SCREEN *display;
{
  setPen(display, self->pen);
  setBrush(display, self->brush);
}
.
.
.
```

Notice the difference in behavior between `setLineTools` and `setRectTools`. Since an instance of LINE owns a PEN but no BRUSH, it sets only a single tool in the display. RECTANGLE instances need to set a BRUSH, as well.

This difference in behavior is handled by having the general `draw` function in class shape check the type of the object before making the appropriate function calls. However, the behavior is far from automatic. In particular, if you add additional shapes later, you will need to update the generalized `draw` function. This may actually increase the likelihood of coding errors.

In contrast, in a completely object-oriented language, the language translator automatically handles the need to dispatch different behaviors for different object types. This makes it easy to create polymorphic behavior. In fact, you can simulate polymorphism with a messaging mechanism.

Supporting Polymorphic Messaging

To implement polymorphism, you need a mechanism that translates a general message into the address of a particular routine at run time. This decision should be based on the object's type and, by inference, its ancestors. Implementing this feature provides several advantages that are difficult to achieve in traditional languages. Special cases are implemented in low-level classes, rather than growing monolithic blocks of code that show very little impact from code changes. As a result, coding, testing, and debugging become considerably simpler.

Since polymorphism is based on late binding and procedural languages are early bound, you must create a lookup table of message IDs and corresponding addresses. This implementation is not particularly efficient, but it is easy to understand. First, you define a structure that includes a message ID and a pointer to a function. Arrays of these structures can be used to build each class's method table.

```
typedef struct meth {
 int messageID;
 void *methodFunc();
} METHOD_MAP;
```

Next, you need a structure with which to model classes. The array methods holds the table that translates messages into function calls for a single class.

```
typedef struct class {
 METHOD_MAP *methods[];
 char[32] name;
} CLASS;
```

In shape.h, you add a variable that points to a CLASS structure. When objects of this class receive messages, they use the methods array in their class structures to translate them into specific function calls.

```
typedef struct shape {
 CLASS *class;
 POINT origin;
 POINT corner;
} SHAPE;
```

Although the method tables for LINE and RECTANGLE classes both store entries for the SET_TOOLS message identifier, the functions they refer to are different.

```
METHOD_MAP lineMethods[] = {
 {INVALIDATE, *invalidateLine() },
 {INVERT, *invertLine() },
 {CONTAINS, *lineContains() },
 {SET_TOOLS, *setLineTools() },
 ...
 {NULL, NULLPTR }
};

METHOD_MAP lineMethods[] = {
 {INVALIDATE, *invalidateRect() },
 {INVERT, *invertRect() },
 {CONTAINS, *rectContains() },
 {SET_TOOLS, *setRectTools() },
 ...
 {NULL, NULLPTR }
};
```

To complete the messaging scheme, you need a sendMessage function. This examines the receiver's CLASS structure to access the method table and execute the appropriate function.

```
void sendMessage(message, receiver, arg)
 int message;
 void *receiver;
 void *arg;
{
 int index;
 METHOD_MAP map;
 index = 0;
 do
 {
 map = receiver->class->methods[index];
 if message == map.messageID
   return (*map->methodFunc)(arg);
 ++index;
 }while(map.messageID != NULL);
}
```

You can now improve the draw method by taking advantage of polymorphism. Since both LINE and RECTANGLE objects have SET_TOOLS entries in their class's methods array, you can ignore the differences between them; they will be handled automatically. When members of each class receive SET_TOOLS, they respond with behaviors appropriate to their type.

```
include <class.h>
include <shape.h>

void draw(self, display)
 void *self;
 SCREEN *display;
{
 if visible(self)
 {
 sendMessage(SET_TOOLS, self, &display);
 drawShape(display, self);
 }
}
```

Adding an Inheritance Scheme

The final aspect of object-oriented programming (OOP) that you need to simulate is inheritance, the heart of developing reusable code. Inheritance enables you to design systems by refining code. In the current simulation, you can most easily model this mechanism by simply extending polymorphic messaging. You can extend the definition of a CLASS struct to contain a pointer to the class's parent class.

```
typedef struct class {
 METHOD_MAP *methods[];
 class *ancestor;
 char[32] name;
} CLASS;
```

The sendMessage function can now be enhanced to search the parent class's method table if the target message is not found in the descendant class. This technique could be extended to allow a linked list of ancestors to implement multiple inheritance.

The techniques that have been illustrated—namely, simulating encapsulation, polymorphism, and inheritance—can be implemented in a variety of different languages and go a long way toward explaining how OOP works. Most OOP languages actually use far more efficient hashing and message-caching techniques in place of the message lookup shown here.

Actors and Their Roles

In a completely object-oriented language, everything is an object, including fundamental entities such as numbers, strings, and even code. Object-oriented constructs that C must simulate, such as classes and messaging, are part of the language definition, resulting in a much cleaner implementation of object-oriented code. Listing A shows how the example from the text box "Objects in C" is implemented in Actor, an object-oriented language.

In listing A, the definition of the class is shown in comments, since the browser actually generates the code automatically. Several other things are worthy of note as well. First of all, the Actor language contains a class construct that carries with it the idea of protected scoping, instance variable and method tables, and inheritance.

When you define a new class using Actor, you need only specify its ancestor, and the compiler automatically associates the ancestor's methods and instance variables with the new class. You don't need to define a class instance variable, because the compiler places that information into every object when it is created.

You can think of the class field as an instance variable of class Object, a root class from which every Actor object automatically descends. You can also eliminate the manual declaration of an instance of the ancestor class in the descendant's instance-variable list.

Second, no types are assigned to the instance variables. Because all variables in Actor hold objects, every object "knows" its own type or class. As a result, type declarations are unnecessary.

Listing A: *The ease with which you can implement object-oriented designs with an OOP language is merely an example of the concept that form follows function.*

```
/* Definitions for class Shape:
Ancestor: Object
Instance Variables: origin, corner
*/
Def draw(self, display)
{ if visible?(self)
  then setTools(self, display);
   drawShape(display, self);
  endif;
}

/* Definitions for class Line:
Ancestor: Shape
Instance Variables: pen
*/
Def setTools(self, display)
{ setPen(display, pen);
}

/* Definitions for class Rect:
Ancestor: Shape
Instance Variables: pen, brush
*/
Def setTools(self, display)
{ setPen(display, pen);
 setBrush(display, brush);
}
```

They can still be useful for integrity validation, but the language can function perfectly well without them.

A third point to observe is the lack of address operators. You never need to use address operators to reference or dereference pointers, because Actor transparently hides the implementation of objects through pointers. The language automatically dereferences pointers in those primitive methods that access an object's actual data. This issue can have a major impact on productivity, because pointer errors are one of the most common and costly mistakes that C programmers make.

In addition, you will notice the absence of a sendMessage call. Every function call is a message send in Actor, so you don't need two different syntaxes. The C form

```
sendMessage(SET_TOOLS, self,
  &display)
```

maps into

```
setTools(self, display)
```

which is less complex and easier to read and avoids the use of an address operator. Furthermore, there is no need to have a methods table that maps a generic operator to a physical function. This is already part of the language itself.

The message dispatcher is written in assembly language based on a threaded-code compiler, similar to those found in Microsoft's QuickPascal and most Forth implementations. As a result, it runs much more efficiently than most high-level message simulations would.

Finally, you don't need to explicitly deallocate objects, because a concurrent garbage collector is constantly running, destroying objects that can no longer be referenced. In the C example, you would have to destroy objects at the appropriate time or risk overflowing the heap. This necessity introduces another class of nasty bugs related to destroying objects at inappropriate times, which is also known as the *dangling pointer* problem.

code is reused and not rewritten. It also decreases the likelihood of creating very generic and reusable classes that fill no real applications development need.

Beyond support at the project level, it is essential to have a corporate or departmental awareness of code reuse and organizational structures that support this. A project team's focus on single-system requirements and stringent deadlines affords its members neither the viewpoint nor the time to engineer generally reusable components. If organizations want to realize large-scale reuse, they will need to form groups whose sole purpose is to build general-usage classes and to manage the class repository as a corporate resource.

Transition Matters

Although the benefits of OOP are significant, so are its costs. If badly managed, the transition can result in much wasted effort and reduced productivity. In many cases, we have found that a gradual, staged adoption of object-oriented technology allows an organization to minimize these costs and, in the long run, take greater advantage of the benefits.

Because OOP is an evolutionary development, most procedural languages can simulate its basic concepts. In organizations with a major investment in structured methods or procedural-language applications, it is essential to maintain compatibility with the existing development cycle. Carrying along existing language technology is often a political necessity as well. Those who use COBOL, FORTRAN, C, Pascal, and other traditional languages need not be excluded from the move toward object orientation.

As an initial step, it can be useful to implement object-oriented techniques within a traditional language. This not only produces useful results, it also helps many programmers understand the inner

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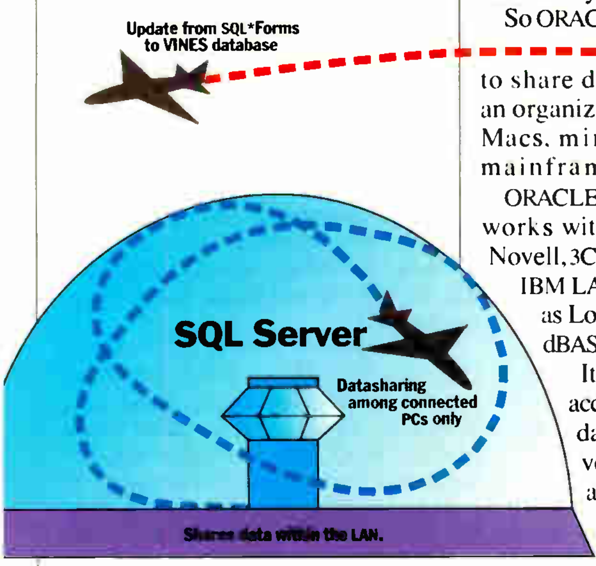

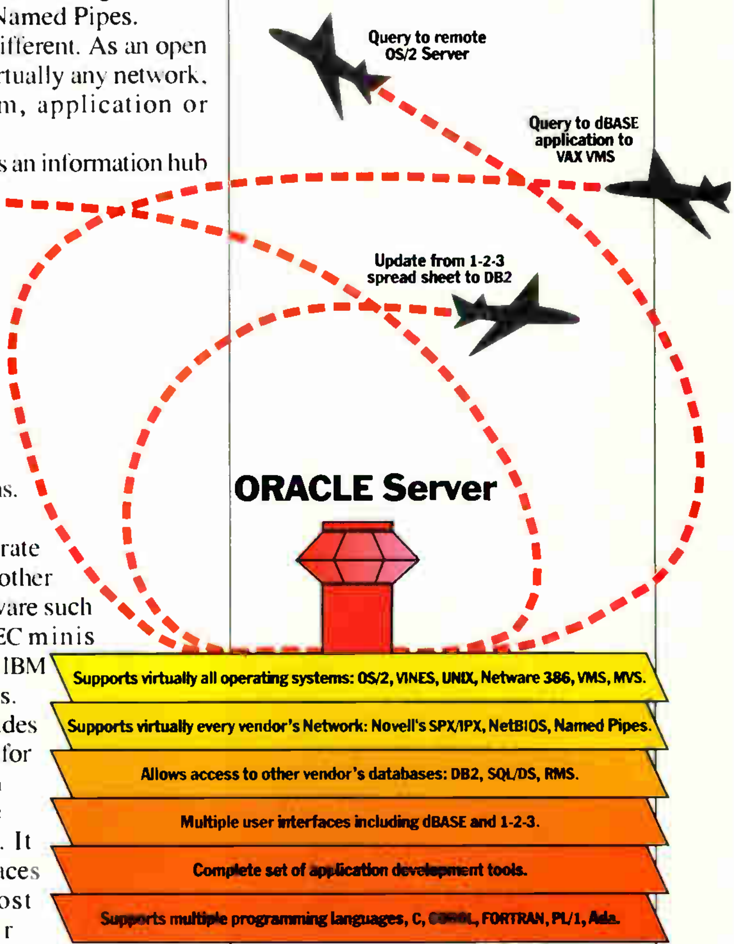

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OOP languages don't make poor programmers into great ones.

workings of OOP languages. This kind of experience demystifies the technology and helps increase acceptance of OOP.

Simulating OOP

There are three important features that distinguish OOP languages from traditional programming languages: encapsulation, polymorphism, and inheritance. To simulate OOP, you need to map each of these into suitable mechanisms in the procedural language.

Encapsulation is generally used to describe an object's protection of its private data from outside access. Strictly speaking, no object should be able to access another object's internal data. In a broader sense of the term, encapsulation also implies the ability to have objects that are bundled data and code.

Polymorphism, the ability to have different kinds of objects respond to the same message in different ways, is based on two techniques: generic operators and dynamic binding. Languages like C demand that each function have a unique name that is bound at compile time to a known address.

OOP relies on being able to associate generic message names with one or many routines, known as *methods*. When an object receives a message, the language translator determines what action to take based on the object's class or type. This process is known as *dynamic binding*, since the address of the method that will execute is determined at run time.

Inheritance denotes the ability of an object to derive its data and functionality automatically from another object. This is based on creating new classes of objects as descendants of existing ones. Most OOP languages, including Actor, Smalltalk, Objective-C, and Object Pascal, allow only single-ancestor inheritance. Some languages, such as C++ and CLOS, allow multiple inheritance.

Writing simple object-oriented extensions to a procedural language like C is fairly easy; that's what some OOP languages, such as C++ and Objective-C, do. Of course, achieving the fast performance of a commercial-quality translator and adding advanced features such as automatic memory management is more challenging.

In C, you can represent a class as a source file that contains the class data definitions and their associated functions. This uses C's language-scoping facilities to hide the data structure's internal representation. Using COBOL, you might create a separately compiled subprogram, with data definition and associated code paragraphs.

To simulate the behavior of classes, the object's data, known as *instance variables*, must be accessed only through its own methods. The text box "Objects in C" on page 226 details an object-oriented implementation in C.

The Real Thing

Although you might be tempted to view the simulation of OOP techniques in a procedural language as proof that OOP is "old wine in new bottles," there is a fundamental distinction between languages that allow OOP and those that actively encourage it.

Yes, it is possible to write OOP code in C by extending the language somewhat and enforcing coding standards and self-discipline. However, it remains much easier to do OOP in a language that requires no extra simulation overhead.

This probably accounts for the fact that many programmers who make the transition to hybrid OOP languages, such as C++, continue to write hard-to-reuse procedural code rather than take advantage of the reusability OOP offers.

In contrast, programmers who use completely object-oriented languages, such as Actor or Smalltalk, are much more likely to write reusable code. These languages and their tools encourage programming in an object-oriented fashion. It's worth comparing the implementation of the graphics classes in C with a completely object-oriented version in Actor (see the text box "Actors and Their Roles" on page 228).

Form Follows Function

The difference between the Actor listing and the C listing reflects the extent to which the conceptual model contained in a tool maps to the model used in the solution. C was designed to be a general-purpose, efficient, medium-level language for systems development. Thus, you can use it to solve virtually any problem—even to implement the basics of OOP.

Actor, on the other hand, was designed as an object-oriented applications development system. Its language efficiently

continued

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supports encapsulation, polymorphism, and inheritance, as well as a large class library, without requiring the programmer to be aware of the internal implementation mechanisms. You can achieve the same concepts in C or other procedural languages, but they require some syntactic baggage as well as additional coding effort.

OOP languages don't do anything magical, or impose good design, or make poor programmers into great ones. They simply let the form of an object-oriented implementation more accurately reflect its function. They do this by moving a lot of the syntax and control logic into the language kernel—code that would otherwise have been necessary to simulate object-oriented features.

The Journey's End

Far from being a solution to all problems, object-oriented technology introduces a whole new set of challenges into a development organization—challenges that need to be dealt with sooner or later, anyway: crafting and archiving reusable components, establishing more consistent and panoramic approaches to system building across organizations, and making a serious commitment to well-factored, high-quality designs.

While the realistic challenges might appear daunting, you can take them on incrementally. A staged approach to object-oriented technology can minimize anxiety by providing some safety ropes in the form of ties to existing knowledge. Object-oriented technology is much less daunting to someone who has made its concepts concrete by implementing them in a traditional language. Although what emerges might not be particularly beautiful or efficient, it is safe, useful, and certainly instructive.

Such an intermediate step lets you undertake the move to true OOP with more confidence, because it exposes the true nature and benefit of object-oriented features. It is important to separate the tools from the techniques. Object-oriented technology gives you a powerful framework for understanding and expressing well-factored designs. OOP languages provide a clean and efficient implementation vehicle for realizing those designs, no more and no less. ■

Chuck Duff is chief technical officer at The Whitewater Group (Evanston, IL), where he designed Actor. Bob Howard is director of training and consulting at The Whitewater Group and the designer of Object Graphics. You can reach them on BIX c/o "editors."

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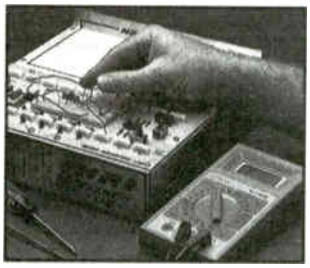

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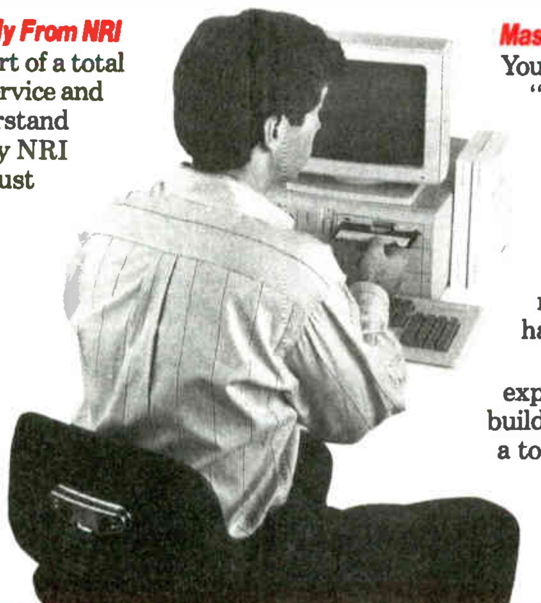

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Database Wars Revisited

How do you decide which type of database is best when even the experts can't agree?

Christopher M. Stone and David Hentchel

When all the dust settled from the great database wars of the 1970s, Codd's 12 rules for a relational data model stood triumphant over the hierarchical and network database. In the 1980s, however, came a challenge called the "Object-Oriented Database Manifesto," written by a gaggle of notable academics specializing in object-oriented technology. The relational camp's response—"Third Generation Database System Manifesto"—was not slow in coming. At stake, after all, were the hearts, minds, and purchasing budgets of database designers and users everywhere.

Although you may have little taste for the theoretical debates of the experts, you do have an interest in the outcome. At issue is the question of the type of data repository that will best suit your needs in the coming decade.

The Relational Gospel

The "Third Generation Database System Manifesto," authored by several database notables (i.e., Michael Stonebreaker, Larry Rowe, David Beech, Bruce Lindsay, and others), attempts to replay the history of data management as nothing less than an evolution of information. These data elders decree that the 1970s was the era of the first generation (better known—or not known—as hierarchical databases); that the 1980s was the era of the second generation (better known as the relational database); and that the 1990s is the era of the third generation—which is, as yet, nameless but certainly just an extension of the relational model of the 1980s.

The third-generation database, as described by the manifesto, has three basic tenets to it:

1. It must accommodate a broader range of data types, such as images, multimedia documents, video, and other "objects." It must also support 100 transactions per second and support rule management for data integrity and business processes.
2. It must support all the "good" features found in the second-generation (relational) databases, such as nonprocedural access and data independence. The manifesto states that C++-based object databases will have to support SQL, thereby slowing down performance (to relational levels).
3. It must communicate and be interoperable with distributed DBMSes, C programs, business applications, Unix commands, software-engineering tools, and so on. It must not be too tightly bound to a specific language.

You may have noticed that these relational aficionados made no mention of

continued

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the "OO" word. Thus, the battle lines are drawn. It's the self-proclaimed good guys (relational companies) against the self-proclaimed good guys (object-oriented companies), all hoping to get a chunk of your database dollars.

According to the third-generation manifestites, the entire evolution of data management is embodied in the three tenets outlined above, and the relational model will prevail in the marketplace. But this doesn't explain the presence and notoriety of the object-database "Huns," who are finding a sizable market for their products.

Look closely, and you'll see that this latest chapter in the database wars is not really a war at all. It's more like a bar fight—with lots of name-calling, missed punches, and broken glass. No clear winners. To understand this battle, and to understand the benefits and liabilities of the two database models, you must first look at some of the historical background and facts in this area.

Database Distinctions

There are very real and clear distinctions between an object-oriented database and a relational database. Object databases, in essence, use a navigational model of computation. This comes under intense scrutiny from the relational crowd, which claims that it is a "back-to-the-future" technique from the world of hierarchical databases. Relational databases are based on a mathematical theory, while most object databases are not.

Relational databases were never really designed to allow for the nested structure and views of a design. Thus, the criticism launched at the object-oriented databases (OODBs) centers on the navigational aspect of "nested" objects. The question is, how do you traverse complex structures (objects)? The advantage to navigation, especially when using large, complex applications such as those used in aerospace, CAD/CAE, and so forth, is that it is easier and much more natural to weave your way through objects that model the real world rather than tables, tuples, and records.

Facts on OODBs

OODBs are, in fact, quite similar to network or hierarchical databases. They follow a nested structure of objects, while hierarchical databases follow a manually navigated record structure. Both have the notion of *pointers*.

In an OODB, object identifiers are logical pointers that are never reused. These object identifiers normally identify an object that is generated by the system. They verify the existence of the object and the *class* to which the object belongs when the system attempts to send it messages. This lets OODBs attach methods to objects that can enforce arbitrary integrity rules.

Hierarchical databases guarantee integrity only for set structure and indexes. Relational databases enforce only index references, but developers have made it publicly known that they are working on more general integrity rules. The most glaring difference between OODBs and the hierarchical and relational models is that OODBs introduce an entirely new suite of concepts—concepts that include inheritance, class, method, and messages.

OODBs let you include much of the code (methods) in the database itself. This incremental knowledge about the applications provides the ability to optimize query processing and to control the concurrent execution of transactions. OODBs are thus active, while relational databases are passive.

Getting the Job Done

Performance is always a major issue in any system implementation. Particularly with information of high data complexity and multiple interrelationships, OODBs may prove to be better performers than relational databases. For example, an OODB could cache certain objects in storage or memory by anticipating what you may do next. In fact, the more complex the data, the more performance benefits you realize with an OODB. Clustering and caching techniques for certain complex nested structures in OODBs can give them a data performance two orders of magnitude greater than that of relational databases.

The two major commercial applications for OODBs are the "document" database and the distributed database. The first allows for rich data modeling constructs, inferencing, and the storage of complex objects such as voice, video, vectors, and graphical images. In addition, it supports lengthy interactions with the database that may take several days and multiple versions of the data. The

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document database should also be independent of a particular programming language to allow for data sharing at the object level among many different applications.

The second of the promising areas for OODBs is client/server applications, where a centralized object server manages the persistent database on behalf of many clients. This can then be extended to include a fully distributed OODB, where objects are distributed across different physical sites completely transparent to the user.

Relational Differences

It's hard to confuse a relational database with an object-oriented database. The normalized relational model is based on a fairly elegant mathematical theory. Relational databases derive a virtual structure at run time based on values from sets of data stored in tables. Databases construct views of the data by selecting data from multiple tables and loading it into a single table. (OODBs traverse the data from object to object.)

Relational databases have a limited number of simple, built-in data types, such as integer and string, and a limited number of built-in operations that can handle these data types. You can create complex data types in a relational database, but you must do it on a linear basis, such as combining fields into records. And the operations on these new complex types are restricted, again, to those defined for the basic types (as opposed to arbitrary data types or "subclassing" with inheritance as found in OODBs).

The object model supports "browsing" of object class libraries, which allows the reuse, rather than the reinvention, of commonly used data elements. Objects in an OODB survive multiple sessions; they are *persistent*. If you delete an object stored in a relational database, other objects may be left with references to the deleted one and may now be incorrect. The integrity of the data thus becomes suspect and creates inconsistent versions.

In the relational database, complex objects must be broken up and stored in separate tables. This can only be done in a sequential procedure with the next retrieval relying on the outcome of the previous. The relational database does not understand a global request and thus cannot optimize multiple requests. OODBs can issue a single message (request) that contains multiple transactions.

SQL, the de facto query language in the relational database world, is forcing the convergence—at least on the interface level—of the OODB and relational language interface. SQL operates on a predicate-search idea that is directed against structures of data that are unknown. OODBs are based on a navigational model of pointers that have known structure. Many OODB advocates are touting extensions to the SQL language that let you query objects as well as tables. This is a natural evolution for SQL (assuming it's done right).

Object SQL or OSQL (we prefer the term SQLO—pronounced "skweelo") is being pursued by Data General, Hewlett-Packard, Object Design, and others. Adapting SQL for object extensions would provide a high-level interface that would take the primitive notion of an object and combine it with a set of functions that have a single argument. This could be a very powerful interface and smooth the path for migration from the relational world to the "real" world of object orientation.

Doing Some Debunking

One effect of the relational-versus-object-oriented disagreement is that it gives rise to extravagant claims on both sides about both technologies. Whom are you to believe? We feel some "myth management" is in order. Here are a few myths that need debunking.

- *Myth: Relational databases are non-navigational.* If you've ever tried to implement SQL in COBOL or defined a "cursor" for a complex join with embedded updates, you know this one is a myth. A good definition of "curser" is someone attempting to code a navigational problem in a nonnavigational language.

- *Myth: Object systems relieve you from strong typing*. Although object systems successfully hide data representation details, they may still require that you know the types of data/objects in requests or operations. In the language environment, strong typing and data hiding prevent methods from different libraries from clashing in their use of data. In the database world, method access means that new methods and new fields don't require changes in the old application. Strong typing is a property of the systems language. For example, OODBs that are extensions of C++ will be "blessed" with C++'s strong typing.

- *Myth: Relational databases are value-based, not pointer-based.* What kind of "value" is put in a field called SSN-TIE-

continued

RELATIONAL VS. OBJECTED-ORIENTED DATABASES

How relational and object-oriented database vendors characterize their respective products gives you an idea of the types of problems these systems are designed to address.

Relational databases	Object-oriented databases
Structured query	Navigational query
Minimize data dependency	Minimize procedure dependency
"The way people really think"	"The way people really think"
Slower than hierarchical,	May be slower than relational
. . . but nobody cares	. . . still, nobody cares
Short transactions,	Long transactions,
optimistic concurrency	gaining optimistic concurrency
Conforms to fourth-generation languages	Conforms to object languages
Implicit relationships	Explicit relationships
No unique identifiers	Unique object identifiers
Can represent "objects"	Can represent "relations"

BREAKER or PART-REC-SEGMENT? When an index or even a program accesses ROW-ID, what kind of meaningful application domain does that come from? In fact, relational database vendors are sneaking pointer-based algorithms into their products like a member of Congress sneaks in tax hikes. In the real world, expediency rules.

• *Myth: C++ is the standard for object data management.* We've avoided making the point that SQL is such a successful standard that there are several different ones to choose from, but we can't sit idly by while C++ is touted as a de facto standard for OODBs. De facto it is, indeed, and we applaud AT&T's cooperation in driving standardization of the language, but *database* standard?—we fear not. It serves well as a schema-definition language, but it doesn't give the application programmer a clue as to how to get things to and from the OODB. Luckily, C++ is an extensible language, and the OODB gang has taken the liberty of extending it to manage persistence. It is critical that the OODB vendors work hard to agree on standards in this interface.

• *Myth: Relational databases support on-line transaction processing better than OODBs.* The third-generation database goal of 100 transactions per second (typically based on a benchmark defined by the Transaction Processing Council) is both laudable and achievable, but it doesn't really have much to do with relational databases in particular. It took these systems many years to catch up with the performance and throughput of the hierarchical databases, and no doubt it will take OODBs a while as well. The point is that the efficiency of storage and lock mechanisms has less to do with the underlying data model than with the design of the particular database product. There is no shortcut: If performance is crucial to your decision, run your own benchmark.

• *Myth: OODBs have unlimited flexibility.* The enormous improvement in flexibility you can derive from the object paradigm is well known, but, at this time, this generally depends more on the object language than on an OODB. Object orientation means fair sailing for good designs, but leaky designs sometimes sink. Part of the cost of "modeling reality" is the pain of fixing things if you got that reality wrong. The object paradigm gives you control points to manage dependencies when a restructure is required, but it gives little assurance that you can accomplish "schema migration" easily. Flexibility can be the rope to hang yourself by.

Reality Check

Everyone is familiar with the types of business applications (e.g., accounting and report writing) where relational databases excel. So, just where are OODBs making headway?

The majority of the object databases are not commercial products, but proprietary systems built into CAD products by companies like Mentor Graphics. These vendors spent many years and millions of

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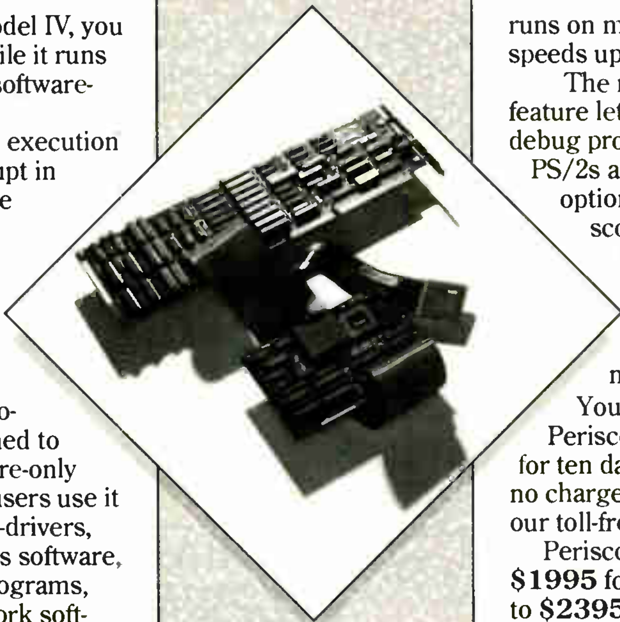

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dollars in R&D concluding that relational databases were incapable of managing the complexity and throughput they required. They built their own databases because they had no other choice. This built-in market is, in fact, the main factor in the recent rash of start-up companies in the OODB field. Over the past two years, the primary standards body defining the International Standards Organization data structures for design data, the Product Data Exchange Specification (PDES) committee, has moved firmly in the direction of object-oriented specifications. (Whether these will be slanted toward OODBs or object layers over relational databases remains to be seen.)

Because CAD is basically closer to a simulation problem than a data management problem, it is desirable that the database support a powerful semantic model. Also, because the relationships between items of data are very complex and constantly changing, the database for a CAD system must provide support for vectors, tables, linked lists, and such because these things constantly recur in very tangible form in the design data.

The pattern of data access in CAD is also different from that of commercial databases. Typically, a design object, such as an IC, is composed of thousands of design elements. Design elements may have connections with external items, such as physical layout, component specifications, or analytical data. When the designer looks at the IC, all the nested elements and many of the associated ones need to be quickly loaded from the database as a cluster. Experience has shown that this combination of aggregate access and complex internal and external structure cannot be efficiently implemented in a relational database.

Another application demanding complex structures is Geographical Information Systems (GIS), but here the database demands are a little different. At least one vendor, Wild Leitz, a Prime Computer subsidiary, has implemented GIS using an object layer over a relational database. This implementation, however, involved significant extensions beyond typical relational capabilities, including built-in data procedures and extensible data types. The reason relational technology is an attractive option here is the relative emphasis on elaborate queries against the GIS database, rather than manipulation of the structure. The historical power of relational databases in managing ad hoc queries and linking internal and external databases can add significant value in this case.

Paradigm Limits

To a person with a new hammer, everything starts to look like a nail. And it is inevitable that some people will choose a relational database or an object-oriented one for a job more suited to the other.

For example, what if engineering design data was stored as relations? A typical shipbuilding project manages 3 million different parts, each of which includes 512K bytes to 10 megabytes of design primitives (i.e., the geometry and topology of the part), plus 10 to 200 scalar attributes, plus up to 10 MB of analytic data. Each part will be maintained in about seven different versions, making the potential complexity of interaction enormous.

The PDES model for engineering data management can be expressed with about

continued

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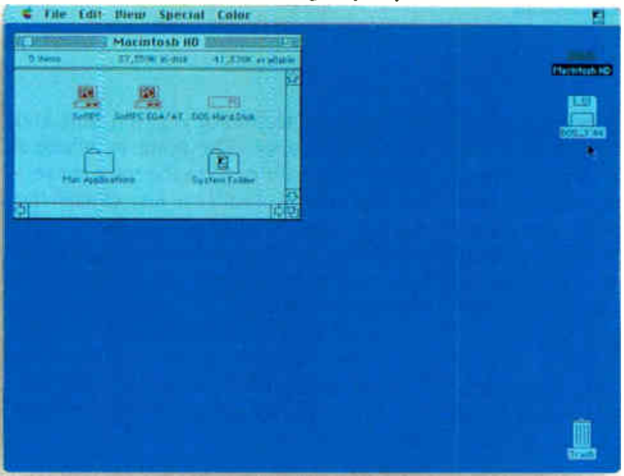

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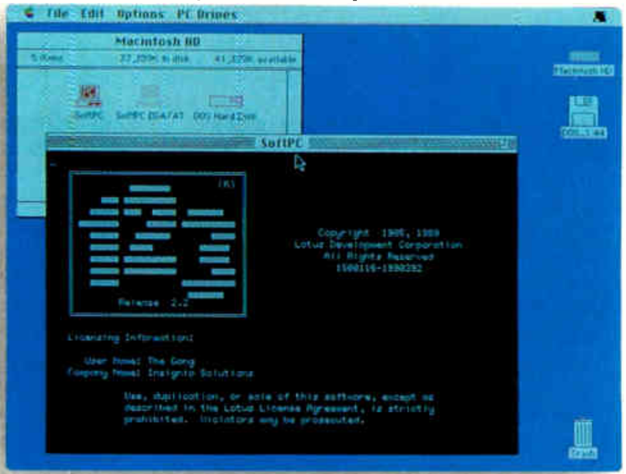

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16 object classes, plus 30 types of object links. In contrast, this type of engineering data management would require hundreds of relational record types and possibly thousands of join links, each of which would have to be separately supported in the application. This is not balanced by any real benefits of relational technology, because ad hoc queries and data restructures are relatively rare in this arena.

On the other hand, imagine if bank accounts were managed as pure objects: A teller transaction would "check out" the account object to credit it. A concurrent ATM transaction, finding the account locked, would generate a new version to debit it. Meanwhile, an enterprising branch manager could use a subclass to customize the interest algorithm for some accounts. What do you suppose the auditors would make of all this?

In both of these extreme examples, you could get working applications from the "wrong" technology, given time and a good developer. The point is, where a problem doesn't require the most powerful features of a tool, it just clouds the issue to have them hanging around. You should quite rightly shun any hot technology that is focused on problems you aren't experiencing.

The table shows how relational and object-oriented databases differ. Your job is not to decide which is intrinsically better, but to decide which better fits your needs.

Closing Arguments

OODBs overlap with earlier semantic data models and provide a much richer environment than the relational model. The generalization and aggregation relationships inherent in object-oriented models have stimulated a reinvestigation into the architectural concepts that were originally developed for relational database systems. These concepts include schema evolution, queries, concurrency control, storage structures, and indexing. OODBs are evolving as a result of the limitations in the relational model—particularly its inability to handle complex data types.

The extensions to the relational model proposed by many pundits, academics, and evolutionists will set the inevitable direction for relational companies. The fact is that most of them (including supporters of the "Third Generation Database System Manifesto") are adding object-oriented extensions on the front end of their products. Over time, there is nothing to prevent them from moving to a full OODB. The issue becomes religious in that technically led companies will find the shift toward OODBs more difficult than market-led companies. The problem is that people in the computer business like to make things much more difficult than they really are or should be. It's never black or white. It's always anthracite, taupe, or flesh tone.

An OSQL and OODB can move you forward in time so that you can start working on the real problem with data management: Getting people to manage the data. Contemplating the coming changes in database technology is like sitting at the water's edge at low tide praying you don't get wet. You can either jump in now, run in the other direction, or wait until the tide surrounds you. ■

Christopher M. Stone is president of the Object Management Group (Framingham, MA). David Hentchel is a training developer for OMG. They can be reached on BIX c/o "editors."

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Objects—Born and Bred

Object Behavior Analysis is a step-by-step, object-oriented approach to analysis

Elizabeth Gibson

To use the power of object-oriented technology, you need to use an approach derived from the fundamental constructs of that technology. Object Behavior Analysis is part of such a methodological approach. In short, OBA provides a conceptual model for the first stage in creating an object-oriented application. Using this approach is a positive first move toward constructing a successful, flexible, object-oriented system.

How do you recognize objects initially? What are their characteristics? What are the relationships among the objects? How do they interact? These are the questions you face in an object-oriented world. And these are questions that OBA can answer. Traditional analysis methods don't deal with them at all.

OBA

OBA is a step-by-step, object-oriented approach to analysis. Whether you're a programmer or not, it provides you with an initial understanding of a proposed application in terms of behaviors and objects. It then specifies how to analyze the application, with the aim of producing a requirements specification. OBA provides the explicit steps to take in performing an analysis; it tells you how to perform each step, and what the desired outcome of each step is.

OBA attempts to develop a natural-language, easily understandable description. Its purpose is to help you understand where the objects come from, in a natural way. It uses the methods of experienced developers who build successful object-oriented systems. It also incorporates research into how people organize real-world objects (see references 1 and 2).

In an iterative object-oriented approach, analysis feeds into design, which feeds into coding, then testing, and so on. There are no surprises so far. What is different about OBA is that it encourages iteration within and between the different phases of development, and uses rapid prototyping judiciously in analysis and design (see figure 1 and reference 3).

One implication of this approach is that the analyzer, designer, and implementer do not have to "get it right the first time." In practice, it is often impossible to get all the information that you need for a complete analysis—or even to understand exactly *what* information you need—much less interpret and represent everything correctly, without iteration. Controlled iteration contributes to clearer and more complete specifications and design.

Since implementation is based on design, and design is based on analysis, the analysis should support the basic notions

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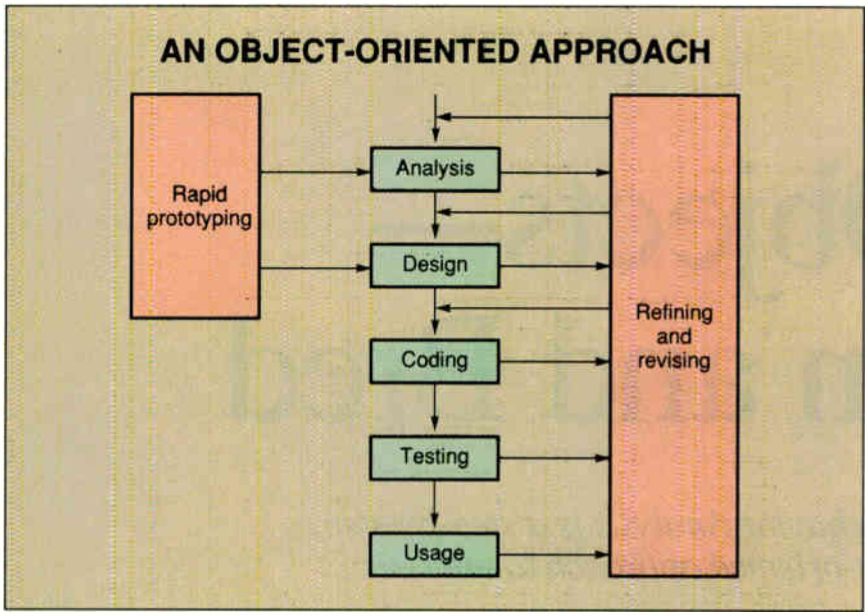

Figure 1: *An iterative, object-oriented project-development approach, emphasizing rapid prototyping at the analysis and design stages, and iterative refinement.*

THE FIVE STEPS OF OBA

Table 1: *The steps constituting Object Behavior Analysis, and the results of each step. These steps are iterated as needed.*

Steps	Action	Result
1	Understand the application; identify behaviors	Initial behaviors of the system
2	Derive objects using the behavioral perspective	Objects and object behaviors
3	Start classifying objects	Objects classified with behaviors and visible properties
4	Identify relationships among objects	Object relations and coordination
5	Model processes	Requirements specification and possible analysis prototype

and focus of the programming paradigm—in this case, object-oriented. This doesn't mean that analysis should be implementation-specific—quite the contrary. But if the implementation is to be object-oriented, it only makes sense that the analysis and design should apply the same set of rules.

Structure vs. Object

Why not use established analysis techniques, such as structured analysis? The evolution of structured analysis (in a highly compressed sequence) shows the following series of developments: structured programming led to structured design, which led to structured analysis. Structured analysis and design were built on top of the basic notions of traditional structured programming, including separation of data and procedures.

Some of the fundamental notions of object-oriented programming (OOP) are quite different from those of traditional programming. For instance, objects encapsulate both behavior and state, whereas traditional programming deliberately maintains a separation.

In OOP, the role of data places it at the same level as behavior. The objects own the data, which is only indirectly visible to the outside because it is hidden via encapsulation. In traditional programming, data is secondary to functions, separated from them, and shared by them, and the entire application can directly access it.

Object-oriented methodology, and especially object-oriented analysis, are relatively new compared to OOP, and they are generating a lot of interest. We have already seen two prominent object-oriented-analysis camps take shape: spinoffs from analysis techniques based on traditional programming languages, and less formal techniques based on hints and advice from experienced object-oriented developers. OBA takes a different approach, bringing a formal structure to the advice of experts.

Several object-oriented-analysis techniques are based on structured analysis. Structured analysis is a powerful means of analyzing an application that is to be designed and implemented using structured design and traditional structured programming.

But mapping functionally decomposed procedures and separately modeled data into objects is contrary to the notion of encapsulation. It ignores a basic rule learned by every successful object-oriented developer: "Focus on behavior and group by behavior."

Unfortunately, a number of object-oriented analysis methods are explicitly derived from some form of structured analysis. It appears, however, that experienced object-oriented developers don't use these hybrid techniques.

Step by Step

OBA consists of understanding the application and identifying the initial behaviors, defining the objects that exhibit those behaviors, classifying the objects, identifying the relationships among them, and modeling their life cycles (see table 1).

I'll use the example of an airport simulation system. For the sake of simplicity, I'll divide the overall administration of the airport into two areas: model airport structure and model airport operation. The example centers on airport operation, including scheduling, both static and dynamic; passage of time, which brings scheduled flights into the present; and events that affect schedules.

Step 1: Identify the Behaviors

How do you go about understanding the application? First, you interview the users of the prospective application and observe them in action to see what they do, who and what they interact with, in what order, and what the outcomes of different actions are. The main point is to elicit a list of desired and necessary behaviors for the system—the highest level of behavior defines the system's *responsibilities*.

Skilled interviewing takes practice and know-how (see reference 4). But

continued

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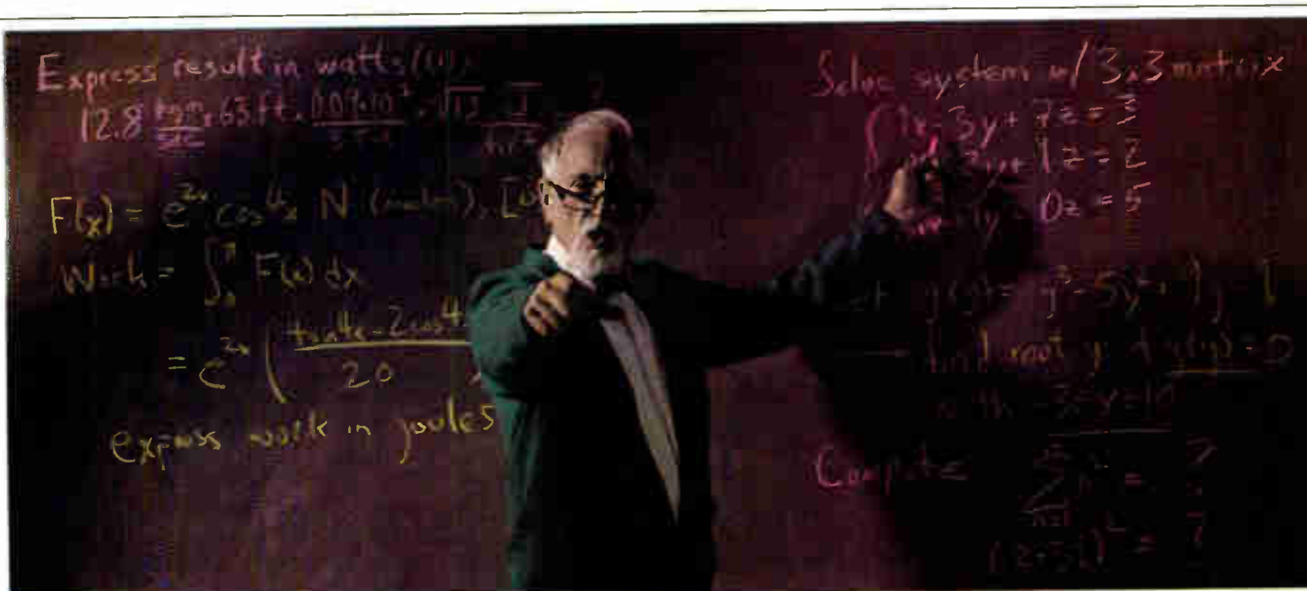

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A SIMPLE SCRIPT

Table 2: *Scripts help to determine system behaviors, as well as who or what is performing those behaviors. Scripts are a part of the output from step 1.*

Agent	Action	Recipient	Result
Event	Delays	Flight	Flight's landing time is changed
Flight	Notifies	Dynamic schedule	Dynamic schedule changes to reflect flight's new landing time
Dynamic schedule	Notifies	Gate and runway	Gate and runway respond to dynamic schedule that they are available at a later time
Dynamic Schedule	Notifies	Flight	Cleared for late arrival at assigned gate and runway

Name: Flight

Responsibilities: indicate or change its source, destination, takeoff time, landing time, assigned gate, assigned runway, notify gates, runways, and schedule of status or changes in status
Collaborators: gate, runway, event, dynamic schedule

Figure 2: *An example of a modeling card from the airport simulation system. Note that a modeling card is required for each collaborator as well.*

there are a few key principles to keep in mind when you are interviewing for requirements specification:

- Don't let your own assumptions or understanding of an application area prevent you from hearing what the person you are interviewing is saying.
- Use open-ended, nonleading questions, such as, "Tell me what you do first when tackling this part of your job." Don't use closed questions, such as, "I'll bet the first thing you do is check the weather report, right?"
- Don't use multiple-choice questions, such as, "Which of these do you check first: the weather report, the air-traffic report, or your fuel level?" Use simple, one-part questions, such as, "You mentioned that you need to communicate any changes in flight patterns. To whom do you communicate this information?"
- Do not use complex, multiple-part questions, such as, "Whom do you talk to when a problem occurs, and what kinds of problems occur? Do you always have to refer air-traffic problems to someone else?"
- Use active listening techniques, such as clarification and summarization, as in: "Let me see if I got all of that straight. First, you check the weather, then the assigned schedule, and then you contact the airport. Is that right?"

To define the behaviors of the system and its components, look at its expected usage and spend time with its potential users. Try to find an answer to the question, "What does the system need to do?" It's useful to think in terms of the system's roles and responsibilities. A subset of the responsibilities of an airport simulation system follows:

- Continuously update status for flights, gates, and runways as changes occur.
- Incorporate any schedule assignment changes caused by status changes.
- Update flight takeoff, landing, and cancellation changes to assignments.
- Keep track of time and assignment changes due to flight delays.
- Modify gate and runway assignments as necessitated by schedule changes.

Determining the expected usage of the system is only a beginning, however, in defining its behavior. Listen for words and concepts that come up repeatedly, or that the interviewee emphasizes, either verbally or nonverbally.

Say that you were interviewing a pilot, and you heard something like, "I need to update changes in flight status frequently." What could you learn from this? The flight status being checked frequently sounds like a behavior—a status-checking behavior. To update the flight status, the pilot needs the flight number. Therefore, the pilot also needs the flight number frequently. The terms that come up in this situation are *flight*, *flight status*, and *flight number*. So, in addition to high-level responsibilities, a second class of behaviors encompasses access to perceived properties.

Once you obtain an overview of the application, ask for specific cases or scripts of interactions (see reference 5). Ask the interviewee to describe a typical interaction in the current system. For a simple example of a script from the airport simulation system, see table 2.

Next, it becomes evident that someone or something has to perform the behaviors. In the process of stepping through scripts, objects, concepts, processes, and events will necessarily appear as the exhibitors or agents of behavior. As you identify behaviors, notice the clusters of behavior performed by each agent, concept, process, or event. These clusters will be used in step 3.

Another source of useful information is any preliminary (functional) requirements specification that might be available. It could help to identify areas of concern and to determine which objects, concepts, processes, and events are central to the proposed application. The outcome of step 1 is a list of the behaviors expected of the system, a list of its visible properties, and the scripts.

Step 2: Define the Objects

Having defined the initial behaviors, you need to determine who performs them. Finding the objects is straightforward once you understand the behaviors. You simply look to see who or what is responsible for particular behaviors.

Modeling cards, a variant of the CRC cards developed by Ward Cunningham, are useful in step 2 (see reference 6). Modeling cards are small index cards with the terms *name*, *responsibilities*, and *collaborators* written on them. On these cards, you write the behaviors of the system (responsibilities); who or what is responsible for particular behaviors, as well as for clusters of behaviors (name); and who or what else this responsible agent interacts with (collaborators). An example of a modeling card for an airport simulation system is shown in figure 2. The behaviors (i.e., *indicate or change its source*...) are performed by the agent, *flight*, who collaborates with *gate*, *runway*, and so on.

The scripts produced in step 1 also showed gate and runway as active agents. Thus, the implication is that gate and runway are objects. The objects of the application are composed of those concrete objects, concepts, processes, and events that exhibit significant behaviors.

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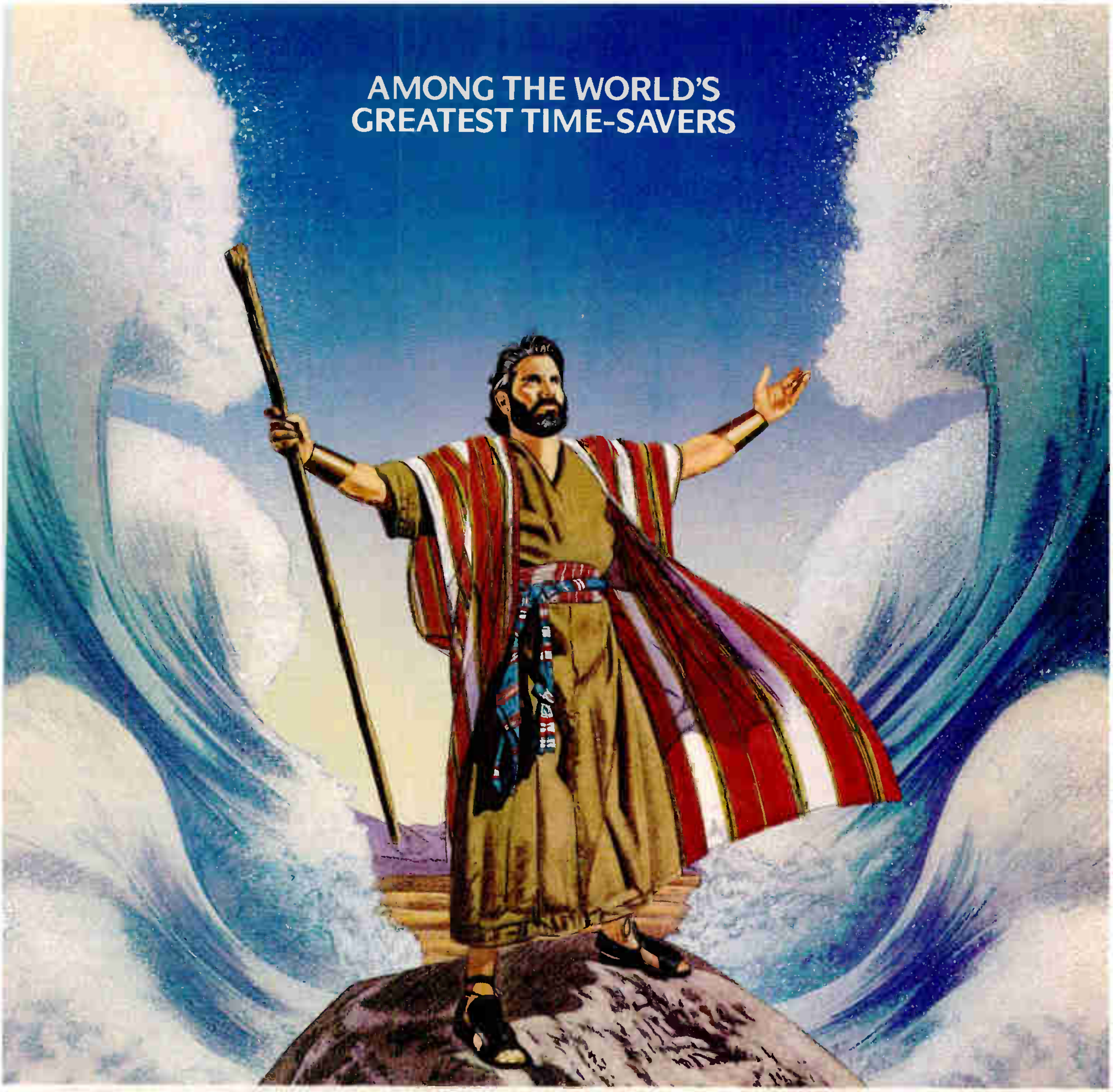

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OBJECT BEHAVIORS AND CHARACTERISTICS

Table 3: *The outcome of step 2 is a list of objects in the system, their related groups of behavior, and visible properties. This sample shows only one object.*

Object	Behaviors/Responsibilities	Visible properties
Flight	Takeoff, takeoff time Land, landing time Update status Notify gates, runways, and schedule Indicate source, destination Assigned gate, assigned runway	Takeoff time Landing time Updated schedule Number of passengers Weight/load Flight number National/international Status: on time, delayed, early, canceled Gate assignment Runway assignment

OBJECT CONCEPTS

Table 4: *Comparing the behaviors for the objects listed here shows sufficient similarity to create a new abstract object that reinforces their commonality.*

Objects with common features	Behaviors	Visible properties	New concept
Flight	Notify gates, runways, dynamic schedule	Status	Status notifier, controller
Gate	Notify flights, runways, dynamic schedule	Status	
Runway	Notify flights, gates, dynamic schedule	Status	
Dynamic schedule	Notify flights, gates, ground personnel	Status	

The outcome of step 2 is a list of the objects, such as flight, gate, runway, dynamic schedule, their related groups of behavior, and visible properties. For example, the visible properties associated with flight consist of takeoff time, landing time, updated schedule, number of passengers, flight number, and so on (see table 3). You may need to perform this step more than once to update the list of objects (e.g., you may find that you need to add a class of objects).

Step 3: Classify the Objects

In this case, *classification* means grouping objects according to some similarity of behavior (i.e., function) and state (i.e., form). Classifying objects primarily by behavior is the key to OBA. To do this, you look for similar behaviors among different objects.

For example, you know that flights use both gates and runways, so you might compare the behaviors for gate with the behaviors for runway (see table 4). They seem to have a lot in common, such as notifying flights and the dynamic schedule of their status.

In looking at their behaviors, you can see that the similarity between them relates to status notification. Thus, you can abstract the commonality of these two concrete objects into an abstract object, a status notifier, or a controller.

In defining this new abstract object, you are grouping the objects by behavior. Early on, I used to skip the first two steps given here and tell people to "group objects by behavior." Everyone would nod as if they understood, and then completely ignore behavior in the exercises. Why did this consistently happen? Looking into the research on how people form concepts and categories showed that the aspect of objects that people notice most readily has to do with state.

For example, if you ask someone to list the characteristics of an apple, you will hear, "Well, it's round and red. And it has a skin and seeds. And you can eat it." Now, if you ask the same person to list the characteristics of an imitation apple, you will hear, "Well, you can't eat it, but it is round and red." People generally identify objects initially in terms of state and then use the behavioral characteristics to distinguish and refine the groupings or categories. *Behavior* may seem like a funny term to apply to an apple, but if you think of an apple's role to a human, it is to be an edible object.

You can do the same exercise with the more behaviorally interesting object "police officer." Write down the characteristics of a police officer, and then write down the characteristics of an actor on TV playing a police officer. How are the lists similar and how do they differ?

Often, in listing the characteristics of a police officer, people write things like "carries a gun, wears a blue uniform, ar-

People generally identify objects initially in terms of state.

rests people," and sometimes, "enforces the law." In describing an actor portraying a police officer, often they write things like "carries a gun, wears a blue uniform," and, maybe, "acts out arresting someone." Again, the observable characteristics of the object "police officer" are listed first. However, what distinguishes a police officer from an actor portraying one has to do with their responsibilities—that is, their behavior.

The outcome of step 3 is a diagram of initial hierarchical relationships between objects (i.e., taxonomies), based on forming abstract objects using the criterion of similar behavior. An important task in the object-oriented world is distinguishing the abstract from the specific. OBA starts the project off on the right foot, because it helps you locate the concepts that will be used to build both abstract and concrete classes during design and implementation.

Step 4: Identify Relationships

Working with the outcomes of the previous steps—objects, their behaviors, and objects grouped according to behavior—step 4 involves drawing a preliminary sketch of the objects in relation to one another. Using this sketch, as well as the script and the modeling cards, you can create a table that clarifies the relationship that each object has to other objects. Looking at table 5, you can see that dynamic schedule *gets information from*

continued

OBJECT RELATIONSHIPS

Table 5: *Grouping objects by their behavior can help to clarify the relationship of each object to the others.*

Object	Relationship	Associates with
Event	Affects	Dynamic schedule
Dynamic schedule	Gets information from	Static schedule
	Notifies/responds to	Flight
	Notifies/responds to	Gate
	Notifies/responds to	Runway
	Notifies/responds to	Ground personnel

static schedule and *notifies/responds to* flight, gate, runway, and ground personnel. These phrases can both be simplified to *communicates with*. You can also use other descriptive terms to denote commonly found relationships.

One simple type of grouping relationship is the *is a* relationship. It is frequently seen, and you can use it to identify concrete subordinate objects as well as abstract superordinate objects.

Dependency relationships are also common, such that a behavior of one object automatically triggers a behavior in another (one object notifies another object when something has happened). For example, when an event occurs, it *affects* dynamic schedule. The dynamic schedule is said to be a *dependent of* event. Watch for phrases such as *cares about*, *notifies*, and *watches* to recognize a dependency relationship.

Communication is another form of relationship among objects. One object may request information (or some behavior) from another object, send information to it, refer to it, or know about it. For example, the dynamic schedule object would notify the gate object of a delay in flight time.

For OBA, you need to obtain as clear a description as possible, in natural-language terms, of the relationships between the objects. Then, you simplify these language descriptions. However, reducing the simplified natural-language descriptions to the subset of implementable relationships in object-oriented languages is part of the design phase, not the analysis phase.

Step 5: Model the Processes

Finally, you need to determine which objects initiate activities, and identify the sequence of activities. To do so, use the scripts developed in step 1 to "run" the model of the application. That is, given the behaviors, objects, and relationships defined thus far, can the scripts be enacted using the object behaviors defined? In the script for the airport simulation system (see table 2), the event starts the interaction and delays the flight, which in turn notifies the dynamic schedule, and so on.

You also must specify the life cycles of objects, and their status at different parts of the cycle. In the airport simulation

continued

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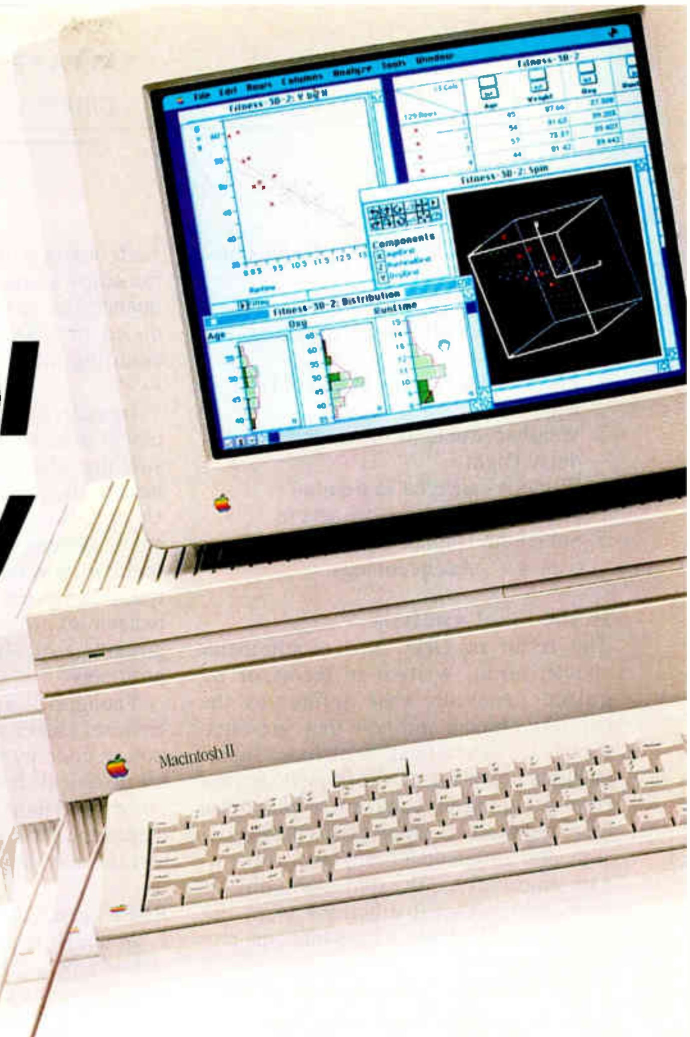

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system, the life cycle of a flight object might be as follows:

1. Flight takes off from originating airport.
2. Flight lands on time at end of first leg.
3. Weather problems on second leg delay flight.
4. Flight is canceled as weather problems become more severe.
5. Substitute flight assigned to continue subsequent legs.

In the Final Analysis

The result of OBA is a requirements specification, written in terms of required behavior, that delineates the primary objects and how they are organized. This specification includes superordinate objects (i.e., the objects derived from grouping by behavior, which often map into abstract superclasses during design and implementation) and subordinate objects (i.e., the real-world objects from which the abstractions were derived, and which often map into concrete subclasses).

The primary behavior and state of each object is listed, as well as the relationships among the objects and the sequences of activities. The scripts produced in OBA are especially useful in detailing how the user interface should work.

In order to deliver on the promise of object-oriented technology, you must ensure that object-oriented applications adhere to the principles of the technology. Using OBA for analyzing an object-oriented system, you obtain a behavioral specification that emphasizes the highly reusable aspects of a system—that is, the behavioral protocols and the hierarchical groupings of objects according to such protocols.

Thoughtful analysis, focusing on behavioral abstractions, promotes a reduction in code by paving the way for good hierarchical construction and inheritance. And judicious use of OBA can help to produce a clear, understandable object-oriented application structure. ■

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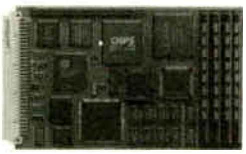

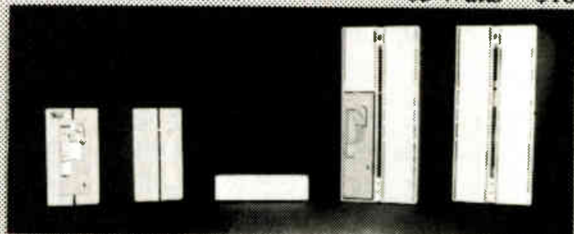

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Auld Lang Syne

Is it time for you to ring out the old and ring in the new?

Edward Yourdon

When *Object-Oriented Analysis*—a book I wrote with Peter Coad (see reference 1)—hit the streets last year, I was inundated with calls from people asking, "What's going on here? You're supposed to be promoting all that structured stuff! Are you telling us that data-flow diagrams are no good any more?" Some callers were merely curious, but others felt they had been betrayed: I might as well have changed political parties, or religions, or my allegiance from the Mets to the Yankees.

What indeed is going on here? Are structured techniques bad or obsolete now? Are the object-oriented techniques—object-oriented analysis (OOA), object-oriented programming (OOP), and object-oriented design (OOD)—better? Is 1990 the year you should abandon structured methods and embrace object methods?

It is difficult to discuss these questions calmly with many software engineers, largely because of the emotional hysteria with which methodologies are supported and promoted. Structured techniques, for example, were hailed by some as the productivity solution of the 1970s and 1980s. Computer-aided software engineering (CASE) was promoted in the same way during the second half of the 1980s. Now, some people are suggesting that object orientation is the salvation of the 1990s.

Just as in the past, some companies are rushing to embrace object-oriented technologies with a nearly religious fanaticism: In some data-processing (DP) shops, structured techniques are now dismissed as the old religion of the ancient 1970s. Just as *Business Week* proclaimed in a 1988 cover story that CASE tools could "save" American business, now you are seeing popular journals proclaim object-oriented techniques as a revolution.

Cracks in the Structure

Ironically, for some DP organizations, the structured analysis and design concepts of the 1970s are still considered radical notions that threaten the creative freedom of the artist-turned-programmer. For a much larger majority, structured methods have only recently become respectable and practicable, with the advent of 386-based CASE tools. These CASE-equipped soldiers of software engineering are quite successfully using structured techniques to build conventional systems with higher levels of productivity and quality than ever before.

But for other DP organizations, structured methods have become problematic. Typically, there are three major problems that people complain about.

One is that structured analysis and

continued

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design methodologies tend to place enormous emphasis on the modeling of functions, with less emphasis on the modeling of data. More recent variants of structured analysis do pay homage to the data by incorporating entity-relationship diagrams, but many project teams ignore them altogether when modeling user requirements, focusing their energy instead on the ubiquitous data-flow diagram.

Perhaps it's unfair to blame this on the structured methodology, but the reality is that thousands of important DP projects have proceeded from analysis into design with only a model of the functions that the system must perform. Similarly, some data-modeling methodologies make the mistake of overemphasizing the data while ignoring the functions. Object-oriented methodologies deliberately package both data and functions together into a single container—the object. More important, the diagraming notation of most OOA and OOD methodologies uses a single, integrated diagram to represent the functions and data.

Another major complaint is that the diagraming notation of structured analysis and design provides little or no mechanism for emphasizing reusable components. Reusability is, of course, a Boy Scout virtue like loyalty, thrift, and bravery, but no one is quite sure how to practice it. Through the inheritance mechanism, object-oriented methodologies promote reuse by inviting software developers to create new subclasses that inherit attributes and methods (functions) from previously developed superclasses. Having watched the way people use this concept during the past few years, it strikes me that this leads to a profound difference in the way you think about developing a new system.

People using structured methods as their development paradigm tend to treat each new project as an intellectual exercise never before contemplated; analysis and design literally begin with a blank sheet of paper. People using object-oriented methods, on the other hand, tend to practice "design by extension." That is, they assume that the new system they have been asked to develop is merely an extension, or refinement, of something that has already been built; so they approach the problem by asking, "What new subclasses do I need to create, and what attributes do I need to inherit?"

A third complaint is that structured methods provide little or no guidance in developing the user interface of a system. This is largely because the structured methodologies were developed in the 1970s when user interfaces were of little concern. The input medium was a string of characters from a terminal or a stream of cards from a card reader; the output medium was equally primitive. Programmers didn't think much about the mechanics of getting data into and out of a system. Today's world of graphical user interfaces (GUIs) is quite different; Sun Microsystems' Bill Joy has observed that as much as 75 percent of the logic of today's windows-based, mouse-driven, icon-oriented systems is associated with the user interface.

Onto the Bandwagon

For many DP organizations, the issue is not whether object-oriented methods will produce miracles, but whether they represent a substantially different approach to systems development that should be adopted as a new standard. Object-oriented methods are substantially different from functional decomposition, structured analysis, and typical information-modeling methodologies. But even if they are different and better than other methodologies, is 1990 the best time to start using object-oriented methods? Would it be better for the typical DP shop to wait until 1995 or 2000?

Most new technologies—hardware-oriented or software-oriented, computer-related or non-computer-related—follow the evolutionary curve shown in the figure. Thus, you could argue that the structured revolution began in the late 1960s with the introduction of structured programming; it advanced rapidly through the 1970s and early 1980s with the development of structured design and structured analysis.

In the mid-1980s, some refinements were added for real-time systems, and a modeling technique known as *event partitioning* was substituted for the "pure" top-down decomposition of data-flow diagrams. But since 1986, virtually nothing has happened to the technology of structured techniques; CASE tools have provided automated support, but the underlying paradigm remains the same.

From this perspective, object-oriented techniques represent a new technology curve. Whether it is currently in the "early development" phase or the "rapid development" phase is a matter of debate, but there is little question that object-oriented methodologies are fundamentally different from the traditional methodologies currently being used by most organizations.

As a result, the real question a typical DP shop has to address is, "Is this the best time to get off one technology curve and onto another?" There are four major issues involved in this decision:

1. Is the object-oriented paradigm sufficiently mature and well developed?
2. Is there a good object-oriented implementation technology available? Does the DP organization provide adequate tools for its practitioners to effectively use object-oriented techniques?
3. Is the DP organization sophisticated enough to successfully change its development methodologies?
4. Are the systems and applications being developed by the organization the kind that will most effectively use the object-oriented paradigm?

Is It Ready?

Some practitioners argue that object-oriented methodologies are still new and somewhat immature; consequently, they are unwilling to risk their company's involvement in the methodology until it evolves further. The relative immaturity of object-oriented analysis and design may be judged by the paucity of books, training courses, and CASE tools on the subject. But object-oriented programming is a fairly well developed technology; there is an excess of books, training courses, videotapes, and programming languages to support this approach.

Each organization will have to decide for itself when the family of object-oriented technologies is sufficiently mature to justify pilot-project experimentation or full-fledged support. Obviously, this will also involve the organization's desire to be either a cutting-edge technology-oriented organization or a more conservative organization that waits until new technologies are well established.

Does It Work?

Object-oriented design and implementation can be carried out in a "traditional" software environment, using classical third-generation programming languages. Realistically, though, many organizations may postpone their commitment to object-oriented techniques until they see a clear path from OOA through OOD and directly into an OOP language.

Consequently, it is fairly common to see organizations adopting object-oriented techniques if they are using a language such as Ada or Smalltalk, or if they view the transition from C to C++ as relatively minor. On the other hand, it is relatively uncommon to see business-oriented DP shops adopting OOA and OOD, simply because it is less obvious how it will work in COBOL. And no

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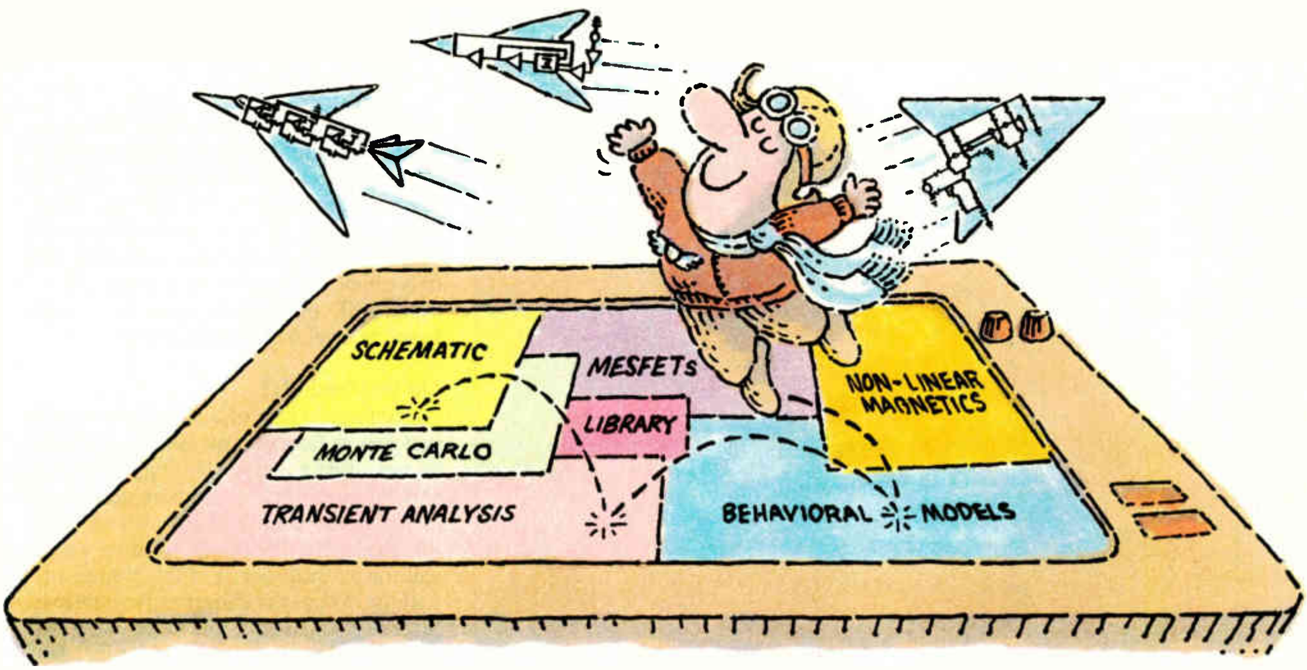

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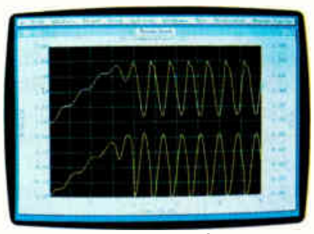

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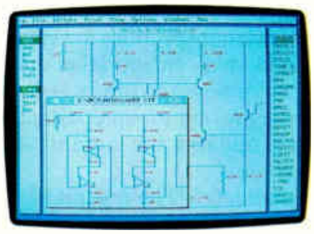

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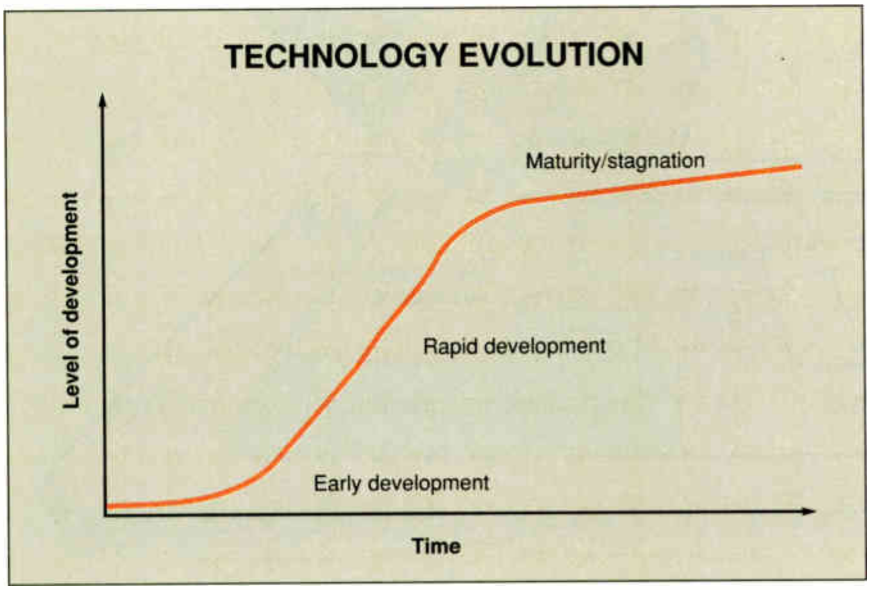

The evolution of any new technology over time is characterized by three stages: early development, rapid development, and maturity. Adopting a technology too early can be expensive and painful; waiting too long may leave you at a competitive disadvantage.

matter what your personal opinion of COBOL may be, the sobering reality is that 75 percent of the business data applications are still written in this venerable language of the 1950s.

In late 1989, CODASYL created a new subcommittee to recommend changes to the COBOL language to make it object-oriented, which will involve adding inheritance, dynamic garbage collection, and message passing. Although the next official version of COBOL is not scheduled to be released until 1999, one or more compiler vendors will probably release interim versions of object-oriented COBOL within the next year or two. After all, if C can evolve into C++, and Pascal into a Pascal with objects, why not COBOL into COBOL++? Such a development could dramatically speed up the adoption of object-oriented techniques within the business community.

Can You Handle It?

Based largely on the work of Watts Humphrey and his colleagues at the Software Engineering Institute, there is a growing consensus that DP organizations can exist at any one of five levels of "process maturity." This concept is discussed fully in Humphrey's book, *Managing the Software Process* (see reference 2). In summary, the five levels are as follows:

1. *Initial level*. There is no formal methodology, no consistency, and no standards on how systems should be built. Every software developer considers himself or herself an artist; anarchy prevails. Neither structured methods nor object-oriented methods will have much of an impact on this kind of organization.
2. *Repeatable level*. There is a consensus within the organization about "the way we do things around here," but it has not been formalized or written down. The systems development process is statistically stable through rigorous management of costs and schedules. However, success depends on the individual skills of project managers; the process has not been institutionalized.
3. *Managed level*. There is a formal, documented process for developing systems. Software inspections are rigorously practiced, and configuration management is more advanced than at level 2. A software process group constantly refines and updates the organization's methodologies.
4. *Measured level*. The organization has instituted formal process measurements (often referred to as *software metrics*) to measure its process for building systems, as well as the resulting products.
5. *Optimizing level*. The organization uses the measurements from level 4 as a feedback mechanism to improve those parts of its process that are found to be weak or deficient.

There is general agreement that an organization cannot make effective use of new tools or methodologies unless it is at or above level 3. This seems like common sense, but the fact is that approximately 85 percent of the large U.S. DP organizations surveyed in the late 1980s were found to be at level 1, another 10 percent to 12 percent were at level 2, and only about 3 percent were at level 3. As of mid-1990, no organizations had been found at level 4 or level 5 in the U.S.

Do You Need It?

One characteristic of a paradigm shift is that people (and organizations) generally do not adopt a new technology simply to solve familiar problems more quickly or efficiently. Because of the cost of making the shift (including training costs) and the natural inertia of the human animal (as well as the conservative nature of large organizations), it is more likely that people will continue using older technologies until order-of-magnitude improvements are available or until new problems appear that cannot be feasibly solved with older technologies.

A case in point: A software manager at IBM recently commented to me that attempts to use standard structured techniques to build applications in an OS/2 Extended Edition Presentation Manager (PM) environment had been dismal failures; the only successes they could point to were applications developed with object-oriented techniques.

The OS/2 Extended Edition PM environment is a typical GUI, characterized by pull-down menus, multiple windows, icons, and mouse-driven commands. In such an environment, the new object-oriented paradigm excels; the older, structured approach typically fails.

But you've got to remember that not everyone is building systems in a GUI environment. Many organizations are still using dumb terminals with character-based input commands, or they may still be building batch systems with card input and magnetic tape output. Walking into some DP shops is like walking through a time warp and watching the calendar turn back to 1969. All that's missing is the long hair and the love beads.

For people spending their days developing batch payroll systems that are fundamentally the same as the payroll systems of the 1960s and 1970s, whose only desire is to improve productivity by 10 percent, it will be hard to justify a major transition to object-oriented systems development techniques. But for people building new systems for which the conventional technologies are demonstrably inadequate, then it may be appropriate to begin using object-oriented techniques.

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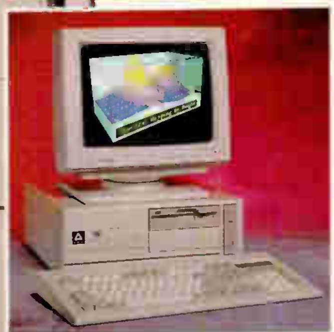

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You Say You Want a Revolution

In many discussions about methodologies, object-oriented techniques are portrayed as a revolution that can (and should) replace the earlier structured techniques. The lunatic fringe of the object-oriented camp even goes so far as to suggest that all the software developed with earlier methodologies is no good and should be thrown out, and that the earlier generation of software engineers (those now in their forties) who were weaned on structured techniques are unsalvageable and should be put out to pasture.

Another group, often labeled the "synthesists," argues that object-oriented techniques and structured techniques are compatible, and that many of the best ideas of both techniques can be used together. For example, some synthesists point out that the event-partitioning approach of structured analysis can be carried out in such a way as to identify a number of discrete bubbles (functions) that surround local data stores in a dataflow diagram. Grouping the bubbles and the data store together is, according to this group, essentially the same as creating objects; thus, voilà!, the system model produced by structured analysis has been objectified.

Walking into some DP shops is like walking through a time warp.

There is no doubt that you can arrive at the same result—the same design or the same model of user requirements—using different methodologies, but it is important to realize that the thinking process, the discovery process, and the communication between user and analyst are fundamentally different with object-oriented methods than with structured methods. Thinking about objects is fundamentally different from thinking about functions. In that regard, I side with the revolutionaries, although I disagree with the idea that older software engineers who began with structured techniques are incapable of shifting to the new object-oriented view.

At the same time, I agree with the fundamental message of the synthesists, even though I disagree with many of their examples and tactics. Fundamental concepts such as abstraction, partitioning, conscious deferral of design decisions, and the like are just as relevant in object-oriented methods as they were in the days of structured analysis and design.

When structured design was first developed, one of the fundamental concepts was that of "design evaluation criteria": guidelines and heuristics that you could use to distinguish between good designs and bad designs. In the object world, there is also a set of evaluation criteria to help you distinguish between good object-oriented designs and bad ones.

Getting Started

Getting started with object-oriented methods is, in many ways, the same as getting started with any new technology or methodology. You first have to perceive that there is a problem that object-

continued

oriented techniques can solve that your conventional approach will not solve adequately.

Then you must sell the object-oriented concept to others in the organization: senior managers who must invest money and provide support; middle-level managers who must figure out how to use a new technology without disrupting their schedules, budgets, and political empires; and various levels of technicians who may or may not be enthusiastic about adopting new techniques.

Pilot projects are a necessity with object-oriented techniques, as with any other new technology, in order to gain experience and adapt the methodology to local needs. Training is inevitably required, and a careful implementation plan must be laid out.

Since details of getting started with object-oriented methods (e.g., What kind of pilot project is best? How long will the training take?) are so similar to the introduction of other new computer technologies that it makes sense to take advantage of the technology-transfer strategies that people have already developed. One excellent source of information in this area is Barbara Bouldin's *Agents of Change* (see reference 3).

No Turning Back

Object orientation is the future, and the future is here and now. However, large organizations change slowly; old methodologies and habits are hard to change, and old software may last for decades before it can be replaced with new software developed with new methodologies.

Consequently, the 1990s are likely to be a period of gradual acceptance of object orientation; it may not become the dominant analysis methodology until the end of the decade. Meanwhile, just as there will always be a job somewhere on the planet for renegade assembly language programmers, there will always be a home for those who want to draw data-flow diagrams. ■

REFERENCES

1. Coad, Peter, with Edward Yourdon. *Object-Oriented Analysis*. Englewood Cliffs, NJ: Yourdon Press/Prentice-Hall, 1989.
2. Humphrey, Watts. *Managing the Software Process*. Reading, MA: Addison-Wesley, 1989.
3. Bouldin, Barbara. *Agents of Change*. Englewood Cliffs, NJ: Prentice-Hall, 1989.

Edward Yourdon is a noted software consultant, thinker, editor, and publisher of American Programmer. *You can reach him on BIX c/o "editors."*

Objects of Note

There are many object-oriented products available, from almost any company you can name. The ones listed here are only those mentioned in the articles in this State of the Art section.

Actor
The Whitewater Group, Inc.
1800 Ridge Ave.
Evanston, IL 60201
(800) 869-1144
(708) 328-3800
Inquiry 1225.

Metaphor
Metaphor Computer Systems
1965 Charleston Rd.
Mountain View, CA 94043
(415) 961-3600
Inquiry 1226.

Object Behavior Analysis
Smalltalk V
ParcPlace Systems
1550 Plymouth St.
Mountain View, CA 94043
(800) 822-7880
(415) 691-6700
Inquiry 1227.

Objective-C
Objective-C System-building Environment
Software-IC
The Stepstone Corp.
75 Glen Rd.
Sandy Hook, CT 06482
(800) 289-6253
(203) 426-1875
Inquiry 1228.

Smalltalk/V
Digitalk, Inc.
9841 Airport Blvd.
Los Angeles, CA 90045
(800) 922-8255
(213) 645-1082
Inquiry 1229.

This resource guide lists information sources for the major concepts and products listed in this section. Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation of the guide.


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A Knowledge Engineering Toolkit

Your own knowledge engineering toolkit for building expert systems

Marc Eisenstadt and Mike Brayshaw

The big boom in expert-systems technology during the last decade has led to the emergence of knowledge engineering—the art and science of building an expert system—as a discipline in its own right.

The spectrum of software for knowledge engineering runs from shells to toolkits. Shells provide a ready-made interpreter that follows a particular style or paradigm of representation, such as backward-chaining rules. Such shells have the advantage of providing various off-the-shelf facilities, such as automatic explanation generation, but the disadvantage of straightjacketing you into a particular and possibly inappropriate style of working. Shells also allow a relatively fast design/edit/run/debug cycle, which lets you prototype expert systems quickly.

At the other end of the spectrum are toolkits, which offer the hybrid features of several different styles or paradigms, along with sophisticated graphics and modeling facilities so that you can develop different parts of a complete expert system by using whichever paradigm is most appropriate. The advantage of toolkits is that they are flexible. However, you generally have to suffer the disadvantage of a longer learning period and a higher capital investment, for both the toolkit itself and the underlying hardware/software platform that supports it (typically an advanced graphics workstation running Common Lisp).

From the Bottom Up

Predictably, the distinction between shells and toolkits, like the distinction between personal computers and advanced graphics workstations, is beginning to disappear. Inexpensive shells are arriving with more features added. Full-featured toolkits are dropping in price. The PC world is migrating toward more powerful machines, such as 386/i486-based and 68030/040-based hardware. Proprietary AI hardware, including dedicated Lisp chips, can be plugged into Mac IIs and Sun workstations.

This downward migration of expensive AI hardware and software inspired us at the Open University's Human Cognition Research Laboratory in the U.K. to provide comprehensive knowledge engineering software that could run entirely on a conventional PC.

There are several excellent shells and toolkits already on the market, many of which run on ordinary or enhanced personal computers. However, developing your own toolkit from scratch lets you make the innards completely accessible and modifiable to suit your own needs. In this article, we'll present the main features underlying the design of MIKE (Micro Interpreter for Knowledge Engineering) and show you how to implement it in a subset of Edinburgh-syntax Prolog so that it will run on standard PC compatibles (see table 1 for a summary of other Prolog implementations). From this, you can study the principles of knowledge engineering and then build your own expert system. [Editor's note: *The source code for the toolkit (as well as an Edinburgh-compliant Prolog) is freely available in a variety of formats. See page 5 for further details.*]

The Design of MIKE

MIKE is implemented in Edinburgh Prolog (see the text box "Notation" on page 274). It has four components: a top level, a working memory, a frame memory, and a rule memory.

- *Top level:* This is the "prompt" to which you type input to initiate MIKE processing. In fact, the MIKE top level is the Prolog top level, so the MIKE prompt is simply the Prolog prompt, namely "?-". The difference between the two is just that several predefined operators in Prolog, such as `add` and `deduce`, are used to initiate MIKE processing.
- *Working memory:* This is a temporary repository for arbitrary items called *working-memory elements*, which are either atoms, integers, strings, lists, or compound Prolog terms (predicate plus argument combinations), such as `loves(john, mary)`. The contents of working memory grows and shrinks during processing as elements are added and removed using the MIKE operators `add` and `remove`. Typically before each new run, MIKE reinitializes working memory (i.e., it removes all

continued

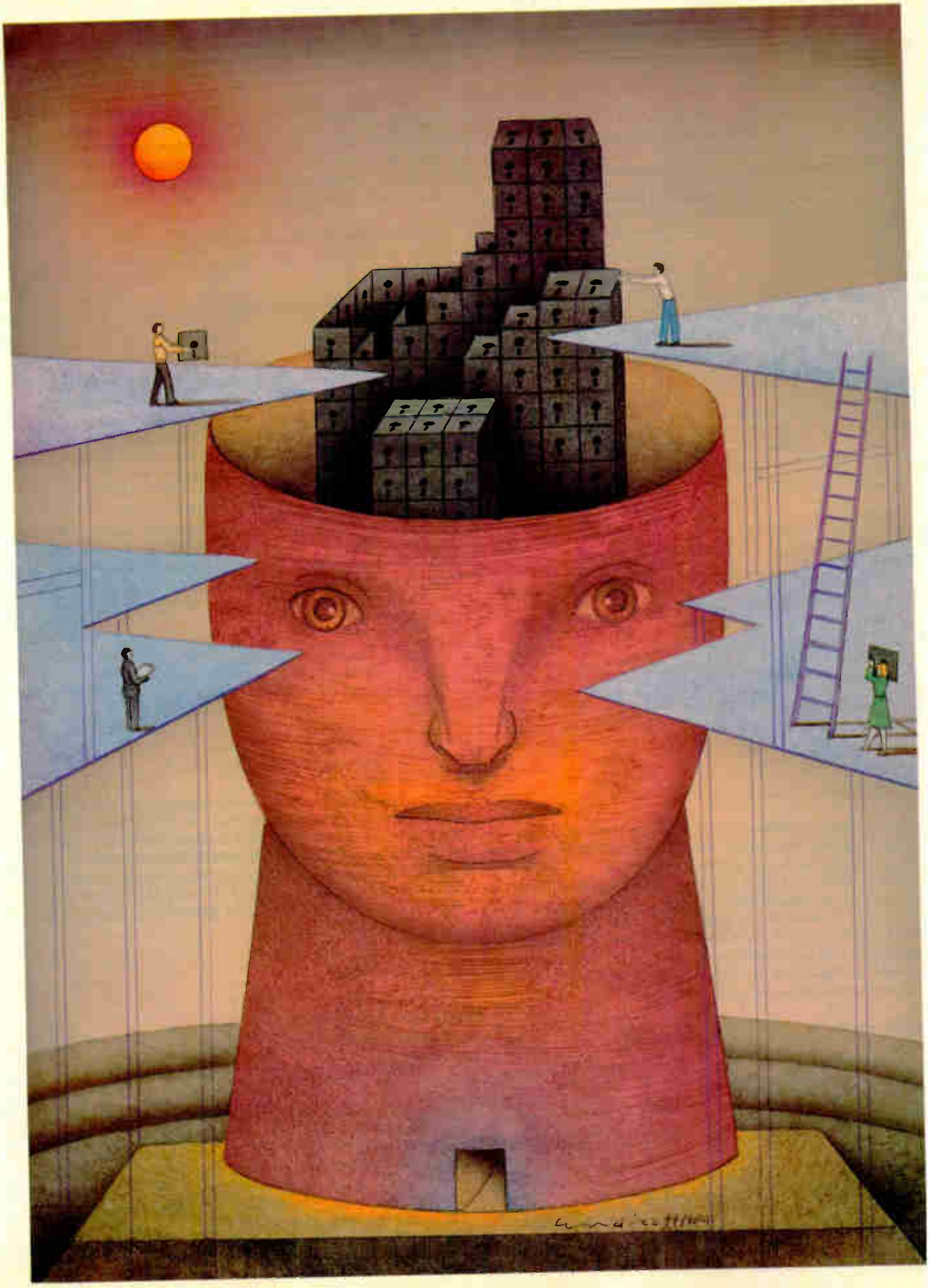


ILLUSTRATION: JAMES ENDICOTT © 1990

PROLOG SUPPLIERS

Table 1: *PC implementations of Edinburgh Prolog.*

IBM PC compatible	Apple Macintosh
A.D.A. Public Domain Prolog Automata Design Associates 1570 Arran Way Dresher, PA 19025 (215) 646-4894 **Inquiry 985.**	**LPA MacProlog** Logic Programming Associates, Ltd. Studio 4 Royal Victoria Patriotic Building Trinity Rd. London SW18 3SX UK 44-81-871-2016 **Inquiry 986.**
Arity Prolog Arity Corp. 29 Domino Dr. Concord, MA 01742 (800) 722-7489 **Inquiry 983.**	**Prolog-II/Prolog-III** PrologIA Luminy, Case 919 13288 Marseille Cédex 09 France 33-91-26-86-36 **Inquiry 987.**
IF Prolog Interface Computer GmbH Garmischer Strasse 4/V D-8000 München 2 West Germany 89-51086-55 **Inquiry 984.**	
LPA Prolog Logic Programming Associates, Ltd. Studio 4 Royal Victoria Patriotic Building Trinity Rd. London SW18 3SX, UK 44-81-871-2016 **Inquiry 982.**	
Prolog-2 Expert Systems, Ltd. Unit 12, 7 West Way Oxford OX2 0RD UK 44-865-794474 **Inquiry 981.**	

working-memory elements and adds the atom `start` as processing begins). Processing is normally initiated by the operator `fc` (which stands for "forward chaining").

• *Frame memory:* This is a permanent (though modifiable) repository for structured objects. Objects can be either *instances* or *classes*. Instances are unique individual objects, such as `fred_smith` and `car_54`. Classes are generic categories, such as `person` and `respiratory_disease`. Each object is characterized by sequences of *slots* and *fillers*, which are attribute/value combinations—for example,

```
fred_smith instance_of person with
 age: 49,
 citizenship: UK,
 weight: 160,
 occupations: [teacher, lifeguard, parent].
```

where `age` is a slot and `49` is a filler for instance `fred_smith` of class `person`.

You can access frame memory contents directly from rules, using either of the following two forms:

the *slot* of *object* is *variable-or-filler*.

all *slots* of *object* are *variable-or-list-of-fillers*.

You usually create frame objects with a text editor and then load them into Prolog (and, hence, into MIKE). However, you can also modify them directly with rules, or even from the top level, using the operator `note`. Thus, from the top level, you could first directly modify the frame and then access it (here your input is shown in italics):

?– *note the age of fred_smith is 50.*

```
yes
```

?– *the age of fred_smith is What.*

```
What = 50
```

• *Rule memory:* This is a permanent (though modifiable) repository for rules. Rules can be one of two types: *forward chaining* or *backward chaining*. Forward-chaining rules are characterized by a sequence of *conditions*, which access either the current working memory or the permanent frame memory, and a sequence of *actions*, which usually `add` or `remove` elements from working memory, or possibly alter the frame memory using `note`. Normally, it is the altered contents of working memory that results in the triggering of yet another forward-chaining rule, until the special action `halt` is invoked by one of the rules (or until no applicable rules can be found). Here is a typical forward-chaining MIKE rule:

```
rule r1 forward
   if
     the suggested_action of
         this_session is A &
     the cost of A is low
   then
     add considering(A) &
     note the recommendation of
         this_session is perform(A).
```

Backward-chaining rules have a sequence of conditions just like those of forward-chaining rules, but rather than having actions to be performed, they have a single conclusion, a pattern to be deduced. MIKE does not store deductions (either in working memory or frame memory); deductions simply succeed or fail. Here is a typical backward-chaining MIKE rule that invokes a call to a primitive Prolog greater-than test in its third condition:

```
rule r2 backward
   if
     the age of X is Age1 &
     the age of Y is Age2 &
     prolog(Age1 > Age2)
   then
     olderthan(X, Y).
```

After you define frames and rules in a text file and load them (typically using `reconsult(`*'filename'*`)`), you initiate processing in MIKE by invoking forward chaining (typically using `fc`) or by invoking backward chaining using the operator `deduce`.

Daemons can initiate additional processing. They are actions associated directly with specific slots in a frame object. You can invoke daemons when you access slots (e.g., when retrieving `the age of fred_smith is What`). You can also initiate daemons when slots are changed (e.g., when performing `note`

continued

MIKE'S OPERATORS

Table 2: *Operator declarations used in MIKE. These typically reside in a file that is read in as a sequence of "directives," such that each directive is preceded by a "?-" provided by the user. MIKE also uses the built-in Prolog operator* `is`, *which typically is defined as* `op(700,xfx,is)`. *In some implementations of Prolog, the range of operator precedences is 0–255 rather than 0–1200. If this is the case of your Prolog system, you will need to rescale the operator declarations accordingly.*

```
op(1200,fx,rule).
op(1199,xfx,with).
op(1199,xfx,forward).
op(1199,xfx,backward).
op(1100,fx,if).
op(1000,xfx,then).
op(1000,xfx,from).
op(999,fx,make_value).
op(999,fx,add_value).
op(950,fx,'--').
op(950,fx,establish).
op(950,fx,deduce).
op(950,fx,say).
op(950,fx,remove).
op(950,fx,note).
op(950,fx,add).
op(950,fx,announce).
op(950,xfy,explained_by).
op(950,fx,why).
op(950,fx,how).
op(950,fx,describe).
op(950,fx,show).
op(950,fx,strategy).
op(955,xfy,or).
op(954,xfy,'&').
op(953,fx,query).
op(952,xfy,receives_answer).
op(899,fx,the).
op(899,fx,all).
op(898,xfx,of).
op(897,xfx,to).
op(876,xfx,for).
op(850,xfx,are).
op(800,xfx,instance_of).
op(800,xfx,subclass_of).
op(799,xfx,':').
op(200,xfx,'<--').
op(10,fx,'?').
```

the age of fred_smith is 50). Typically, daemons cause other slots to be altered as well. If daemons cause other daemons to be invoked, such processing terminates only when there are no more daemons invoked. Backward chaining terminates when a conclusion has been deduced successfully (or, alternatively, when it fails). Forward chaining terminates when `halt` is invoked by one of the rules (or, alternatively, when no applicable rules can be found).

MIKE in Action

Before discussing some of the specific features of MIKE in detail, here is an example that shows some of MIKE's features. This will help you see at a glance the style of representation and processing in MIKE.

The example is based on a generic marketing-strategy selection system by R. J. Mockler. Imagine that you are a marketing executive working for a consumer products manufacturer, and that you are looking for advice about what generic strategy to pursue in the home computer market, which is seen as part of the larger high-tech consumer market. Possible recommendations in Mockler's system include "get out of business," "hold position," "selective investment," "niche concentration," and "aggressive investment." Each of these can be substantially refined, but this example focuses just on the generic recommendation.

In listing 1, we begin with a sample of frames and forward-chaining rules, which you define in a text file and then load into MIKE. The example presented here depicts just a small fraction of the total number of frames and rules that are needed to tackle this domain realistically. The order of classes and instances is unimportant. Having loaded in the frames and rules of listing 1, you might have the following interaction:

?- *fc*.

```
I propose the following strategy for home_computer
_market: selective_investment

Successful termination.
```

When you invoke the rule interpreter with ?-*fc*, MIKE finds the first applicable rule, which in this case is `init`. This rule deposits the list `[current_market, home_computer_market]` in working memory, and MIKE finds the next applicable rule, which is `industry_assessment_1`. That rule relies on frame inheritance to satisfy one of its left-side conditions, namely that the `technology` of `home_computer_market` is `mature` (this is inherited from the class `high_tech_consumer_market`). The other left-side conditions are satisfied directly by the frame description of `home_computer_market`, so the rule's right side is performed, thereby updating the frame description of `home_computer_market` with the additional *slot*: *filler* pair `industry_type: declining`. On the next execution cycle, MIKE finds that `strategy_recommendation_1` is applicable. If you carefully inspect that rule, you'll see that some of its left-side conditions are satisfied directly (e.g., `the overall_strength of my_company is strong`), whereas others are satisfied by inheritance of attributes from the `key_player` frame (e.g., `the financial_strength of my_company is average`). The right-side action of rule `strategy_recommendation_1` deposits the term `recommended_strategy(home_computer_market, selective_investment)` into working memory. This, in turn, causes the rule `conclude` to be triggered, resulting in the cosmetic printout "`I propose etc...`" and an end to forward chaining.

Implementation

We implemented MIKE as a meta-level interpreter (i.e., a Prolog-like interpreter, which is itself written in Prolog). The implementation is compact (about 100K bytes of source code, including extensive comments), and it involves five key ideas:

1. Operator declarations provide syntactic sugar.
2. Frames are stored as ordinary database facts.
3. Inheritance is a recursive search along `subclass_of` relations.
4. Backward chaining works just like Prolog itself.
5. Forward chaining searches for the first rule that has all its conditions already satisfied.

Naturally, details of conflict resolution strategies and extra features, such as daemons, require considerable extra work, but the five key ideas provide a basic working implementation.

Operator Declarations Provide Syntactic Sugar

An input such as

?- *note the age of fido is 34.*

is short, simple, and sweet. But it is parsed internally as

```
note(the(of(age, is(fido,34)))).
```

This is because `note`, `the`, `of`, and `is` are all predeclared to be

continued

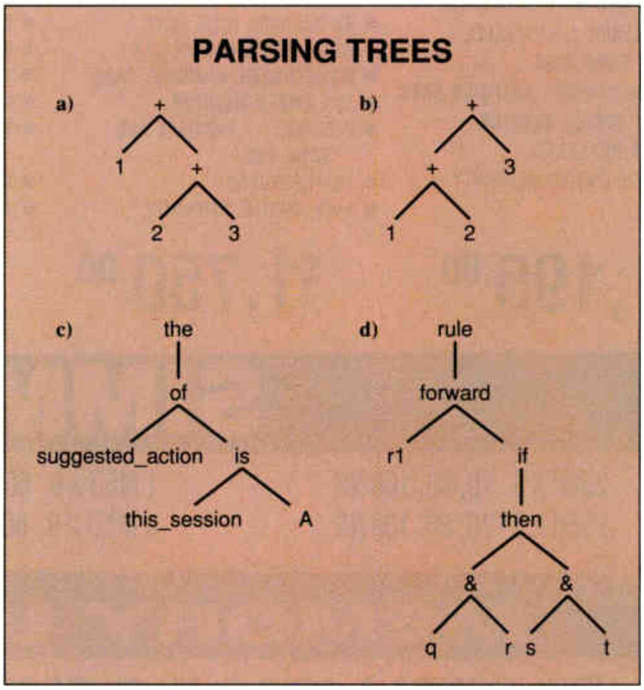
Notation

Because MIKE is implemented in Prolog, it shares syntax conventions with Prolog. There are two fundamental consequences of this:

- Inputs that you type in response to Prolog prompts and MIKE prompts must be terminated by a dot.
- Variables are signified by words beginning with uppercase letters, such as X, Num, and THIS. Case is significant, so that NUM and Num refer to two different variables. The underscore character (_) on its own is also known as the "anonymous" or "don't care" variable.

We use the word *operator* to refer both to MIKE keywords, which act analogously to commands or actions in other programming languages, and to Prolog infix operators (much like the mathematical operators + and −), which is precisely how MIKE operators are implemented.

In listing 1, comments are either enclosed within comment brackets /* like this */ or else preceded on a single line by the comment character %.



Parse tree for four cases: **(a)** *(1 + 2 + 3), assuming + is xfy type;* **(b)** *(1 + 2 + 3), assuming + is yfx type;* **(c)** *the suggested_action of this_session is A;* **(d)** *rule r1 forward if q & r then s & t.* ▶

operators with the correct precedences or order of consumption. Although the use of these common English words may seem trivial, each adds meaning to the simple and sweet statement. The precedence of these words is as important to the knowledge toolkit's ability to parse your statements as the precedence of arithmetic operators is to the parsing of a mathematical expression, such as

```
3 + 4*2
```

to determine the correct internal representation

```
+(3, *(4,2))
```

The mathematical expression is parsed correctly because + and * are infix operators, with * having a lower precedence (i.e., earlier order of consumption) than +.

Operators are declared in Prolog using the following syntax:

?- *op(precedence, associativity, name).*

For example, the mathematical operators would be declared as follows:

?- *op(310, xfy, '+').*

?- *op(300, xfy, '*').*

MIKE's operator declarations, shown in table 2, specify one of three types of associativity: *fx* (prefix operator), *xfx* (infix operator with left and right arguments of equal status), or *xfy* (infix operator with sequences of operators embedded in a structure branching downward and to the right). An example of the need for an *xfy* operator is the arithmetic term `(1 + 2 + 3)`, which is parsed internally as `+(1, +(2,3))`. If the plus (+) operator were declared to be *yfx* instead of *xfy*, the `(1 + 2 + 3)` would be parsed internally as `+(+(1,2),3)`.

Rules and frames are implemented by using these operators. In many dialects of Prolog, the built-in predicate `display` lets you see the true structure of Prolog terms. For instance, observe the following interactions:

```
?- write(3+4*2).
3+4*2.
?- display(3+4*2).
+(3, *(4,2)).
```

The figure above shows the graphical representation of the parse tree of four Prolog interactions. The interaction represented by part (a) is

```
?- op(300, xfy,'+'),display(1+2+3).
+(1,+(2,3)).
```

The interaction represented by part (b) is

```
?- op(300, yfx,'+'),display(1+2+3).
+(+(1,2),3).
```

The interaction represented by part (c) is

```
?- display(the suggested_action of this_session is A).
the(of(suggested_action,is(this_session,A))).
```

And the interaction represented by part (d) is

continued

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Listing 1: *This sample text file, loaded into MIKE, includes sample frames and forward-chaining rules.*

```
/* class definition */
high_tech_consumer_market subclass_of consumer_market with
  technology: mature,            /* default slot fillers... */
  r_and_d_budgets: increasing,
  proportion_new_customers: high.

/* instance definition */
home_computer_market instance_of high_tech_consumer_market with
  proportion_new_customers: low,     /* this overrides default */
  r_and_d_budgets: decreasing,
  number_of_competitors: decreasing.

my_company instance_of key_player with
  overall_strength: strong,
  market_share: strong,
  organizational_flexibility: high.

competition instance_of key_player with
  organizational_flexibility: low,
  financial_strength: high.

key_player subclass_of player with
  overall_strength: average,
  market_share: average,
  financial_strength: average,
  organizational_flexibility: average.

rule init forward
  if
    start /* special symbol "start" always in working
                              memory to begin */
  then
    remove start & /* take special symbol away... */
  add
    [current_market,
   home_computer_market]. /* put arbitrary list
                          into working memory to provide context */

rule industry_assessment_1 forward
  if
    [current_market, M] & /* will work with any market M */
    the technology of M is mature & /* use frame access here... */
    the proportion_new_customers of M is low & /* and here... */
    the r_and_d_budgets of M is decreasing &
    the number_of_competitors of M is decreasing
  then /* update frame representation for M */
    note the industry_type of M is declining.

rule strategy_recommendation_1 forward
  if
    [current_market, M] &
    the industry_type of M is declining & /* given this
                              market/competitor appraisal... */
    the overall_strength of my_company is strong &
    the overall_strength of competition is average &
    the market_share of my_company is strong &
    the financial_strength of my_company is average &
    the organizational_flexibility of my_company is high
  then /* suggest this strategy */
    add recommended_strategy(M, selective_investment).

rule conclude forward
  if /* got a winner residing in working memory? ... */
    recommended_strategy(Market, Strategy)
  then /* then tell user */
    announce
      ['I propose the following strategy for ',
       Market,': ', Strategy] &
    halt.
```

?- *display(rule r1 forward if q & r then s & t).*
```
rule(forward(r1,if(then(&(q,r),&(s,t))))).
```

Notice that for parts (c) and (d), the operators of lower precedence appear lower in the tree. It may seem strange that the `if` part of the rule in part (d) (the subtree `(q & r)`) appears bundled beneath the operator `then`. This is entirely an artifact of trying to juxtapose enough operators so that the term (`rule` *rule* `forward if` *if-part* `then` *then-part*) can be parsed sensibly. This turns out to be simpler to do by having `if` as a prefix operator with a single argument, which is always of the form (*if-part* `then` *then-part*). The term (*if-part* `then` *then-part*) is handled in a straightforward manner by declaring `then` to be an infix operator, which leads in turn to the structure `then` (*if-part*, *then-part*). The same rationale leads us to declare `forward` as an infix operator and `rule` as the highest-precedence prefix operator. The objective is always to ensure that the terms get consumed into a syntactically legal structure.

Recall the rule we used earlier (here in condensed form):

```
rule r1 forward
   if
     the suggested_action of
       this_session is A &
       ...
   then
     ... &
     ...
```

You can get an idea of the parse tree for that rule by taking all of part (c) and substituting it in place of node `q` at the bottom of part (d).

Frames as Database Facts

Consider the following frame:

```
fred_smith instance_of person with
 age: 49,
 citizenship: UK,
 weight: 160,
 occupations: [teacher, lifeguard, parent].
```

Given the operator declarations presented in table 2, we can now understand the actual internal representation of the above frame. First, we'll represent `with` and `instance_of` as ordinary Prolog predicates:

```
with(instance_of(fred_smith,person),
 (age: 49,
  citizenship: UK,
  weight: 160,
  occupations: [teacher, lifeguard, parent]).
```

Notice in the expansion above that `with` has two arguments. The first argument is `instance_of(fred_smith, person)`, and the second argument is all the rest. An ambiguity in Prolog, which makes the parsing of terms somewhat confusing to novices, is that the comma plays three different roles. First, it separates arguments, as it does between `fred_smith` and `person`; and second, it serves as a conjunction infix operator, which could be pronounced "and." In fact, if we replace just this conjunctive comma with an ampersand, a symbol with more obvious meaning, the ambiguity is cleared up.

```
with(instance_of(fred_smith,person),
 (age: 49 &
  citizenship: UK &
  weight: 160 &
  occupations: [teacher, lifeguard, parent]).
```

The third use of the comma is to separate elements of a list, as in `[teacher, lifeguard, parent]`. This notation, in fact, is shorthand for the true internal representation of the list construction predicate, the dot, as in the following:

continued

a winner because of its wealth and, finally, performance." *PC Magazine* September 11, 1990

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Speed, transaction	(125)	Good
Speed, burst transfer	(25)	Excellent
Expandability	(100)	Excellent
Documentation	(50)	Excellent
Setup	(100)	Good
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System design	(50)	Good
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```
'.'(teacher,'.'(lifeguard, '.'(parent, [ ]))).
```

To control expansions, we preserve the shorthand notation for lists (e.g., [teacher, lifeguard, parent]).

Next, look at what happens when we represent the infix colon operator as an ordinary Prolog predicate.

```
with(instance_of(fred_smith,person),
  (':'(age, 49),
   ':'(citizenship, UK),
   ':'(weight,160),
   ':'(occupations,[teacher,
       lifeguard, parent])).
```

Finally, we expand the comma conjunction operator:

```
with(instance_of(fred_smith,person),
  ','(':'(age, 49),
    ','(':'(citizenship, UK),
      ','(':'(weight,160),
        ':'(occupations,[teacher,
            lifeguard, parent]))))).
```

If you know Prolog and are given this last representation, it should be clear that there is nothing special about the storage of frame representations: They are simply assertions in the Prolog database. An interesting artifact of this particular choice of representation is that the entire database of frames is stored under the predicate `with` rather than directly under the name of the relevant object (e.g., `fred_smith`). Prolog provides easy access to information about `fred_smith`, however, since it may be retrieved internally using the following query:

?– *fred_smith instance_of X with Y.*

```
X = person

Y = (age: 49,
  citizenship: UK,
  weight: 160,
  occupations: [teacher,
  lifeguard, parent])
```

The following query produces exactly the same results:

?– *with(instance_of(fred_smith, X), Y).*

More specific retrieval of frame information, such as the weight of `fred_smith`, requires searching along the conjunction of slot-filler pairs for a match. Some searches use inheritance, really a recursive search along `subclass_of` relations. Next month, in part two of this article, we will go into this and the implementation of forward and backward chaining, as well as an overview of some of MIKE's more advanced features. ■

Editor's note: *For more information on MIKE, contact the authors at the Human Cognition Research Laboratory, the Open University, Milton Keynes MK7 6AA, UK.*

Marc Eisenstadt is a professor of AI. Mike Brayshaw is a Research Fellow. Both authors work at the Human Cognition Research Laboratory at the Open University in England, where they are currently focusing their attention on program visualization and the Prolog programming language. You can reach them on BIX c/o "editors."

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Date of Residence: Month · Year · **Monthly Payment: $** · Buy ☐ Rent ☐ Other ☐

Previous Address: · **Dates of Residence:** From · To

Your Employer: (If self-employed, see rear panel) · **Date of Employment:** Mo. Yr. · **Position:** · **Monthly Income:** Gross $ · Net $

Employer's Address: Street · City · State · **Business Phone:** ( ) –

Previous Employer: · **Address:** · **Dates of Employment:** From · To

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation. · **Other Income:** · I have received since (Date) · Monthly Income Gross $ · Net $

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Bank Account: · ☐ Checking ☐ Savings

	Payment	Balance
Bank Loan Reference:		
Bank Card Reference: ☐ **VISA** ☐ **MasterCard**		
Other Credit Card Reference		
Other Credit References: Account No: · Expires:		

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Address Street · Apt. # · City · State · Zip · **Date of Residence:** Mo. Yr. · **Home Phone** ( ) –

Employer: · **Date of Employment:** Mo. Yr. · **Position:** · **Monthly Income:** Gross $ · Net $

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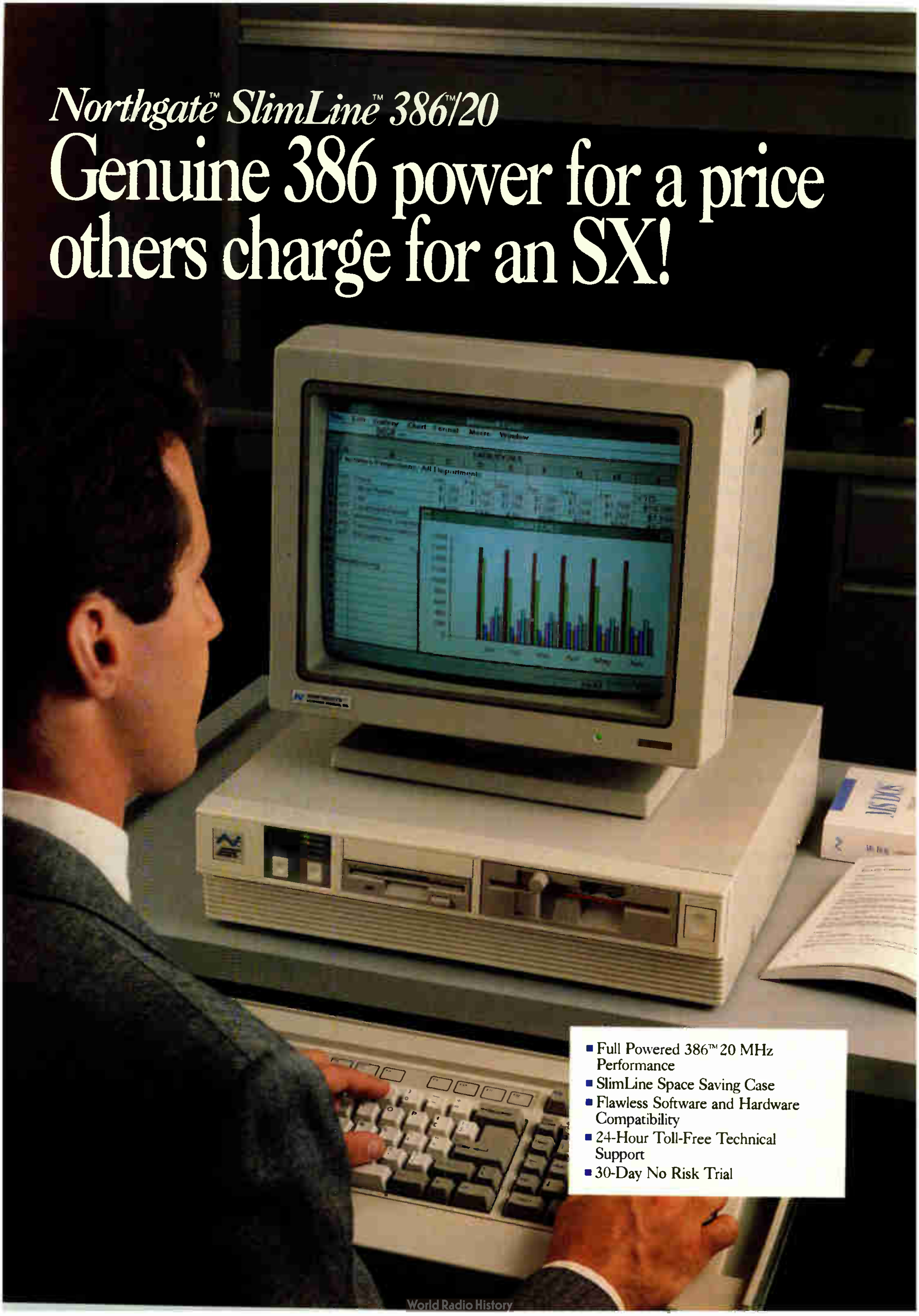
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Jerry Pournelle* on Northgate Page Mode 386/20**

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ES: A PUBLIC DOMAIN EXPERT SYSTEM

This free program lets you experiment with expert systems without being a knowledge engineer

Eric Summers

An expert system is a software package that has knowledge about a particular subject embedded in it. By querying the expert system's database, you can diagnose problems or come to conclusions based on the reasoning performed by the program. In general, an expert system explains how it arrived at one or more conclusions. High-end expert systems can even graphically display the rules that proved to be true or failed.

The public domain expert-system shell I have developed, called ES, is designed to help you develop knowledge bases and let you diagnose problems or learn about a specific knowledge domain. ES runs on the IBM PC, XT, AT, and some compatibles, and it requires 640K bytes of memory; a CGA, EGA, or VGA monitor; and 2 megabytes of hard disk space. This public domain system has some limitations, however, mostly concerning memory and error recovery.

Editor's note: *Let's face it, expert systems aren't exactly news these days. You've been hearing for some time now about how you can use such systems to capture knowledge from human experts and, thereafter, diagnose diseases, tune automobiles, or design a nuclear power plant.*

Of course, to create a truly powerful expert system, you need a knowledge engineer with powerful tools, like the MIKE system described in "A Knowledge Engineering Toolkit" on page 268. But what if, like most of us, you just want to experiment with an expert system? As the saying goes, "Have we got a deal for you." It's called ES, a ready-to-run, public domain, expert-system builder, complete with samples you can use to develop your own expert systems.

A Kinder, Gentler Chemical Company

To illustrate some of the capabilities of expert systems, I have developed an example using a specific knowledge base.

Suppose you're the manager of a plant that manufactures several chemicals that are useful but potentially damaging to the environment. A chemical spill is possible at any time. One of your responsibilities is to create a detailed plan to deal with a worst-case scenario. You decide to plan for a potential crisis by developing a logical way to identify the specific chemical(s) involved in the spill, a method for organizing cleanup teams, and a way to clean up any spill as rapidly as possible.

As with any expert system, the first step is to isolate the cause of the problem. Thus, in this situation, ES must initially identify the specific chemical spilled by knowing its color, density, and smell. This is done by asking you questions, such as "What is

continued

ILLUSTRATION: JAMES ENDICOTT © 1990

the color of the chemical?" If the color is known (see table 1), ES displays a menu, and you can select a color.

An expert system has the built-in capability to answer queries concerning a question it asks and the reason for the question, as well as explain the fact values. In all but the most rudimentary expert system, the program can explain its knowledge. And in general, expert systems can display the results of conclusions that were determined during a query. This could be in the form of text, graphics, or even animation. You can display conclusions determined up to that stage and the rule that is currently being accessed, and you can stop the operation at any point or exit to the DOS command prompt.

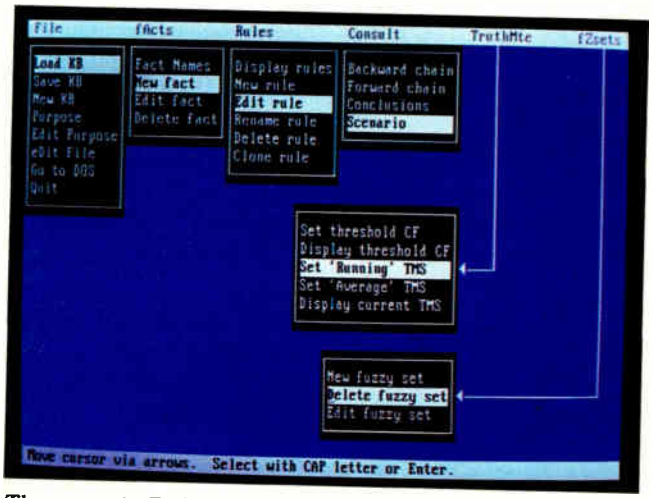
To tell you what chemical has been spilled, the program needs more information (e.g., how dense the chemical is and what it smells like). After you enter the requested data, ES can infer the name and class of the chemical and the appropriate cleanup procedures.

For example, if you entered black, high, and oily in response to queries regarding color, density, and smell, the program might conclude that the chemical spilled was crude oil; that it is extremely damaging to the environment; that if the amount spilled is more than 1000 gallons, cleanup must start immediately; and that if the substance was spilled into a nearby stream, communities along its banks must be notified. The program also displays which rules in the knowledge bases were tested, which rule antecedents proved to be true or failed, and which rule consequents were asserted.

A KNOWLEDGE-BASE MENU

Table 1: *Using this table from an ES knowledge base about chemical spills, you can respond to the "color of chemical" question by selecting from lists of possible color values.*

Color	Chemical
Black	Crude oil
White	Sodium hydroxide
Green	Hydrochloric acid
Brown	Benzene
Clear	Ammonia
Red	Gasoline



The menus in ES help ease the burden of developing and using knowledge bases. Not all the ES menus are shown, since selecting an option from one of the displayed menus usually begets another menu.

Rules Weren't Made to be Broken

Heuristics are rules of thumb that you use in your everyday life. An expert system uses a structured representation of heuristics to codify useful knowledge into a form the computer can understand. A mechanic tells you, "If your car won't start, the problem may be the battery, or your car may be out of gas." Or a professor might say to a student, "If you use tail recursion in your program, it will not run out of memory."

The mechanic's heuristic encoded as a rule might read as follows:

```
RULE: Diagnose car not starting
IF battery_indicator=off or
   gas_level=0
THEN car_starts=no and
     new_battery=yes or
     battery_recharge=yes
```

You can sometimes assign probabilities to your heuristics. For example, you could say that the mechanic's rule is true 90 percent of the time, which would further qualify the heuristic.

You can also encode these probabilities in rules that are usually known as certainty factors, or *confidence factors*. Expert systems can make use of CFs when describing information in constructing or using a knowledge base. CFs are numbers that measure how sure developers and users are that the rules are accurate.

A spectrum of CFs might look like this:

1.0	Absolutely true
0.75	Almost certainly true
0.50	Reasonably true
0.25	Somewhat true
0.0	Unknown
−0.25	Somewhat false
−0.75	Almost certainly false
−1.0	Absolutely false

ES rules are composed of multiple antecedents and multiple consequents. Antecedents are part of the IF component of the rule and consist of relation tests, such as =, < >, <, >, and > =. Consequents are part of the THEN component of the rule and simply assign conclusions to specified facts if the IF part of the rule proves to be true during a user forward-chaining or backward-chaining session.

Forward chaining—available in most expert systems—is a search technique that applies user-specific knowledge to knowledge-base rules and then reasons forward to conclusions. Forward chaining is helpful when you need to know everything about the domain under consideration. For example, a military commander would probably want to know everything about the enemy from field observations.

Backward chaining applies a user-specific goal to appropriate rules in the system to determine if a solution exists. Backward chaining is useful when you need to satisfy a specific goal. For example, a knowledge base containing information on how to construct an industrial plant might also include plans for building a tower, a motor pool, and offices. If you need to construct a water tower, you need only invoke the "construct water tower" goal.

continued

Dealing with Fuzzy Logic

ES supports the ability to define, display, and edit fuzzy sets and to use fuzzy sets as attribute relations in rules for forward or backward chaining. A fuzzy set is a means to define partial set membership within a specific context.

You deal with fuzzy logic every time you tune into the morning news. The station's announcer says, "Today it will be partly cloudy with a 40 percent chance of showers." What does "partly cloudy" mean? Although it's not "fully cloudy," the meteorologist may expect some chance of rain. Within an expert-system context, you can use fuzzy sets to give probabilistic definitions to knowledge.

"Middle age" is another example of a subjective term. Some might consider people middle-aged if they are between 40 and 60. Others might consider middle age to be between 38 and 62. In the ES.KB knowledge base, "fuzzy set age/middle age" is used as an example. Table 2 shows it as a set of ordered pairs, V/SM (value/strength of set membership) where, in the example, V is the specific age, and SM is the strength of set membership. The figure displays the middle-aged fuzzy set graphically.

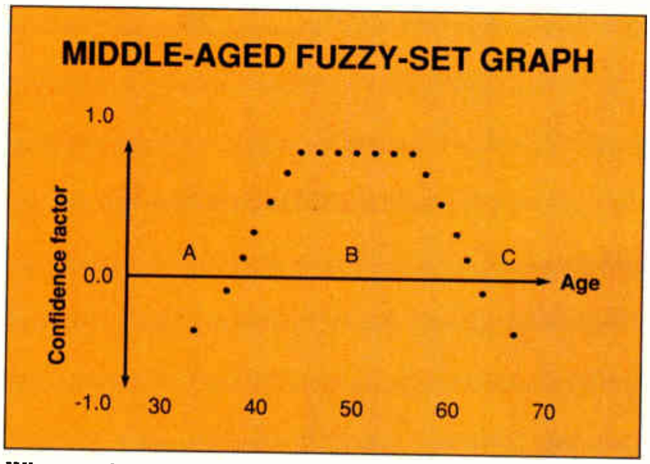
An ES rule that determines if a person is a large person and makes use of fuzzy relations could look like the following:

```
Rule Large Person
   IF
       OR SET:
       weight fz=heavy
       height fz=tall
       girth fz=sizable
   THEN
   person=large person
```

MIDDLE-AGED FUZZY SET

Table 2: *The fuzzy-set value/strength of set membership exactly disclose when you have reached middle age.*

Value	Strength of Set Membership
30	– 1.0 (Not member of fuzzy set)
38	0.2 (Slightly member of fuzzy set)
40	1.0 (Full member of fuzzy set)
60	1.0 (Full member of fuzzy set)
70	– 1.0 (Definitely not member of fuzzy set)



When used in rule construction, a fuzzy set allows flexibility in knowledge definition and high-relation resolution. This figure graphically displays the fuzzy set "middle age." Note that the confidence factor for whether a specific age is considered middle-aged peaks in the center of the graph.

If you are backward chaining and the goal is person, ES prompts you for the weight, height, and girth and makes use of the largest SM value to determine if he or she actually is a large person. If you are the owner of a large men's store, you might be interested in the above rule.

ES supports the following fuzzy-set rule antecedent relations:

- Fuzzy less than (fz<) defines a fuzzy relation that proves true if the attribute value of the antecedent is less than any other value that is a member of the fuzzy set (see value A in the figure).
- Fuzzy equal to (fz=) defines a fuzzy relation that proves true if the attribute value of the antecedent is a member of the fuzzy set (see value B in the figure).
- Fuzzy greater than (fz>) defines a fuzzy relation that proves true if the attribute value of the antecedent is greater than any other value that is a member of the fuzzy set (see value C in the figure).
- Fuzzy not equal to (fz< >) defines a fuzzy relation that proves true if the attribute value is not a member of the fuzzy set (i.e., resulting in CF < = 0.0).

Making Expert Systems More Useful

Since I started evaluating expert systems in 1985, the technology has improved greatly. However, knowledge bases are still difficult to develop. I believe that the addition of certain capabilities will make expert systems more useful.

First, it must become easier to acquire the knowledge from the expert. Rules in particular are not easy to develop, and you need some form of knowledge-acquisition front end to ask the expert questions to acquire the knowledge. Some expert-system vendors are starting to provide this capability (e.g., Nexpert and Nextra from Neuron Data).

Second, expert systems must operate in concert with other types of software. A complicated program, such as a DBMS, would be more useful if developers would embed expert-system capabilities in it.

In addition, expert-system vendors should provide an interface to C, FORTRAN, COBOL, and other languages so you can access an expert system's capabilities within a business or scientific application. You should be able to use these internal expert systems to develop your own knowledge bases so your custom applications are also more intelligent.

To demonstrate how ES works, I have developed three knowledge bases. ES.KB demonstrates most of the features of ES; SPILL.KB is the chemical spill knowledge base described above; and DISEASE.KB demonstrates identifying a disease from sickness attributes, such as fever and aches and pains.

By experimenting with forward or backward chaining on these knowledge bases, you can learn how to use the features of ES. You can also diagnose problems or provide guidance for understanding specific knowledge about a given subject. ■

Editor's note: *ES is available for the IBM PC and compatibles in a variety of formats.* *See page 5 for further details.*

Eric Summers is a computer scientist employed by the federal government. He evaluates state-of-the-art computer technologies. You can reach him on BIX c/o "editors."

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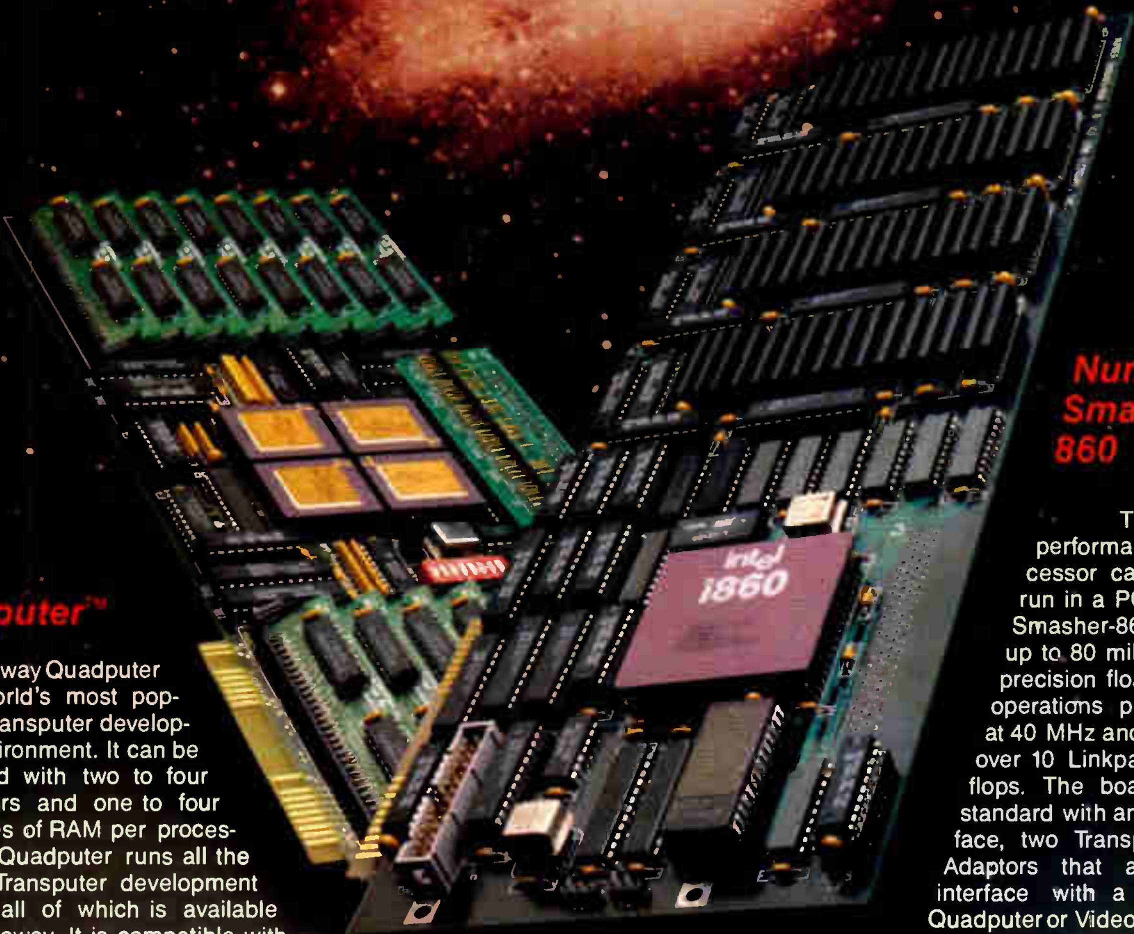

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THEOS: SERIOUS BUSINESS

A multiuser operating system with a database engine

Tom Yager

PART Three

When you set out to design a multiuser operating system, you don't start from scratch. A prudent way to begin is to find another system that comes closest to your vision of "the right way" and use selected capabilities as goals for your own project.

One popular target for this sort of emulation is Unix. The two previous entries in this series, QNX and OS-9000, are both examples of operating systems that have been patterned after this time-tested operating system. Without borrowing any code, the designers of these two products managed to emulate important features from Unix, while creating real-time operating systems that were both smaller and faster than the real thing.

Unix isn't the only kid on the block when you're looking for an operating system worth emulating. Years ago, Tim Williams set out to build an operating system that could run on the microcomputers of the day: Z80-based 64K-byte systems with limited permanent storage. Unix was around then, but instead of taking that route, Williams chose a more unlikely candidate: Conversational Monitor System (CMS).

Mainframe Roots

CMS was developed by IBM when mainframe users started turning away from punched cards and toward interactive terminals. The standard IBM operating system, MVS (for Multiple Virtual Storage), was cranky and primitive. While you could run it from a terminal, a lengthy session with MVS might leave *you* feeling like a punched card.

CMS still exists and is still used by those who live in front of mainframe terminals and 3270-connected PCs. Tim Williams' impersonation of CMS, called Theos, exists, too. His company, Theos Software, has grown the product from a little-known Z80 operating system to a popular platform for vertical-market applications. It has been installed in more than 80,000 locations and is backed by over 1000 third-party software programs.

Mainframe Feel

Theos 386 release 3.1 is the latest incarnation of Theos. It is a protected-mode operating system, supporting as much memory as the 386 can address, 128 users, and several gigabytes of disk space. My configuration was more modest, relying on a CompuAdd 386 with 4 megabytes of memory. Even with its lofty memory capacity, Theos can run in 1 MB.

Theos has its own distinctive look, but it borrows some fundamental things from CMS—most notably, the structure of its file system. Ordinary filenames are built of three components: *filename*, *file type*, and *file mode*.

The file type is similar to a DOS filename extension, and there are reserved types that identify special files. The COMMAND type, for instance, is a binary executable program, while the EXEC type identifies a script to be interpreted by the EXEC program (discussed later).

The file mode identifies the logical drive on which the file is located. The main drive, S, is the default repository for all commands, configuration files, and the like. On a system with a single hard disk drive, S is usually the only logical drive on the hard disk. There is also F for floppy and M for RAM disk. With this in mind, the filename SYSTEM.EXEC:S identifies an EXEC script named SYSTEM, residing on logical drive S. The filename and type components are limited to eight characters each, the file mode to one.

The CMS file system stops there, but Theos adds a couple of important features. A special class of file, called a library, brings together a group of files under a common filename and type. Theos libraries can serve the same purpose as traditional DOS and Unix libraries (as collections of object files) but are generally useful wherever a collection of files is called for. A library file adds a fourth qualifier to the Theos filenaming scheme, the *member name*, which follows the file type—thus, BASIC.PROGRAMS.CHKBOOK.

The last Theos filename component is the directory path, and this operates in a manner similar to Unix. Directories can

continued

have any filename and type, and directory names in a path are separated by slashes. So, the *fully* qualified Theos filename reads something like this:

```
/USER.AREA/JOES.JUNK/BASIC.PROGRAMS.CHKBOOK:S
```

If you wondered why I spent so much time explaining Theos filenames, imagine trying to figure out what that filename means without the explanation.

Telling Theos What to Do

The front end of Theos is the *command string interpreter*, or CSI. This provides command entry and editing and launches applications. Unlike many command interpreters, the CSI has no built-in scripting or "batch" capability—that's handled by EXEC.

The EXEC language's basic syntax is, again, borrowed from CMS. It's a terse language that contains relatively few keywords, but its simplicity belies its versatility. EXEC includes facilities for floating-point math, string operations (e.g., concatenation, substrings, and fields), and rich variable handling. There are also subroutines, structured programming directives (i.e., FOR, WHILE, UNTIL, BREAK, and CONTINUE), and error handling. These elements make EXEC a *real* language, unlike many scripting facilities grafted on top of already-inadequate command interpreters (e.g., DOS's COMMAND.COM).

If Theos is famous for anything, it's the Theos BASIC language. Most commercial Theos applications are written in BASIC, and there's a good reason for that: This is a serious language.

CMS lacks I/O redirection (Unix-like facilities have been added to Theos), so CMS's EXEC has an unusual workaround that Theos retained: the STACK and BEGSTACK keywords. STACK (actually, &STACK, because all EXEC keywords and variables are prefixed with an ampersand) places a single line of text on a stack, which has precedence over the keyboard buffer. When an EXEC script or other Theos program requests data from the keyboard, data placed by the STACK directive is read instead. STACK, as its name suggests, is cumulative. For the really big jobs, a block of text can be surrounded by BEGSTACK and END keywords. An entire session with an application can be driven in this way.

A BASIC Understanding

If Theos is famous for anything, it's probably the incredible Theos BASIC language. Most commercial Theos applications are written in BASIC, and there's a good reason for that: This is a *serious* language.

Long before the term *incremental compiler* found its way into the PC vernacular, Theos BASIC was proving that concept's validity. Each line of BASIC code, whether part of a program or an immediate-mode statement, is compiled and then executed. That incremental compilation allows BASIC to trap syntax errors before you have a chance to type the next line.

Every aspect of Theos is supported and illuminated by BASIC. One of the more powerful features of Theos is its four types of operating-system-supported data files: sequential, direct, indexed, and keyed. The latter two types are where the real excitement lies. It's as though a database manager were built in as part of the operating system. Both BASIC and C have well-integrated access to these specialized file types.

Indexed files behave much like traditional databases. Theos places and reads records with *keys*, which it stores in an index with a fast access format. So, instead of searching a data file for Joe Smith's personnel record, you can just tell BASIC to get it for you:

```
INPUT #1, "Joe Smith": A$
```

Keyed files are accessed the same way but are not kept in alphabetical order, so you can access them somewhat faster than indexed files.

Theos is a multiuser system, and, again, this is reflected in the facilities of Theos BASIC. If you request read/write (UPDATE) access to a file, reading a record's contents locks that record; another user (or process) can't write to it until you unlock it or read another record. Also, Theos BASIC has a set of very functional routines to support multitasking. You can launch a program from Theos BASIC through the CSI, of course, but you can also start a low-level task, even specifying that task's scheduling priority and size.

Theos and BASIC also support asynchronous events via semaphores. A semaphore is a switch, either on or off, with a numeric identifier (see "Just Between Friends: Talking Tasks" on page 313). Semaphores are shared by all tasks, so one task can change a semaphore and others can see that change immediately.

Semaphores can be used to lock resources, synchronize disjoint tasks, and perform other interprocess functions. A TIMER statement in BASIC sets off an alarm at a specified time, setting a semaphore to indicate expiration of the timer. A task can be interrupted when a semaphore is set. BASIC's ON EVENT statement specifies a program location to jump to when the interrupt is posted. Each BASIC program can handle up to 64 semaphores, so the potential for interprocess coordination is enormous.

Theos also provides for the creation of full-screen programs that run identically on several kinds of terminals. Graphics commands are built in as well, for those devices that support it (like the console). With these features, developers need not be concerned with the type of display being used. Once a program runs under Theos, it will run on any system, from any terminal or console that Theos supports.

Beyond the functions of Theos, the BASIC also has a robust set of features all its own. It compares well to the Microsoft BASIC compiler under DOS. Structured programming, multiline functions, C function call interface, display control, and practically everything else you could need to write worthwhile applications is standard in Theos BASIC. I believe that this language makes Theos what it is.

The C compiler is certainly worth using, too. It is ANSI-compatible and plugs into all the same interfaces as Theos BASIC. Several function calls in Theos C's library have no

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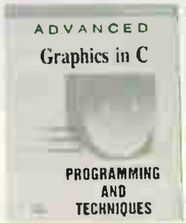

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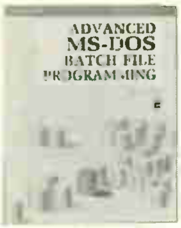

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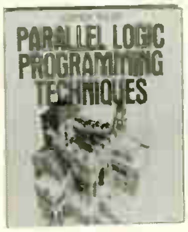

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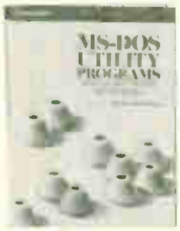

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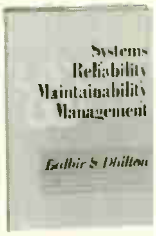

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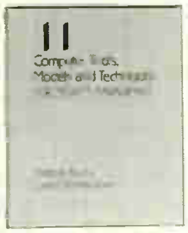
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purpose but to provide Unix programmers with an easy porting path. A table (which should be standard in every C library reference) shows Theos C's library compatibility with Unix, OS/2, and the older Theos Definitive C compiler.

Even though the Theos C library is fat and well documented, porting applications from other environments may be the best way to get C code into Theos. It lacks a source-level debugger and is short on other tools (e.g., `make`) that career programmers expect to have available. There is an assembly-level debugger, and you can use that to find null pointers and the like. Theos BASIC's debugging and error-handling features are much more robust.

As much of a C fan as I am, I'm inclined to say there's no need to use C in Theos unless you're writing a device driver or another time-critical program. The BASIC is so robust, so fast, and so well integrated with the operating system that there's practically nothing you can't do with it.

What Good Is It?

All this technical achievement amounts to naught unless it can be applied. With everybody raving about Windows 3.0, OS/2 2.0, and the new Unixes, it's easy for a smaller player like Theos to be forgotten. The fact is, however, that Theos is probably better suited for general-purpose business use than any of these others. If you run a video store, construction company, medical office, or other business that could benefit from industry-specific (vertical market) software, there's probably a mature Theos application ready to run. Since most Theos applications use the system's built-in database file types, you can generally manipulate their data files with simple BASIC programs.

If you're a consultant, value-added reseller, or systems integrator, you should look into Theos. The large number of existing applications (made larger by Theo+DOS, the multiuser DOS module for Theos reviewed in "DOS on a Pedestal," August BYTE) and the ease with which new ones are created and maintained make Theos an excellent choice for even your most demanding customers.

Customers demand value, too, and Theos lacks nothing in that regard. A five-user Theos installation (with high-speed terminals instead of DOS workstations) costs about half as much as a passable five-node Novell-based PC network. It's also cheaper (and easier) to add more users: A $400 terminal and a $30 cable are usually all you need.

What Theos lacks is compatibility. The only real standard to which it adheres is ANSI C. The rest is pure Theos, and in these days of standardization, a proprietary operating system tends to attract a critical eye. Ordinarily, my eyes are more critical than most in this respect, but Theos gets my dispensation because it's such a perfect match for business applications. ■

Tom Yager is a technical editor for BYTE. You can reach him on BIX as "tyager."

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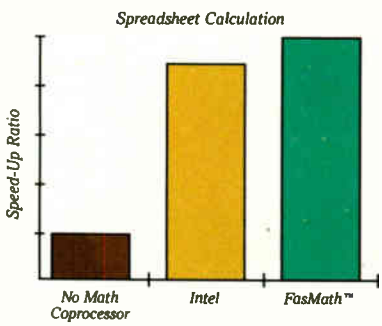

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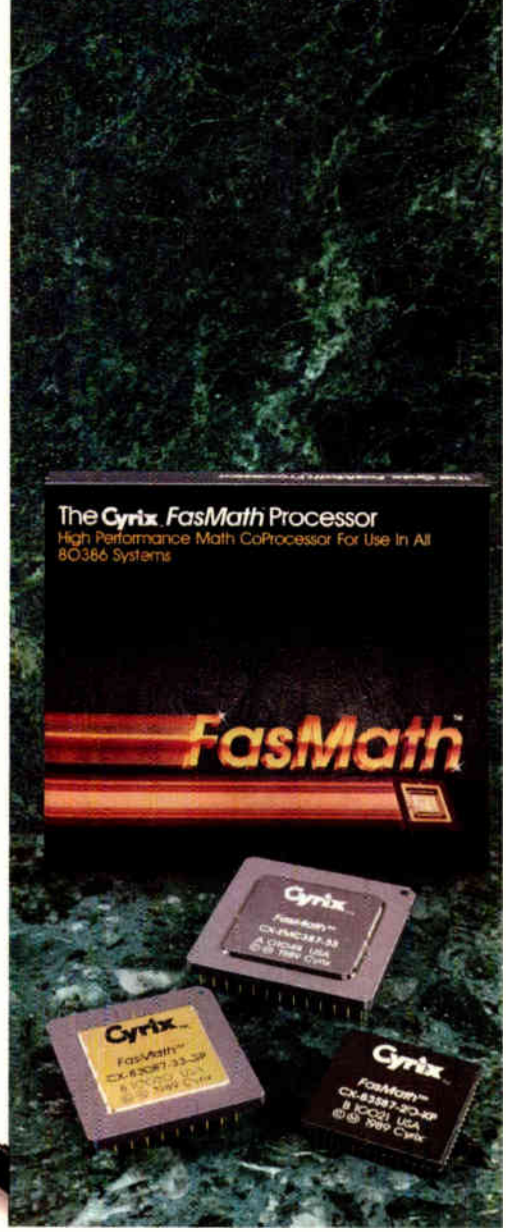

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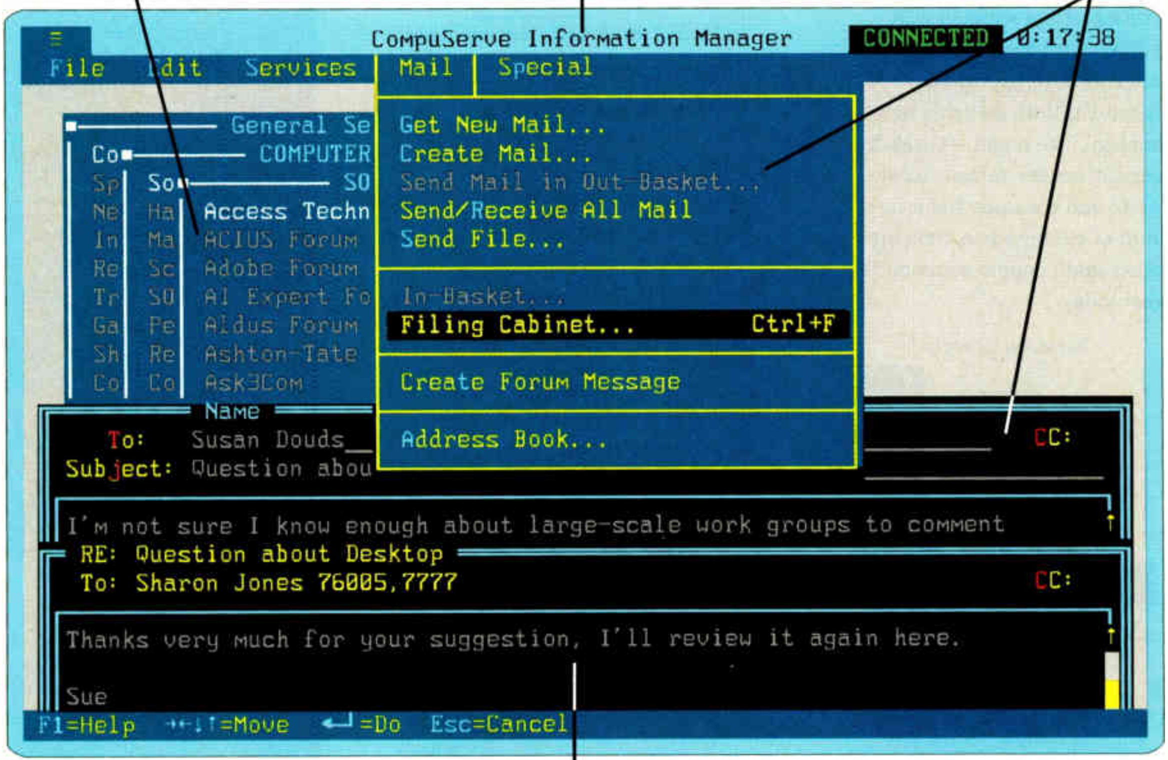

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Circle 69 on Reader Service Card

MEGAFLOPPIES

Four new technologies are in the bidding to be the next standard A drive

The Osborne I's 5¼-inch floppy disk stored 80K bytes. Seven years later, the 5¼-inch disk's capacity had grown to 1.2 megabytes—a fifteen-fold increase. In the 1990s, floppy disk capacity will grow by another order of magnitude with the introduction of the very high-density floppy disk. I'll define a VHD floppy disk as one that stores at least 5 MB of data on 3½-inch-diameter (or smaller) Mylar-based flexible media in a sleeve or hard case not larger than 100 by 100 by 5 millimeters. The form facter is compatible with existing cases for the 3½-inch floppy disk drives used on a number of popular desktop and laptop computer systems.

No one can dispute the need for VHD floppy disks. While word processing documents and spreadsheet files usually fit on existing media, color images, desktop publishing documents, and databases often don't.

Backup is also a hot topic. Programs such as FastBack can help you span multiple floppy disks, but you still have to sit there and change disks. Floppy disks with significantly higher capacity will lower the annoyance factor and make it easier to do the right thing.

Finally, as I'm sure you've noticed, software keeps getting bigger. Programs do more and require more support—tutorials, examples, large help files. The result has been a proliferation of floppy disks inside the boxes you buy at the corner computer store. Larger-capacity media will lower the cost of distributing software, because vendors won't have to duplicate and package as many disks.

In this article, I'll examine four competing technologies. Toshiba proposes a conservative 2.88-MB format that uses existing drive mechanisms and doubles bit density. NEC, Brier, and InSite are pushing for more ambitious schemes that require new optical or magnetic mechanisms but achieve an order-of-magnitude increase in storage capacity. NEC's embedded-servo technology yields 10.8 MB; Brier's Twin Tier servo approach can store 21.4 MB; and InSite's optical servo scheme can store 20.8 MB on a "floptical" disk.

Servo Positioning

Purely mechanical positioners, such as those used on current 720K-/800K-byte and 1.44-MB floppy disk drives, locate tracks by dead reckoning. Although there's no feedback to help the positioner lock onto a track, dead reckoning handles today's formats (up to 135 tracks per inch) well enough. You can usually move disks from drive to drive without fiddling with drive alignment.

The servo positioners used by NEC, Brier, and InSite *do* rely on feedback. To hit a smaller track accurately, the drive's head positioner takes navigational fixes on the terrain, using servo patterns on the disk's surface, and adjusts the heads to follow the magnetic recording track exactly. This adjustment happens while reading and writing data, not just once each time the head moves.

Tracks are never perfectly concentric on a floppy disk. At 135 tracks per inch (tpi), the deviation from a perfect concentric circle is measured in fractions of a track. As you squeeze the tracks together, the deviation exceeds the width of two or more tracks.

The deviation of a track is called *runout*, and, as you'll see, there are several ways to compensate for it. Thanks to servo positioning, track density—and thus net storage capacity—grows by an order of magnitude.

NEC, Brier, and InSite use different types of servo patterns (i.e., terrain markers) and mechanisms to keep the head on the data track. NEC puts servo data between each of 48 data sectors, so that 48 times per disk revolution the head positioner can adjust to keep the heads on the data. Brier's Twin Tier technology stacks data and servo patterns on top of each other, so that the position can be corrected much more often than with the NEC method, at the expense of electronics to separate servo and data patterns. InSite's use of optics means that the head can be fine-positioned continuously using markers that are completely separate from data.

So Many Standards to Choose From

No VHD floppy disk format will succeed unless drives can also read, and ideally write, disks recorded at 720K/800K bytes and 1.44 MB. System houses can incorporate such a drive into single-drive systems as an "all-purpose A drive." Because the track density of a VHD floppy disk is much higher than that of a 1.44-MB disk, the read/write head requires a smaller gap.

All VHD proponents plan to solve this problem by means of dual-gap heads. The first gap reads and writes 720K-/800K-byte and 1.44-MB floppy disks, while the second, smaller gap reads and writes the VHD format. To properly position the head assembly, head-positioning electronics in the drive need to know which gap in the read/write head is active. In the case of drives with servo capability, the positioner dead-reckons—just like standard floppy disk drives do—when reading and writing lower-density disks. When reading and writing high-capacity media, the servo positioner kicks in.

Toshiba and NEC have demonstrated that this scheme works successfully, and both Brier and InSite are showing potential OEM customers prototypes of drives that also read and write to lower-density disks.

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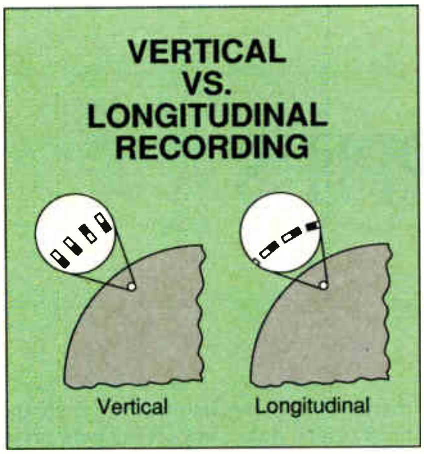


Figure 1: *Toshiba's vertical recording method stands the bits "on end," packing them more tightly together than the conventional longitudinal method.*

Toshiba's 2.88-MB Evolutionary Design

Take a 2-MB floppy disk (with a formatted capacity of 1.44 MB) and double the number of bits per track: That's the Toshiba proposal in a nutshell.

To pack twice as many bits on each track, Toshiba's drive records the data up and down (perpendicular recording) instead of end to end along the track (longitudinal, or surface, recording), as shown in figure 1. Since bits are vertically oriented, more fit into the same space.

To make it work, you need floppy disks with a barium-ferrite coating. Current media are coated with cobalt-modified iron-oxide particles. The barium-ferrite coating is smoother, and its coercivity (i.e., resistance to pole changes within a magnetic field) is more than doubled. The industry calls these disks *4-MB media*. Interestingly, they're used (with modifications) by the NEC, Brier, and InSite products.

Toshiba's proposed new standard does not increase either the number of tracks on the disk or the track density, so existing head-positioning assemblies can be used without modification. There are no major changes to the basic design of the disk drive. It needs only a new head, supporting electronics, and a modified controller to make it work. In short, this is a minimal change for higher capacity, with no fancy electrical or mechanical components required.

Users can format and reformat media in the same drive used for reading and writing data; raw media as supplied by floppy disk vendors don't have to be preprocessed. Why mention such obvious facts? Because, as you'll see, these basic assumptions don't hold for the higher-capacity VHDs.

The Toshiba drive transfers data about twice as fast as a conventional floppy disk drive (see the table). That performance boost comes entirely from the higher bit density; the drive spins the disk at 300 revolutions per minute (rpm), regardless of the mode selected.

Toshiba showed the drive at the 1989 Spring Comdex. Other companies licensed to manufacture drives are Teac, Chinon, Sony, and YE Data. Analysts have been waiting for IBM to bless or curse the new 2.88-MB format; as yet, that hasn't happened. According to Edward Kay of Practical Computer Technologies in Fairfax, Virginia, other system houses plan to use 2.88-MB drives in their systems.

Currently, the OEM price for these drives and controllers, in quantities of 5000, is around $220. The OEM price for disks will be about $4.

NEC's 12-MB VHD Drive

NEC has been working on its VHD floppy disk drive for a long time. Like the proposed 2.88-MB standard, NEC's 12-MB drive uses the same barium-ferrite 3½-inch media that Toshiba specified for its 2.88-MB drives. To quadruple capacity, NEC triples track density to 431 tpi; it also boosts recording density by a few percent.

NEC puts its servo patterns *between* the data sectors (see figure 2). This, in NEC's view, provides the best compromise between simplicity and performance. As the head spins over the track, the electronics check for accurate tracking 48 times per disk revolution and make corrections as required to keep the head over the data. The servo information is recorded on both sides of the floppy disk.

For this scheme to work, the sector information has to be recorded precisely; if the user's drive had to be that precise, the cost would rise to an unacceptable level. So NEC decided that the sector information should be recorded at the factory using dedicated floppy disk drives with very precise drive motors and head positioners. The user's drive reads the prerecorded servo information when positioning the heads.

Note that disk duplicators for NEC disks could use these precise drives to write servo and user data at the same time. The added cost of the special drive in the duplicator would be offset by the lower cost of the raw, unrecorded media.

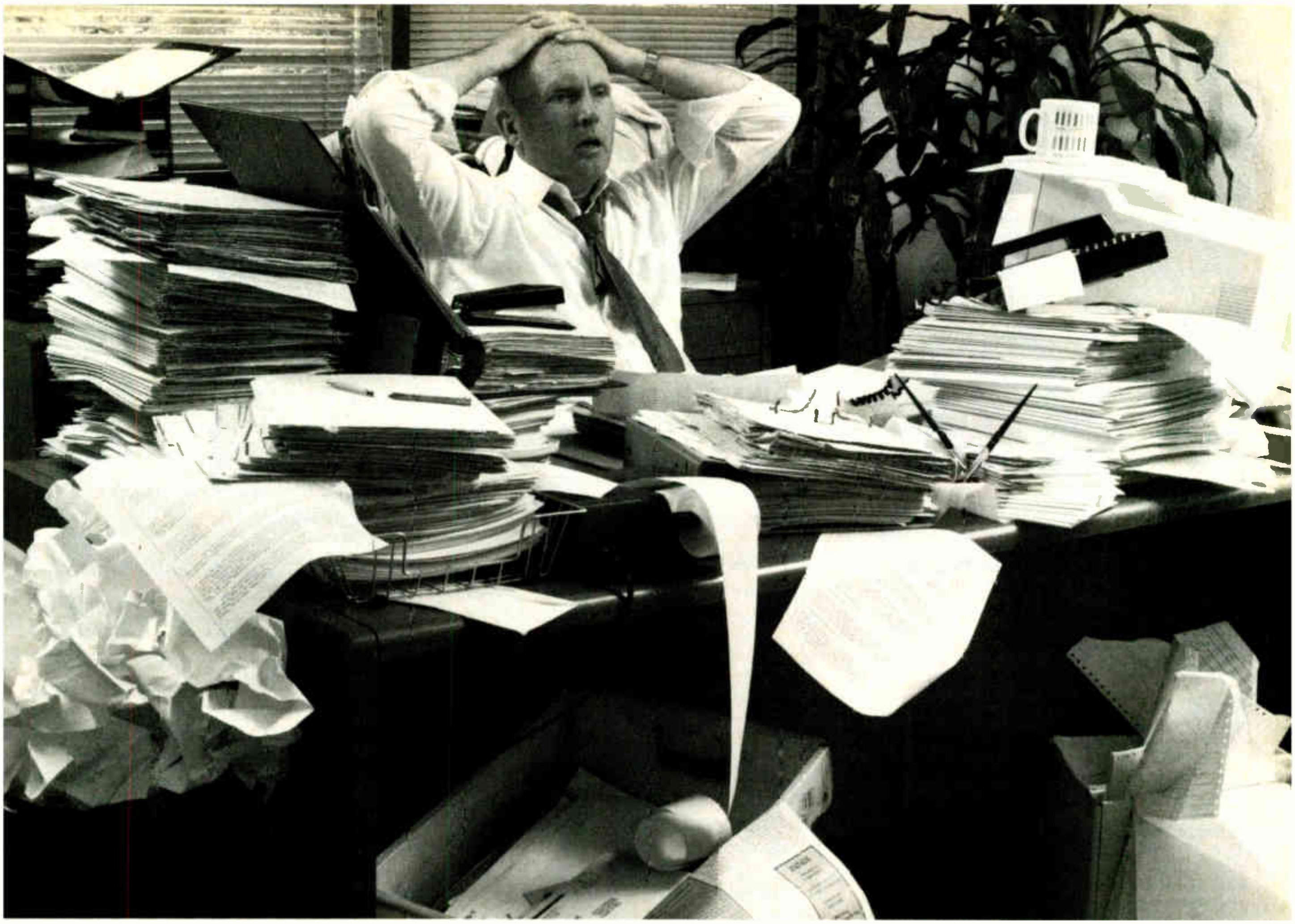
The NEC system records servo information on both surfaces of the disk independently. Data is recorded on each surface using the servo on that surface, instead of using one side's servo to control head positioning when reading or writing to the other side. As a result, the heads don't have to be exactly aligned with each other. But a head switch isn't instantaneous—it takes about 50 milliseconds for the servo system to find and lock onto the proper track. According to

continued

BY THE NUMBERS

Comparison of key specifications for the Toshiba, NEC, Brier, and InSite drives.

	720/800 K bytes	1.44 MB	Toshiba 2.88 MB	NEC 12 MB	Brier 21.4 MB	InSite 20 MB
Cylinders	80	80	80	205	463	759
Heads	2	2	2	2	2	2
Sectors per track	9	18	36	39	40-48	27
Formatted capacity (MB)	0.72	1.44	2.88	10.18	21.4	20.8
Unformatted capacity (MB)	1	2	4	13	25	25
Rotation speed (rpm)	300	300	300	360	720	720
Recording density (bits/inch)	8717	17,432	34,868	36,595	26,000	23,980
Track density (tracks/inch)	135	135	135	431	777	1250
Transfer rate unformatted (Mbps)	0.25	0.5	1	1.25	2.2	1.6
Transfer rate formatted (K bytes/sec.)	22.5	45	90	117	240-288	162
Run-out (tracks)	0.3	0.3	0.3	2	10	8



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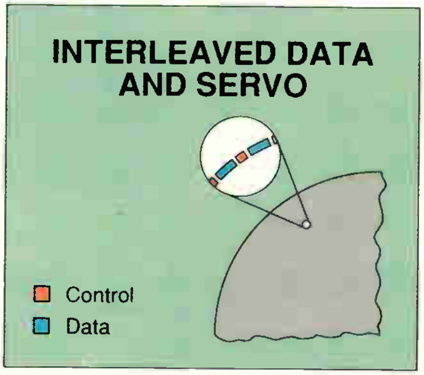

Figure 2: *NEC puts servo data between each of 48 data sectors, so the head positioner can adjust 48 times with each revolution of the disk to keep the heads on the data.*

NEC, this servo system can follow run-out of up to two tracks.

If the servo information is damaged or erased, the disk becomes useless. You can either throw it away or send it back to the factory to have the servo information rerecorded.

To improve throughput, the NEC system spins the disk at 360 rpm when accessing high-density media. The drive reads and writes 25 percent faster than the 2.88-MB drives. For large data blocks, though, the head-switching time and track-to-track seek and settle time can reduce performance significantly.

The NEC drive's head-settle time is about three times longer than that of either the Brier or the InSite drive. In one disk rotation, the NEC drive sees the head position 48 times. In contrast, the full-track servo patterns in the Brier and InSite drives give the head-positioning electronics much faster feedback.

Pricing has not been set for this drive. When the Micro Manager's Association performed its initial evaluation of NEC's VHD floppy disk drives, it determined that the OEM price would be about $250 per drive and controller, and $10 per floppy disk.

Brier's 21.4-MB Twin Tier System

The Brier VHD floppy disk uses an interesting servo system. As with the NEC and InSite formats, Brier's servo patterns have to be prerecorded at the factory. In this scheme, servo patterns are written on the disk using very high write currents. A user's drive stores the data (using more reasonable write currents) on top of the prerecorded servo information.

The theoretical limit for such a system, according to Brier, is about 100

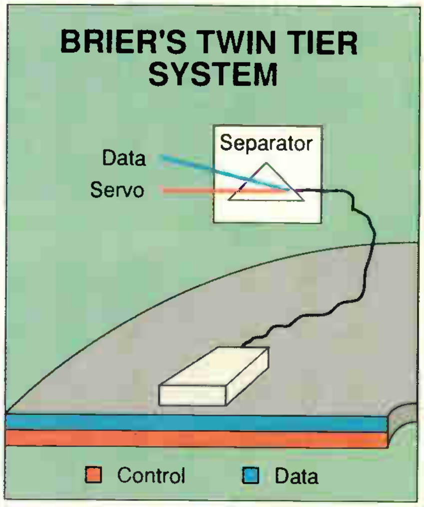

Figure 3: *Data and servo information are recorded at different frequencies. The controller incorporates an electromagnetic "prism" that uses the differing frequencies to separate data information from servo information.*

MB, with a track density in excess of 6000 tpi. By using one out of eight tracks, the Brier drive defines 555 tracks for each surface, for a total capacity of over 21 MB. Like the NEC drive, the Brier drive writes independent servo information on each surface of the disk.

Magnetic fields obey the inverse-square law. Particles deeper in a magnetic coating—that is, farther away from the read/write head—need a much larger field strength to change their magnetic orientation. Brier uses a huge amount of write current to record the servo information onto the surface—so much that, says a Brier spokesperson, "We reach all the way through the coating to the Mylar backing" of the floppy disk. By the way, the servo information for one surface is written at an offset to the servo information for the other to prevent interference.

Since the user's drive can't position the heads accurately enough to record the servo information, a precision dedicated drive at the factory writes the information. The servo information is recorded using very high write currents, and at a different frequency from the data. A duplicator that could do that would require a precision drive with both high-write-current electronics and normal-write-current electronics with the ability to follow the servo. I don't think you'll see duplicators with that capability. It'll be easier to use preformatted media and a standard user's drive in the duplicator.

Extracting the data recorded on top of

continued

the servo from the servo itself isn't all that difficult, since they're recorded at different frequencies. An electromagnetic "prism" separates the two (see figure 3). The controller that accomplishes this is built into every drive. Instead of the standard floppy disk interface, the Brier drive uses SCSI. This also makes the drive attractive to Macintosh users and to users of other SCSI-capable systems.

Another way Brier squeezes more data onto the drive is to use a varying number of sectors per track. The outer 310 cylinders (pairs of tracks) hold 48 512-byte sectors each, while the inner 153 cylinders hold 40 sectors each. (This is the same idea that Apple used on the Macintosh floppy disk drives to pack 400K bytes per side on a 3½-inch floppy disk instead of 310K bytes.) The SCSI controller takes care of this detail, so the system and applications only have to worry about specifying which sector is to be written to or read.

The Brier drive is clearly the winner in moving raw data, topping all the other technologies in speed of transferring data to and from the disk. Random access is as good as with mid-priced 20-MB hard disks. The transfer rate is 77 percent faster than the InSite drive's, and more than 100 percent faster than those of the rest of the field.

The Brier drive spins the disk at 720 rpm instead of the 300-rpm rate used in standard 3½-inch floppy disk drives today. This produces a data transfer rate of between 240K bytes per second and 288K bytes per second, or roughly three times faster than the Toshiba 2.88-MB transfer rate of 90K bytes per second.

Most magnetic servo systems require either a dedicated surface or dedicated areas (such as between sectors) to store servo information. Brier has found a way to limit the loss of usable recording space with its Twin Tier system. Bravo.

The drive is priced at around $325 in quantities of 5000. That number includes the expected price increase for downward compatibility. The OEM price for disks will be about $12.

InSite's 20-MB Floptical Drive

What is a "floptical" drive? No, it isn't an optical floppy disk drive. It's a device that mates optically sensed servo information with magnetic recording to increase track density, without sacrificing reliability or requiring any unusual recording modes as Brier's Twin Tier system does.

InSite takes a standard 4-MB barium floppy disk, removes the "cookie" from

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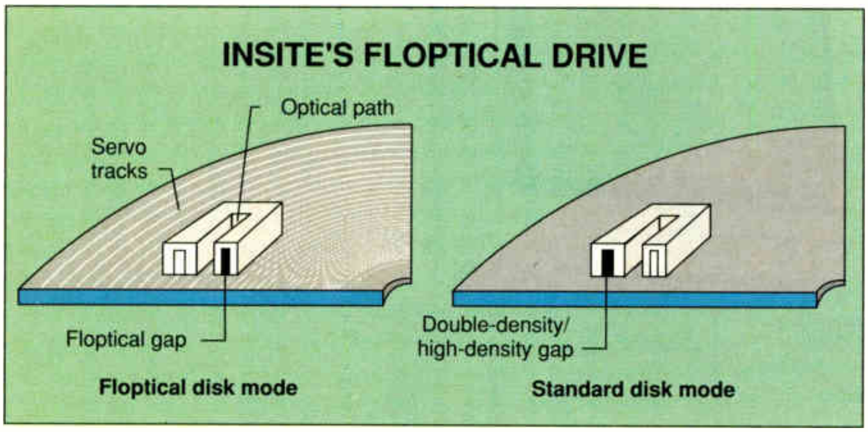

Figure 4: *An optical tracking assembly uses grooves etched in the surface of the disk to maintain head position relative to magnetic tracks. Notice how the dual head accommodates both very high-density (floptical) and double-density/high-density conventional disks.*

COMPANY INFORMATION

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its case, and etches the surface of the floppy disk with servo information using a laser (see figure 4). (To save money, InSite has perfected a way of stamping the servo information onto the disk surface, similar to the way compact disks are pressed.) Put the cookie back in the case, and voilà! You have a floptical disk ready to go.

The magnetic read/write heads are coupled with an optical sensing assembly. When the drive gets the heads in the right neighborhood, the optical sensors track the media and fine-tune head position. The magnetic heads go along for the ride, and the magnetic-head electronics only have to worry about reading and writing data. This separation of tracking and recording means that the drive can handle run-out for up to eight tracks—an amount of run-out that would give 1.44-MB floppy disk systems a fit.

Of the three VHD drives, only the InSite uses a single servo pattern, etched on the top surface of the floppy disk, to control the position of both heads. The design of the drive is such that the relationship between the optical tracking system and the recording gap in the head is well controlled.

When the drive switches to the bottom head, though, it performs a little magic. When the floppy disk is first inserted into the drive, the drive hunts for special calibration tracks recorded on the bottom surface. When it finds these tracks, it sets a benchmark using the optical servo information. From that point on, whenever the drive wants data stored on the bottom head, it uses this benchmark to figure out the offset of the lower head's data from the upper head's data, and it uses this offset when positioning.

The alignment of the bottom head to the top head is critical. Even so, InSite claims that the drive requires *no* preventative maintenance during its lifetime.

The performance specifications published by InSite look like low-end hard disk specifications: 65-ms average seek time, 1-ms track-to-track seek time, 15-ms head-settle time, and 41-ms latency. It's not blindingly fast, but it's not bad for an inexpensive mass storage device with random data access. The long latency is because the disk spins at 720 rpm.

InSite uses an error-correction code capable of correcting single error bursts of up to 80 bits and multiple bursts totaling 70 bits or less. In addition, the ECC uses a cyclic redundancy check (CRC) to be sure that any data correction does indeed correct the error. This prevents the drive from incorrectly "correcting" a sector and garbling data.

Neither Toshiba nor NEC offers error detection or error correction. And, while Brier uses an ECC that can correct a single burst error of up to 23 bits (with no confirming CRC), InSite's much longer ECC, coupled with a CRC, stands out as superior.

If that isn't enough, the disk drive can automatically detect a bad sector and assign a different good sector on the fly. This means that, as the floppy disk ages, the apparent data-storage capacity does not decrease, and the user (and floppy disk controller) doesn't have to do anything. (However, in some applications, the performance penalty is not acceptable. I understand that a way to disable this feature is in the works, if it isn't available already.)

As with the Brier drive's controller, InSite's controller doesn't have to contend with drive-head positioning and servoing, ECC, or sector sparing. The InSite drive uses SCSI, with the basic controller built into every drive. This also means that, when higher-capacity drives become available, the BIOS, operating system, and applications need not change at all.

Separating the servo pattern and data by using completely different techniques (i.e., optical for the first and magnetic for the second) gives the drive the best chance of holding to track and recovering data, even on slightly damaged disks. This offsets the increased complexity of the drive.

It remains to be seen how well the system holds up under the rough conditions endured by laptop systems. Remember, though, that Compaq proved the experts wrong by showing that a hard disk can survive in the rough-and-tumble world of portable and laptop computers.

The InSite drive is considerably more expensive than the other drives. Projected OEM price in quantities of 5000 is $350 for drives that are downward-compatible with older 3½-inch floppy media, and $10 for floppy disks.

Downward Compatibility with the 2.88-MB Format

Assume for a moment that the Toshiba format is accepted and soon becomes

continued

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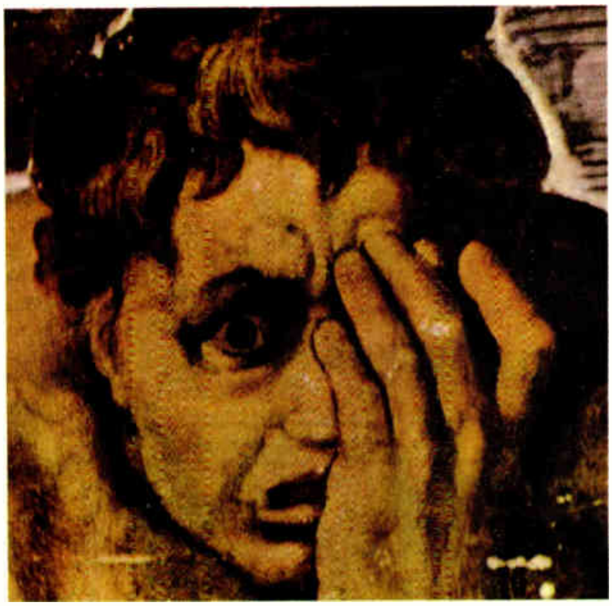

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Circle 273 on Reader Service Card

widespread in the industry, and that NEC, Brier, and InSite are unable to stall its acceptance. What would that mean to NEC, Brier, and InSite? Users might scream for downward compatibility with yet another standard 3½-inch floppy disk format before they will look at the VHD drives for anything other than special purposes.

At first blush, this looks like an impossible task, since, in theory, the head design would be different for the three VHD proposals vis-à-vis the 2.88-MB standard. This is probably true for writing to 2.88-MB formats, but it appears that the narrow gap that is used for the VHD format could be used to read the 2.88-MB format.

NEC, Brier, and InSite will examine both the technological and market issues. If 2.88 MB is met with a yawn, they won't bother. If 2.88 MB takes off like 360K bytes did, then that is a different problem. Current betting is that 720K-byte and 1.44-MB compatibility will be important, and 2.88 MB won't be.

Floppy Futures

Let's start with reality. The Toshiba 2.88-MB drive is too far along in development, standardization, and production to be stopped completely—it's a done deal. Vendors are selling retrofit kits that upgrade existing XT and AT compatibles to the new format. The most important claim made by vendors of the 2.88-MB drives is that the upgrade is virtually painless.

Of the low-end systems that those upgrade-kit vendors target, a majority of them have hard disks varying in size from 10 MB to 40 MB. This means that you need from five to 15 2.88-MB floppy disks to completely back up the hard disk drive, and you still have to sit there changing those floppy disks. That's better than the 90-plus 360K-byte floppy disks needed to back up that same 40-MB drive, but it's still less than ideal.

The NEC drive is a more interesting technology for that low-end system upgrade market, though. For about the same price, you get three times the storage space per floppy disk, and my tests indicate that you get exactly the same total throughput. The 10-MB cap limits the NEC drive's application in larger systems.

Speaking of large systems, now that SCSI II has taken care of some of the performance problems, more and more high-performance systems will incorporate SCSI controllers to interface with high-capacity hard disk drives, image scanners, and CD-ROM players. Replacing the old floppy disk drive with a Brier or InSite drive means you can eliminate the floppy disk drive controller completely from the system.

But which drive? My choice would be InSite's. The Brier drive is clearly the performance winner, with seek times equivalent to those specified for medium-performance hard disks, but what tips my scales toward the InSite drive is the extensive in-drive attention to data integrity. The combination of lower media bit density, 80-bit ECC, and the CRC double-check tells me that when the drive says it is giving me good data, I can believe it.

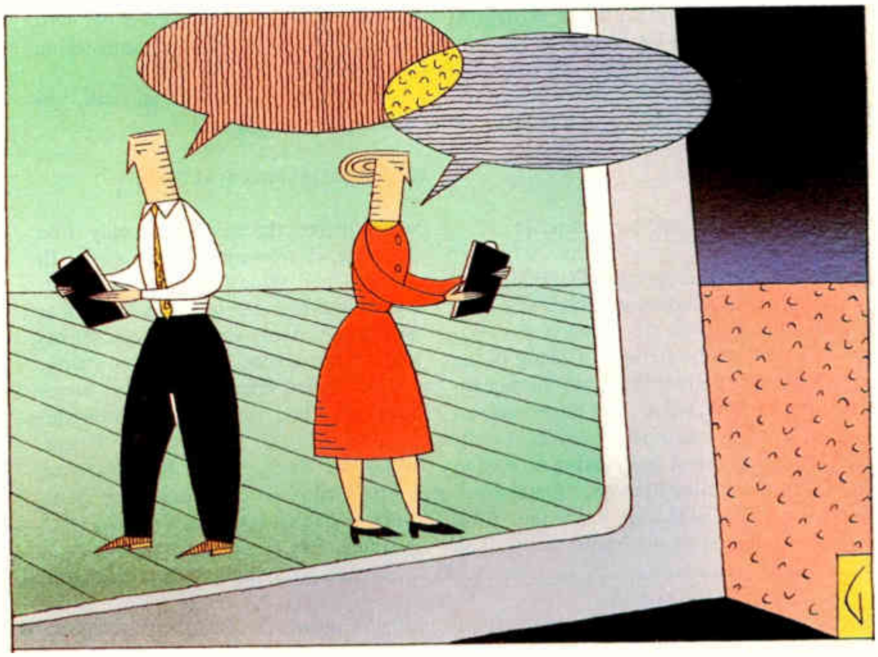
If you can't trust your data, then why bother? ■

Stephen Satchell is president of Satchell Evaluations, an Incline, Nevada, consulting firm that specializes in product testing. He can be reached on BIX as "ssatchell."

← *Circle 201 on Reader Service Card*

JUST BETWEEN FRIENDS: TALKING TASKS

Taking a look at the interprocess communications of Windows and Desqview



I have heard many people describe themselves as being "single-task-oriented." I have taken this to mean: "I am currently so confused that you'd better not ask me to do anything else." Happily, computers are different, and they will gladly accept multiple simultaneous jobs without complaint. They may begin to operate at an unbearably slow pace, thrash, or—if not properly managed by the software—trip over their own digital feet, but not a whimper will you hear.

Certainly, the microcomputer world believes that multitasking is a good thing. Unix has been around for some time, OS/2 and Windows continue to pick up steam, and I've lost track of the alternative multitasking operating systems that have sprung up. A multitasking operating system, however, creates a unique situation: You don't want all these multiple tasks to operate in *total* isolation. How can they reasonably talk to one another?

This is a topic I touched on in an earlier column (see "Multitasking for the Masses," February BYTE). It is, however, significant enough—and will become more so as multitasking operating systems proliferate—that I decided a closer look was warranted. In this first part of the series, I'll examine the methods employed by Microsoft Windows and Desqview for interprocess communications (IPC).

Windows and Tasks

When you talk about IPC in Microsoft Windows, it makes sense to divide the subject into two topics: task-driven IPC and user-driven IPC. Task-driven IPC, which I'll cover first, refers to Windows' Dynamic Data Exchange (DDE).

Windows' very lifeblood is pumped to the beat of messages (see "In Any Event," May BYTE), so it makes perfect sense that Microsoft should choose the messaging system already present on which to construct an IPC system. DDE uses a server/client scenario to guide its transactions: The server window typically acts as a source of information in response to client requests (where a client is another window).

There's additional abstraction within DDE that aids in the coordination of client requests and server responses. The client initiates communications through DDE by sending a WM_DDE_INITIATE message either to a specific server or to all currently active windows. The parameters of the message specify an application name and a topic name within that application.

These names are simply strings that act as descriptors for abstract objects, so don't confuse the term "application name" with "application program." The application and topic names define the client program's areas of interest. When the WM_DDE_INITIATE message is received, the server examines the application and topic, determines whether or not it is possible to fulfill the client's request, and responds accordingly.

For example, suppose you're lucky enough to enjoy two printers attached to your system: a high-cost, high-quality laser printer and a dot-matrix printer you use for draft output. Say that you have constructed two server programs, one to manage each printer. The server task handling the laser printer would respond to initiate messages that have application name set to Printer and topic name set to HighQuality, while the task handling the dot-matrix printer would respond to

continued

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The Mighty Atom

The scene: a Windows Dynamic Data Exchange message. Speed is critical; you want to get the message from client task to server task as quickly as possible. The client task has to identify the kind of service needed, but you don't want your program to drown in a sea of ID numbers (e.g., 1 means database, 2 means printer, and 3 means remote LAN). Enter the global atom.

A global atom number is digital shorthand, a 16-bit handle to an arbitrarily long string. Windows keeps the strings in a region of memory that can be accessed by all tasks. For example, the following code

```
aATOM=
 GlobalAddAtom("Database");
```

would add the string "Database" to Windows' global atom table. The handle—or atom—to the string is returned in aATOM. If the string is already in the global atom table, Windows simply returns the atom value. Any other task can retrieve this atom using a similar call. Now, if my client task sends a request to a server handling the topic "Database," the message need only carry the 16-bit atom rather than the entire string. The server can retrieve the string associated with the atom number using the following call:

```
len=
 GlobalGetAtomName(aATOM,
 sbuff,sblen);
```

where sbuff is a pointer to a buffer of sblen bytes where the atom's string (if found) will be placed. The caller will receive a 0 in len if the atom string wasn't found.

When you're done with an atom, you make the following call:

```
GlobalDeleteAtom(aATOM);
```

which deletes the atom string only if no one else is referencing that atom. In other words, Windows attaches a reference count to every string in the global atom table. Every time someone makes a GlobalAddAtom() call for that string, the associated reference count is incremented. When you make a GlobalDeleteAtom() call for the same string, Windows decrements the reference count. Once a string's reference count drops to 0, that string is removed from the table.

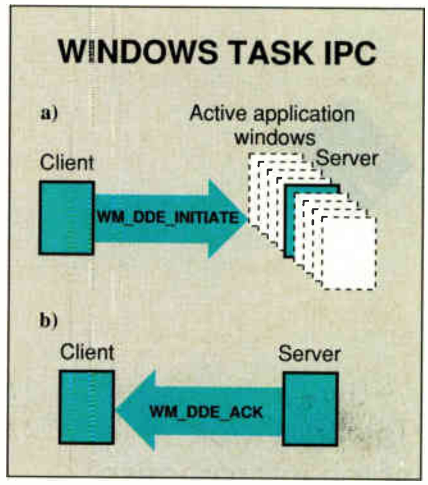

Figure 1: (a) *The client broadcasts its request to all active windows.* **(b)** *The server responds directly to the client.*

messages directed to application Printer and topic Draft.

You'll notice that the applications and topics are meaningful strings (which is another way of saying "They are there for the benefit of us humans"). These strings are not passed in toto in the message from client to server; rather, the *global atom number*—a 16-bit handle to the string—is passed. (For a description of atoms, see the text box "The Mighty Atom" above.)

So, given that aPrint is the atom corresponding to Printer and aDraft is the atom corresponding to Draft, a client task can request service from the draft printer server using the following call:

```
SendMessage((HWND)-1,
  WM_DDE_INITIATE,
 hClientWind,MAKELONG
  (aPrint,aDraft));
```

where hClientWind is a handle to the client window task (see figure 1). The -1 in the argument position usually occupied by the handle for the destination window tells Windows to send the message to all active windows.

The draft printer server window acknowledges the initiate message using the following call:

```
SendMessage(hClientWind,
  WM_DDE_ACK,
 hServerWind,MAKELONG
  (aPRINT,aDRAFT));
```

where hServerWind is the handle to the server window. You'll notice that both client and server use SendMessage() calls. Usually, a window uses a PostMessage() call when sending a message to another window. PostMessage(), however, places the message at the end of the destination window's message queue, and you don't want either end of a DDE initiation waiting around for queues to empty. SendMessage() has the effect of placing the message at the front of the destination queue, so the receiving window gets it immediately.

At this point, the client typically establishes a more permanent connection with the server by sending another message, WM_DDE_ADVISE. In effect, this tells the server that the client is to be kept abreast of the value of a particular data item. The WM_DDE_ADVISE message takes two arguments. The first one is yet another atom, which defines the data item in question. The second argument is a pointer to a memory structure that carries options and format information. The data item might define a cell in a spreadsheet, the message buffer in a network chat session, or a record in a data file.

In the example that I've chosen (i.e., a printer queue), however, it's not the case that the client needs data from the server—the tables are turned. The client task wants to send data to the server. You use the WM_DDE_POKE message for this. As an example, see listing 1, where I have created an atom carrying the string "File." The server will read this atom and recognize that I've sent the name of a file whose contents I want printed. The filename is carried in a global memory block, whose handle I've passed in as part of the last parameter of the PostMessage() call.

Notice that the global memory block also holds a two-word header. The first word includes the fRelease flag, which, if set, tells the server to release the global data item when the job's done. The second word, cfFormat, identifies the format of the data—in this case, text data with each field terminated by a carriage return/linefeed combination.

The WM_DDE_ADVISE message I described above establishes a permanent communications exchange between server and client about a specific data item.

continued

Such an exchange is referred to as a *data link*. When a client no longer has use for a particular data link, it can request termination of the data link by sending the server a WM_DDE_UNADVISE message. The message carries, as an argument, an atom that identifies the data item that the client no longer needs.

Of course, a server may be supplying information to the client on more than one data item. Therefore, to completely shut down a conversation between server and client, either side can issue a WM_DDE_TERMINATE message. Applications must anticipate receiving a WM_DDE_TERMINATE message at any time in the likelihood that the program at either end of a conversation may encounter some abnormal error condition and attempt orderly shutdown.

Listing 1: *The client task sends the filename File to the server using* WM_DDE_POKE. *The filename is carried in a global memory block, whose handle is the last parameter of the* PostMessage() *call.*

```
aITEM=GlobalAddItem("File");
hfname=GlobalAlloc(GMEMDDESHARE |
  GMEM_MOVEABLE,(long)sizeof(DDEPOKE)+lstrlen(filename)+2);
lpfname=(DDEPOKE FAR *)GlobalLock(hfname);
lpfname->fRelease=TRUE;
lpfname->CF_TEXT;
lstrcpy((LPSTR)lpfname->value,(LPSTR)filename);
lstrcat((LPSTR)lpfname,(LPSTR)"\r\n");
GlobalUnlock(hfname);
if(!PostMessage(hServer,WM_DDE_POKE,hmywind,
  MAKELONG(hfname,aITEM)))
{     GlobalDeleteAtom(aITEM);
}
```

Listing 2: *Putting data into the Clipboard:* hmywindow *is the handle to the window storing data into the Clipboard, and* hmydata *is the handle to the global memory object holding the data.*

```
if(OpenClipboard(hmywindow))
{
       EmptyClipboard();
       SetClipboardData(CF_TEXT,hmydata);
       CloseClipboard();
}
```

Windows and Users

A more explicit form of IPC—data exchanged as a direct consequence of a user action—takes place through the Windows Clipboard. From the human's vantage, you select a (usually) rectangular region within the window of one task, issue a Copy command from the Edit menu, move to a different window in some other task, and paste the data in.

From Windows' perspective, the selected block is moved into a globally accessible region called the Clipboard. You can think of the Clipboard as a collection of slots, each slot differentiated from the others by the type of data it carries. At last count, Windows predefines 13 data types. Fortunately, if that's not enough, you can define your own.

Each slot in the Clipboard holds three fields. The first is the data type, the second is a handle to a global memory block holding the actual data, and the third is the handle of the window that placed the data into the Clipboard.

An application puts data into the Clipboard by first allocating a global memory object (using GlobalAlloc(), as in the DDE examples above) and copying the data into the object. Next, the application opens the Clipboard, flushes any old data out, and puts the new data in. This entire process would, of course, be triggered by your making selections with a mouse.

An example of the source code to handle it is in listing 2, where hmywindow is the handle to the window storing data into the Clipboard, and hmydata is the handle to the global memory object holding the data. (Actually, I should be more precise; earlier I talked as if applications operated on the Clipboard. That's not strictly true: A single window has access to the Clipboard at any given moment. And a given application might corral several windows.) The CF_TEXT parameter, which you met before in the DDE discussion, identifies the data as being of type text.

It's important to note that the program never copies actual data into the Clipboard; it merely places a handle in the proper slot. You'll see why this is significant in a moment.

The target window (again, selected by the user) can retrieve the data that was just stored in the Clipboard with the code in listing 3, where, for readability, I've left out a *lot* of error checking. The GlobalLock() function serves two purposes here. The first is to temporarily lock the global memory object in place while data is being moved into or out of it; the other is to resolve a 16-bit handle into a full 32-bit address.

Notice that the recipient task does not commandeer the Clipboard data by "snatching" the global memory block handle out of the slot. Instead, the recipient builds another global memory block, copies the data in, and closes the Clipboard. On the surface, this appears to be a memory-consuming extra step. But when you realize that other tasks "down the road" may be recipients of the same data, it makes sense that each should own a private copy.

This leads to the question of how the Clipboard is cleared in preparation for new data. When a window opens the Clipboard with an OpenClipboard() call, that window passes in its window handle. A subsequent SetClipboardData() call tells the system that the window that has the Clipboard open is the Clipboard owner. The Clipboard owner becomes the guardian of the original copy of the Clipboard's data.

Listing 3: *The target window can retrieve the data stored in the Clipboard. It should lock the Clipboard while it is copying the data out. The* GlobalLock() *function also resolves a 16-bit handle into a full 32-bit address.*

```
hhisdata=GetClipboardData(CF_TEXT);
hmycopy=GlobalAlloc(GMEM_MOVEABLE |
  GlobalSize(hhisdata));
lhisdata=GlobalLock(hhisdata);
lmycopy=GlobalLock(hmycopy);
lstrcpy(lmycopy,lhisdata);
GlobalUnlock(hhisdata);
CloseClipboard();
GlobalUnlock(hmycopy);
```

Later, another window that wants to become the new Clipboard owner will issue the EmptyClipboard() call. EmptyClipboard() causes Windows to send to the old Clipboard owner a message that says: You can now release the data object you allocated for the Clipboard—a new owner is taking over. Thus, any

continued

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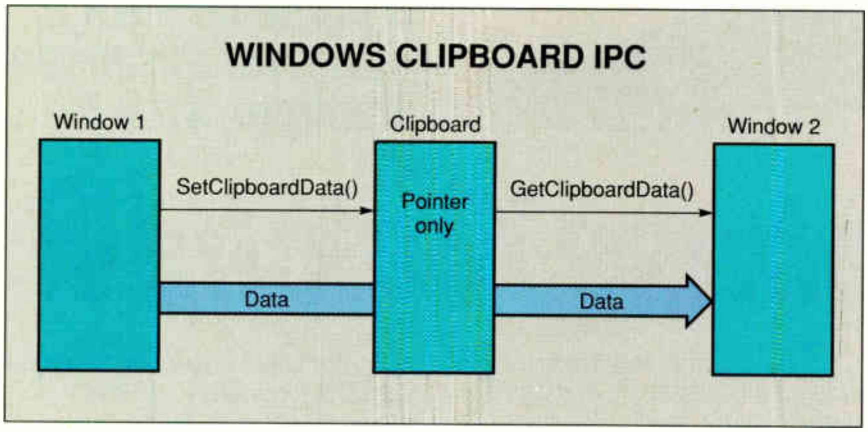

Figure 2: *Window 1 places a pointer to the data in the Clipboard, where Window 2 can pick it up and actually bring across the data in one move.*

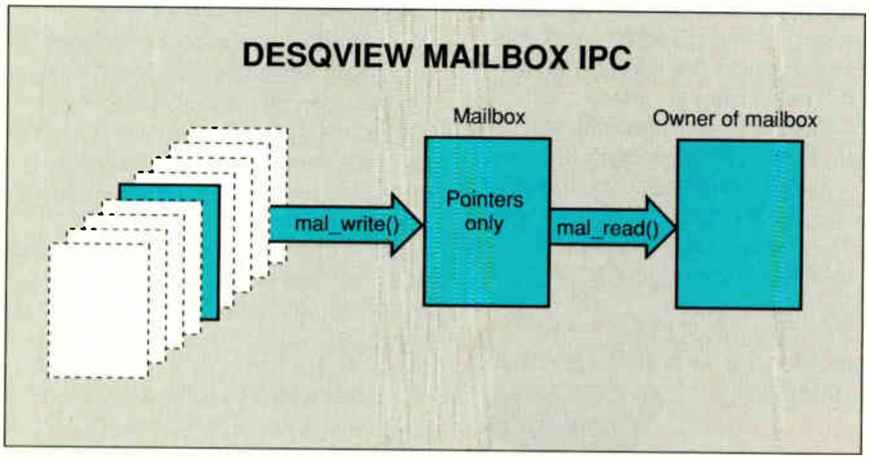

Figure 3: *Once a mailbox is created by a program, it can be used to store pointers to data for reading and writing. All programs can write to the mailbox, but only the owner can read it.*

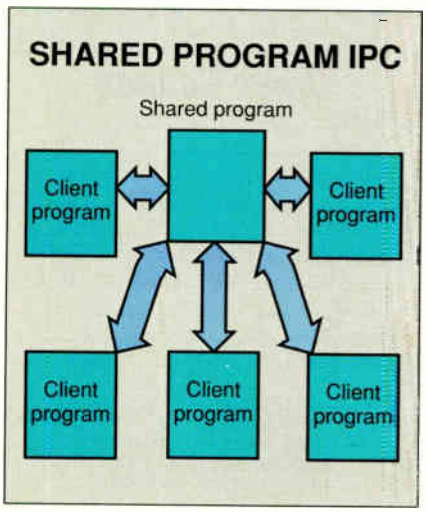

Figure 4: *A program running as a shared program can act as a server to other programs.*

window that puts data into the Clipboard is ultimately responsible for cleaning that data out.

The duties of the Clipboard owner go beyond merely cleaning things up for the next owner. For example, it's likely that the Clipboard owner is unaware of all the formats recipients may need; the owner may be a spreadsheet that keeps the data in a numeric format, while one recipient might be a word processor that can only accept the data in text.

Such a situation calls for on-the-fly data conversion that is done through *rendering data on request*, a term from the Windows documentation. The Clipboard owner advertises all the data formats it is capable of supplying by making multiple calls to `SetClipboardData()`—one for each format—with a null argument in place of the handle to the data item. Then, when a recipient requests the data with a call to `GetClipboardData()` (see figure 2), Windows sees that the associated handle to the global memory block is empty. This causes Windows to send a `WM_RENDERFORMAT` message to the Clipboard owner. The owner converts the data to the desired format and loads it into the Clipboard for the waiting recipient.

Desqview: What's in the Mail?

The Desqview *mailbox* is a structure for IPC that rolls several features into one package. On the surface, it looks like a named message queue, a communications structure that lets one task send discrete packets of data to another. Further investigation reveals that Desqview has bolted additional features onto mailboxes that let your program use them as semaphores.

I'll take it from the top.

To create a mailbox, you send a `NEW` message to Desqview with an argument indicating that you want to create a mailbox object. The Desqview application programming interface function call looks like the following:

```
mhandle=mal_new();
```

which returns a long integer in `mhandle`, the handle to the mailbox. Actually, it's often the case that you'll never resort to creating a new mailbox. Whenever you create a new task, Desqview automatically builds a mailbox for that task. A task can retrieve its Desqview-built mailbox's handle with a call to `mal_me()`.

Now that you've got the mailbox's handle, you can open the mailbox with a `mal_open(mhandle)` call and receive messages from other tasks through the mailbox. The `mal_open()` call establishes your task as the mailbox owner and, therefore, the only task allowed to read from the mailbox. Other tasks may only write to the mailbox (see figure 3).

In order to begin sending messages to a mailbox, other tasks must determine that mailbox's handle. How is this accomplished? The mailbox's owner must assign a name to the mailbox using the `mal_name()` function. (This is why I said the mailbox looks like a named message queue.) Thereafter, other tasks in the system can locate the mailbox with the `mal_find()` function, which returns the mailbox's handle (or a zero if the named mailbox doesn't exist).

Messages sent to a mailbox consist of three components: a pointer to an arbitrarily long string of bytes (the message itself), an integer indicating the length of the byte string, and a status word. The

continued

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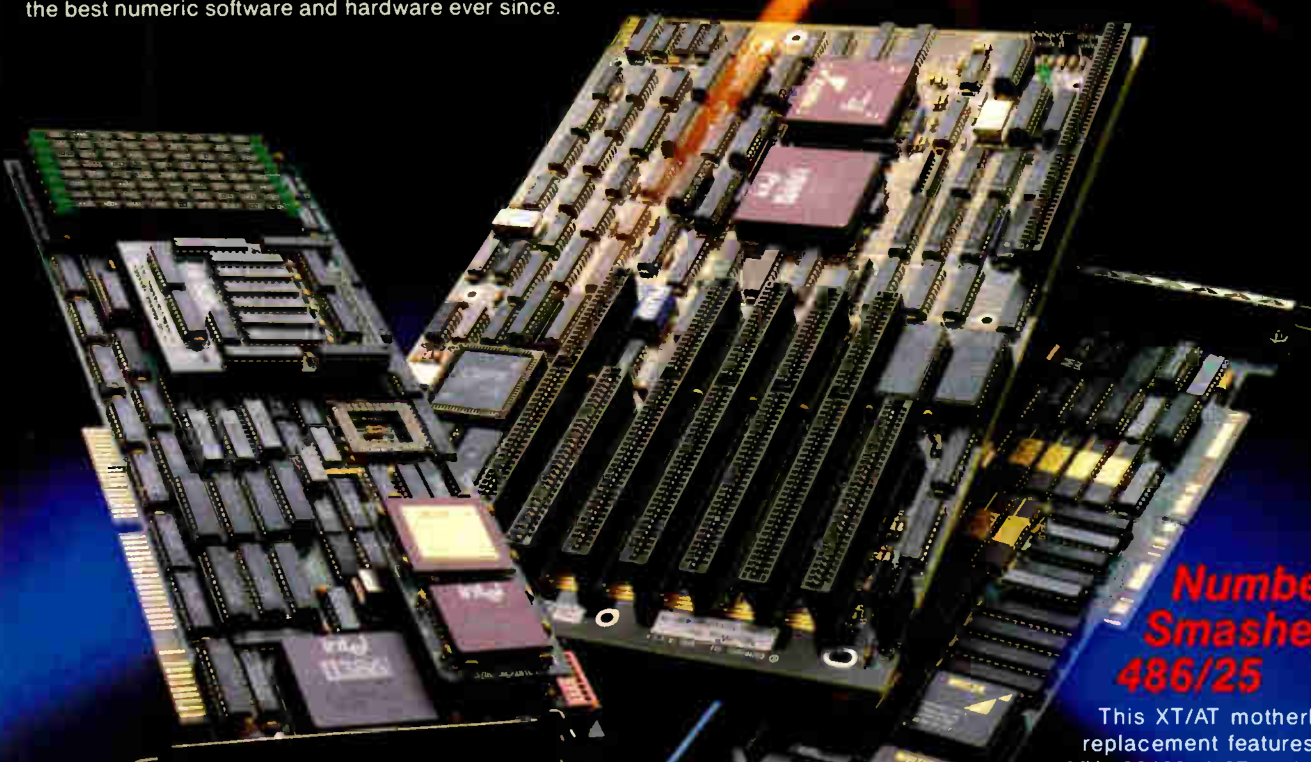

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Listing 4: *Desqview mailboxes. The receiving task names the associated mailbox* BYTE *and reads an incoming mail message. The sending task first searches for a mailbox named* BYTE *and then sends a message to that mailbox. At this level, mailbox messages are simply treated as strings of bytes, but your program can impose any suitable structure to a message using casts.*

```
/* RECEIVING TASK */
char *myname;     /* Pointer to my mailbox name */
int rmsglen;      /* Size of incoming message */
char *rmsgptr;    /* Pointer to message body */
char chr;         /* Character variable */
int i;            /* Offset into message body */
/* Use the mailbox Desqview created for
** us at start-up. Name it BYTE.
*/
myname="BYTE";
mal_name(mal_me(),myname,strlen(myname));
/*
** Read input from the mailbox. Notice that
** you have to give Desqview the address
** of the pointer to the message.
*/
status=mal_read(mal_me(),&msgptr,&msglen);

/*
** Get ith character in message body.
*/
chr = *(rmsgptr+i);

/* SENDING TASK */
char *hisname;   /* Pointer to receiver's mailbox name */
int smsglen;     /* Number of bytes in message buffer */
char *smsgptr;   /* Pointer to message buffer */

/*
** Find the receiving task's mailbox handle.
*/
hisname="BYTE";
hismhand=mal_find(hisname,strlen(hisname));
if(hismhand==0L)
{    printf(" Mailbox not found!0);
     return;
}

/*
** Send a mail message.
*/
 mal_write(hismhand,smsgptr,smsglen);
 ...
```

status word lets the recipient determine the relative priority of the message and is in the range 0 to 255. Your program can also use the status word as a means of governing which routine should handle the message.

As an example, messages sent by the window manager always have a status of 128, so you could design your program so that a single routine handles all window management functions and quickly dispatch any messages with a status of 128 to that routine.

You can send mail messages either by reference or by value. Usually, you send messages by value, in which case Desqview actually copies the message string from the sender's mailbox to the receiver's mailbox (although Desqview maintains ownership of the memory occupied by the message string). However, you can send unusually long messages by reference, which simply transfers a pointer from the sender to the receiver rather than copying the entire string of bytes.

Notice, however, that sending mail by reference can be dangerous. As an example, suppose task A and task B are in separate processes, and task A sends mail by reference to task B. If the parent process of task A terminates before task B checks its mail, task B could well end up with a pointer to a block of memory with undetermined contents. A sample mail exchange between two tasks is in listing 4.

As I mentioned earlier, Desqview permits your program to use a mailbox as a semaphore, in which case the mailbox serves as a means of controlling access to a shared resource. Suppose you've put together a Desqview application that lets several tasks submit jobs—possibly simultaneously—to a print queue. You can regulate access to the queue by creating a mailbox and naming it PrinterQ. Then, whenever a task wants to send something to the queue, it issues a `mal_lock(mhandle)` call (where `mhandle` is the handle of the mailbox).

continued

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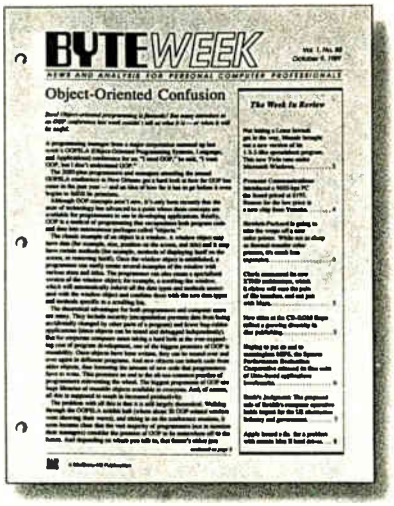
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The `mal_lock()` function locks the PrinterQ mailbox. Any other task that attempts to use the queue will first issue its own `mal_lock()` call and—since the mailbox is already locked—will be suspended. When the first task completes its print job, it issues a `mal_unlock(mhandle)` call, freeing the second task, which can proceed to load the queue.

Whenever a task locks a mailbox, the mailbox becomes the property of that task for the duration of the lock. This means that you cannot lock an open mailbox, since this puts you into conflicts concerning who actually owns that mailbox (i.e., the task receiving mail through it or the task locking it?). Therefore, close a mailbox—using the `mal_close()` routine—before locking it.

Desqview Shares

Another means of constructing an IPC channel in Desqview is through the use of the shared programs feature—a sort of scaled-down version of dynamic link libraries. You're already familiar with Desqview's shared programs if you've ever gone to the Advanced Features screen while adding a new program to the list of programs-to-open on the pop-up menu.

Whenever you ask Desqview to launch an application, it first looks into the application's program information file to see if you've specified a shared program. (Desqview creates a PIF for every program it recognizes in its open menu.) If so, Desqview first loads and executes the shared program before it executes the application. As its name implies, a shared program can be called by more than one process. Consequently, whenever your application asks Desqview to load a program that is already loaded, the copy already in memory is used.

It's easy to use a shared program as a sort of auto-loading TSR program.

Shared programs are unique in several ways. They look like .COM files (their contents are memory images), but they are loaded without a program segment prefix and begin executing at offset 0. Also, Desqview will explicitly call a shared program twice: when the shared program is initially loaded (and prior to Desqview's executing the first instruction of the application that requested the shared program) and again when the requesting application terminates. The shared program's entry point routine can distinguish between an initialization call and a termination call by looking at the CX register (which is 0 for the former and 1 for the latter).

Given the capabilities that I've just described, it's easy to see how you could use a shared program as a sort of auto-loading TSR program (see figure 4). When your shared program's initialization routine is invoked, it could attach itself to an unused software interrupt. Thenceforth, applications that called that interrupt could receive the segment address of a shared memory block. When the shared program received a termination call, it would "unhook" the interrupt. Desqview automatically releases memory occupied by the shared program once the last process using the shared program terminates.

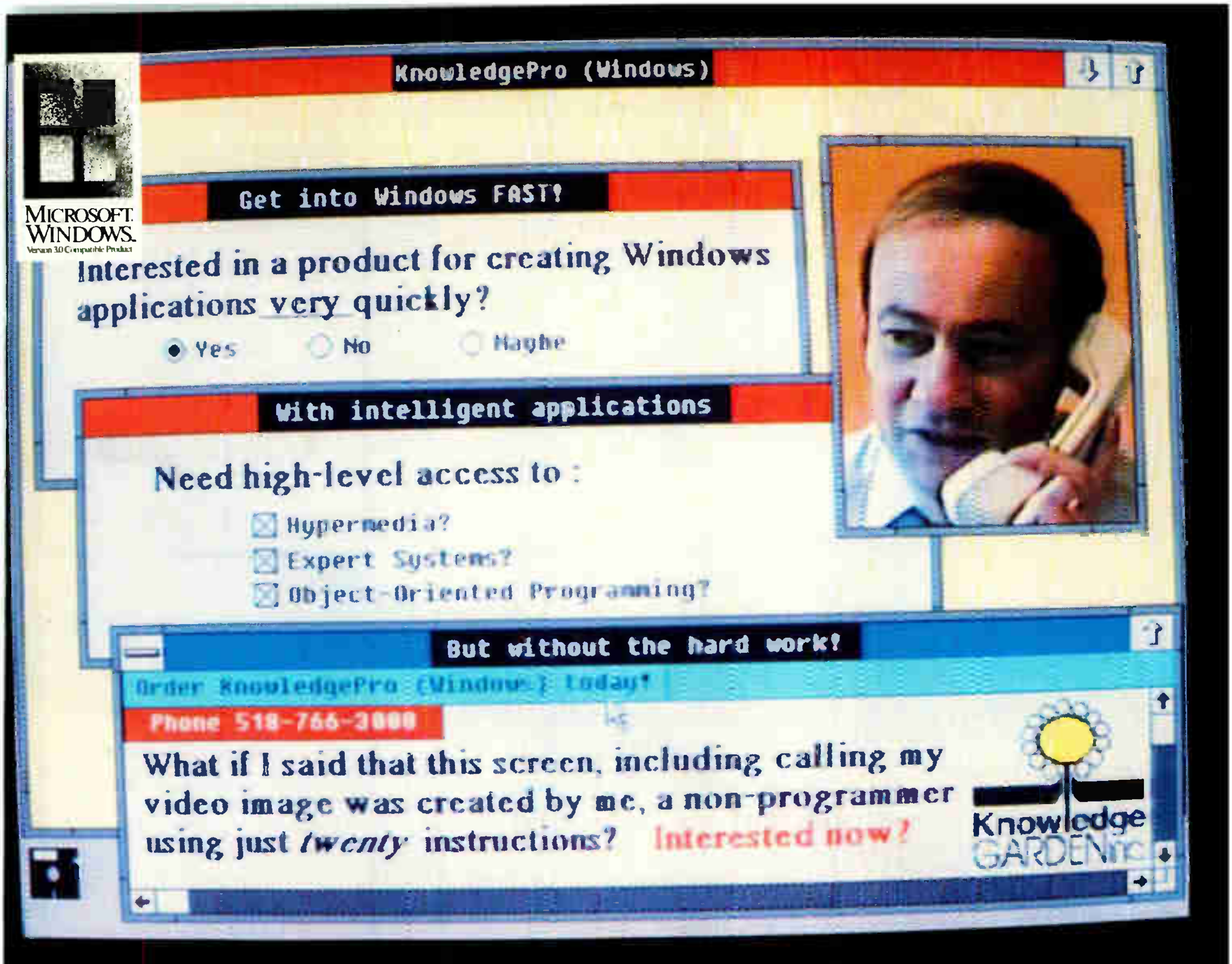
Stay Tuned

As a starting point for your explorations into IPCs, I've provided the source code for a Desqview program that demonstrates the use of mailboxes. The program creates a randomly arranged array and then launches a variable number of child processes. The parent carves up the array and, via mailboxes, sends pieces to each child. The children sort their subsets of the array and mail the results back to the parent. The source code is available through the usual sources (see page 5 for details).

Next month, I'll continue my discussion of IPCs with a look at Unix and OS/2. ■

Rick Grehan is the director of the BYTE Lab. He has a B.S. in physics and applied mathematics and an M.S. in computer science/mathematics from Memphis State University. He can be reached on BIX as "rick_g."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



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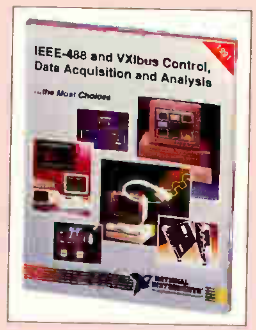

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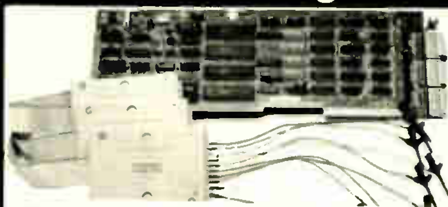

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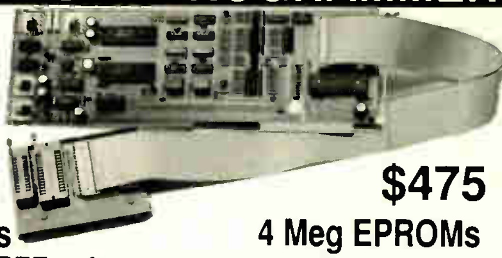

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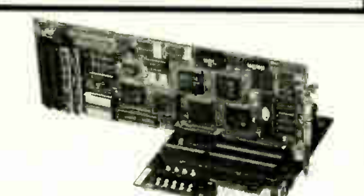

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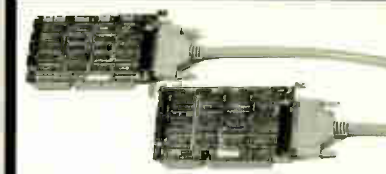

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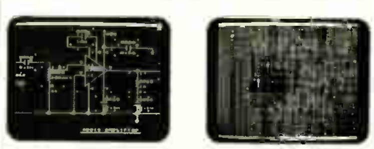

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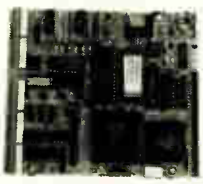

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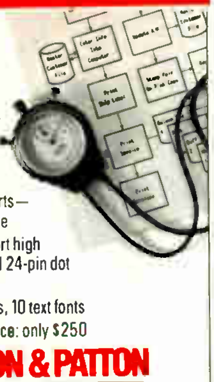

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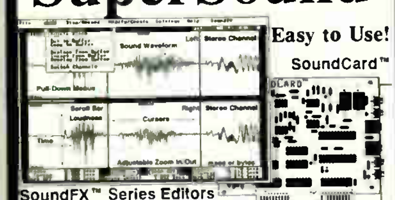

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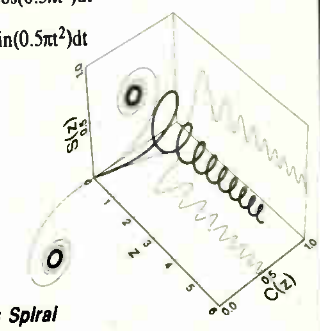

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Company ______________________

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( ) ______________ ( ) ______________

Phone Number — Fax Number

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes 11 ☐ No

D. What operating systems are you currentl using? (Check all that apply.)

12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* tl purchase of hardware or software?

18 ☐ 1–25
19 ☐ 26–50
20 ☐ 51–99
21 ☐ 100 or more

Inquiry Numbers 1-495

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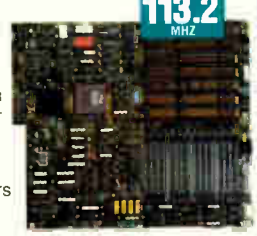

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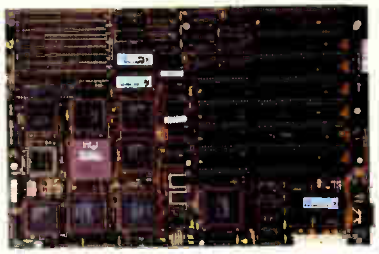

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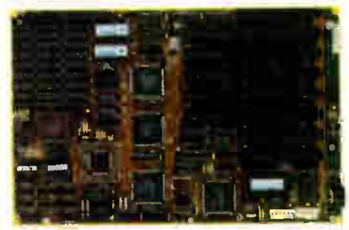

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Chaos Manor Mail

Jerry Pournelle answers questions about his column and related computer topics

Desqview Grumbles

Dear Jerry,

As an avid follower of Computing at Chaos Manor, I have a wee bone to pick with you regarding Desqview. A while back, when speaking of 286 systems, you stated offhandedly that "Desqview is probably better than nothing." I've got news—it's a lot worse!

I can't believe that I'm the only one having trouble with Desqview 2.2. Nowhere in the advertisements does it state that Desqview is incompatible with MS-DOS 4.01. (PC-DOS 4.0 is specifically mentioned as being supported.) According to the technician I spoke to, Desqview is written specifically for PC-DOS, essentially telling the legions of MS-DOS users to go hang. If Desqview truly does not support RAMDrive (Microsoft's version of Vdisk), then the claims of support for MS-DOS 3.x are, in fact, false.

As I stated, even after adding EMS memory, I cannot run my word processing, desktop publishing, or graphics programs. I have wasted days of effort to try to get the thing to work. Optimizing my CONFIG.SYS and AUTOEXEC.BAT files with /x to use EMS memory as much as possible freed up only 28K bytes. Does anybody have any ideas on how I can pry loose another 70K to 100K bytes of RAM?

Incidentally, Desqview is the only application I have found to date that does not work under MS-DOS 4.01. I took a bootable copy of DOS to work, and it ran on everything except certain early ITT-Xtras. My only complaint with MS-DOS 4.01 so far is its size—which, I understand, will be addressed in the upcoming version 5.0. The new disk-handling features alone make me determined not to switch back to DOS 3.x.

Richard W. Pownell
West Covina, CA

Are you a relative? Possibly not; the usual drift of the name is different. The Parnell branch in Ireland, for example.

You may not be the only one having trouble with Desqview, but I don't get all that many complaints, either. I think if I were you I'd get a refund.

I don't use DOS 4.0x; I just haven't found any need for it. I do know a lot of things that won't work properly with it, including all but the latest version of Norton Utilities.

I don't claim that Desqview is great for everyone. It works for me. I use the RAM ROM statements with QEMM to free up memory between 640K bytes and 1 megabyte. The ALL Charge card will let 286 systems execute 386 instructions.

—Jerry

Farsi Computing

Dear Jerry,

I'm an undergraduate student studying programming and systems analysis in the industrial engineering department of the University of Science and Technology in Tehran. I love computers and programming. Up to now I have written all but one of my programs in BASIC, but I learned Pascal recently, and I got a copy of Turbo Pascal 4.0 and wrote a program with it last month. It was a beautiful experience, so I have decided to make it my primary programming language. My computer is an AT-compatible Commodore PC 40 with a 10-MHz 286 processor, 1 megabyte of RAM, a 1.2-MB floppy disk drive, a 20-MB hard disk drive, and a CGA color monitor.

In Iran no personal computers are imported on a large scale for ordinary consumers. Government organizations import only enough computers to meet their own needs. Ordinary people like me have to either travel abroad and import a computer or buy it on the black market (the only market for personal computers in Iran) from people who have done so. That's why a PCompatible like mine costs around $25,000. A Commodore 64, which is usually used as an adult toy here, costs about $2600, yet more and more of them are sold every day. The other common personal computers in Iran are the Sinclair ZX Spectrum 48 and the ZX Spectrum 128, which I used to own until six months ago. The 128 model costs about $1600 here. (Having owned a Sinclair for three years, I think they are the absolute best for first-time programmers. Some great features of the Sinclair BASIC are missing even today from the best BASICs around, among them QuickBASIC 4.5 and Turbo Basic.)

But there is a good news, too. In Iran nobody ever hears of nasty things like copyright laws, so when new software enters Tehran, sooner or later someone unlocks the copy protection, if it exists in the first place, and as soon as that is done, in next to no time the software is totally free. After buying my computer six months ago, I got all this software free in less than three months: Advanced Flight Trainer, AutoCAD 2.60, a COBOL compiler, dBASE III Plus 1.10, Borland's Eureka, a FORTRAN 77 compiler, FoxBase+ 2.0, IBM Storyboard Plus, Lotus 1-2-3, Lotus Symphony, MathCAD 1.0, Microsoft Project, Norton Commander, Norton Editor (by the way, the next time you see Peter Norton, tell him that even in Iran his books and software are loved by many—I ordered a couple of his books only two days ago), PC Tools 4.30, PE2, a PL/I compiler, PrintMaster, QuickBASIC 4.0, Borland's SideKick, Turbo Basic 1.0, Turbo C 1.0, Turbo Pascal 4.0, Turbo Prolog 1.10, and WordStar 2000, which I'm using to write this letter. I have mentioned only the more famous software packages, not all the ones I own.

But we are not happy, after all. The only software that is not easily attainable in Iran is software produced by Iranian software companies. These programs are very limited in range and power; as a matter of fact, up to now I have not seen a Farsi word processor of any real value or power, although I have heard of one recently.

The main problem with Farsi word processors up to now was their lack of ability to print (on-screen and on the printer) mixed Farsi and English. This has now been achieved very well, but some problems remain. To print Farsi, ASCII characters with codes of above 127 have been used to dump the codes for Farsi letters, so when working with Farsi we don't have some useful shapes and characters available. For example, I usually have to prepare documents in Farsi that also contain mathematical symbols, so I need to use the extended character set, but in today's Farsi word processors, these characters are not available. Of course, given time, I could come up with a word processor much better than the ones available today, but either I'm not aware of some difficulties or we don't have very good programmers in Iran. I think you can find better Chinese word processors than Farsi ones, and that tells us a lot (the Farsi alphabet has only 32 letters).

The first thing that comes to mind when we talk about free software is computer viruses. So far, I haven't heard of anyone encountering a virus in Iran. However, I don't think it is going to stay that way for long. We might succeed at keeping AIDS out of our country because in this regard we don't practice what the Americans are used to, but I'm sure we won't succeed in keeping computer viruses out, because we do practice software piracy—and we do it bloody well, too.

The only other thing I'd like to say is that I'm very interested in having a pen pal. My first interest is, of course, computers, but we could talk about almost anything mentionable, even religion and politics. So if you know of anyone interested, please do give my address to him or her.

Kamran Behbahanizadeh
Tehran, Iran

I don't know about viruses in Iran. The virus threat is quite real, as we have discovered over here, but it's not as serious as people supposed.—Jerry

Maintenance Challenge

Dear Jerry,

Concerning maintaining APL programs, I've been using APL for about the last 10 years, developing new programs and maintaining old ones—some of the old ones I wrote myself, and others come from a variety of sources. Before that, I spent a similar amount of time doing similar tasks with all the old COBOL, FORTRAN, and PL/I favorites.

What I've learned from this experience is that all the benefits that APL brings to the development process are just as applicable, relevant, and real in the maintenance phase. APL programs that are difficult to maintain are so for just the same reasons as other programs that are hard to maintain—principally because the writer started to produce code before he or she really understood what the program was supposed to do.

But if you've got a sick APL program on your hands, all those development aids are right there in front of you immediately. Given the choice of fixing an APL program or anything else I'm competent to fix, I know which would be my task of choice.

Dick Bowman
London, UK

I keep swearing I am going to teach myself APL, and one day, by gollies, I will do it.—Jerry

Son of Sir Zed

Dear Jerry,

I am not a regular reader of BYTE, but I happened to see your December 1989 Chaos Manor Mail column, in which there was quite a bit about the Sinclair Z-88 portable. I am afraid I missed your original comments on the subject.

I have recently become the proud owner of a Z-88. The first one broke down the day I bought it, but the dealer replaced it without even blinking. He said that they're a bit like light bulbs—they either work well, or they break down as soon as you turn them on. My second Z-88 has now been in daily use—often rather intensive use—for six weeks without a hitch. It has passed through three airport metal detectors and has been lugged around in an already overfilled briefcase with no loss of data at all.

No, it's not as fancy as other laptops; the keyboard is a bit small (you hit keys every time you pick it up by the edges); the display is weak; it's a little slow, especially with large documents; and it doesn't have disk storage; but it works very well for me. I bought it so that I can download files to a Mac. This may not be a computer that is as easily available as an IBM clone, but on a recent visit to Los Angeles, I had no difficulty finding one to download onto when the Z-88 filled up, and I brought the disks home without trouble, carefully passing them around the airport x-ray machine. The alternative is the Macintosh Portable, which may have a 40-MB hard disk drive and 10 hours of batteries, but is heavy and too high-priced.

Frank Cross
Norwich, UK

I carry Sir Zed everywhere, and I find I use it quite a bit; it downloads into the Zenith SupersPort quite easily, which is just as well, because while it's great for writing, I'd hate to edit text on that machine.—Jerry

Lost and Found

Dear Jerry,

Some years ago, I read an article in an anthology edited by you. The article, which I believe you wrote, defined a two-dimensional graph of political positioning, as opposed to the traditional linear left-right spectrum. I don't recall the title of the book, and I haven't been able to find it. Could you tell me where I might obtain a copy of the article?

Brian Tucker
Monterey, CA

It was originally published in a quarterly "bookazine" called Destinies. *I am in the process of revising it for inclusion in Jim Baen's newest book series,* New Destinies, *and when it's scheduled I'll mention it in my column.*—Jerry ■

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. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."

PRINT QUEUE

Hugh Kenner

Interface/Shplinterface

Should a computer interface be invisible, or gorilla-proof?

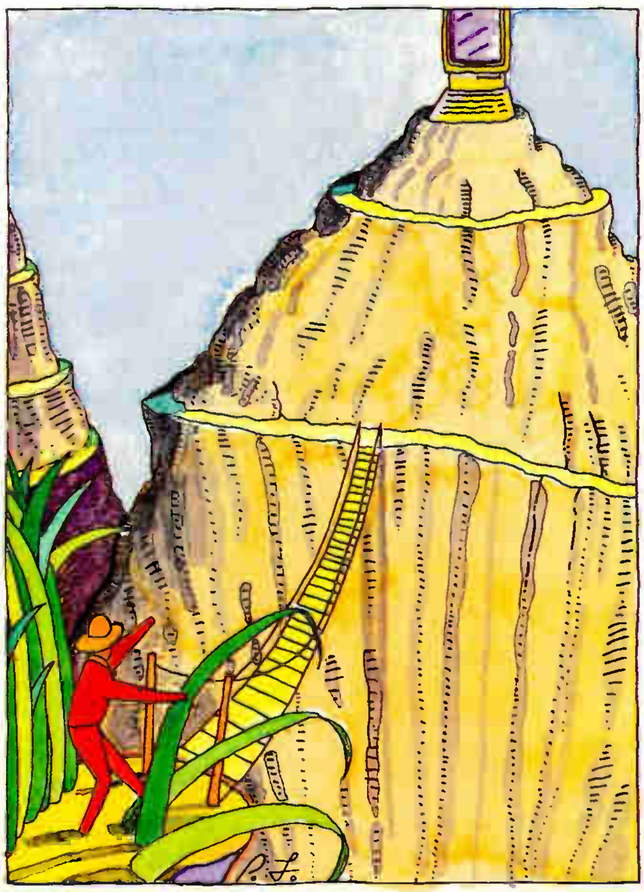
La la, look-and-feel time again. As I drew the first breaths to write this, a Boston federal judge was just telling Lotus competitors they mustn't market a spreadsheet that imitates "the appearance and command set" of Lotus 1-2-3. The way precedent works in law, that seems to nail down copyright coverage of how a program prompts a user, not just of how, in detail, it guides a CPU. I say "seems to" not only because I am no lawyer, but because the *New York Times* was so incautious as to quote the judge as follows:

"I conclude that a menu command structure is capable of being expressed in many if not an unlimited number of ways, and that the command structure of 1-2-3 is an original and non-obvious way of expressing a command structure." So there's a command structure expressing a command structure, and even if the learned judge understood what he was talking about, he's left it unclear what he'd have the rest of us understand. So, la la, once more, for the law.

Elsewhere, a West Coast lawyer is quoted in the act of putting his finger on something crucial: If that ruling really means what Lotus thinks it does, then once a program has become an industry standard, whoever markets a competing product will have more to do than devise alternative code. They'll have to be "willing to retrain users extensively." Yes indeedy, and don't suppose the folks at Lotus ever faltered in their rapture over such a notion. Recalcitrant fingers by the million! Look and feel, pish tush. The hidden theme (to the measure of megabuck legal fees) is habit.

That's one cat out of the bag. Users of any program must do what it wants them to, and they invest precious time in learning how. (That is why I'd guess that most writers, hardware permitting, go on using whatever word processor they started with. Why restructure so many reflexes?) But contrast the following snippet of Happy Talk: "The first and most important question to ask is, *what does the user want to do?* The process of interface design, as explained . . . in this book, returns again and again to this fundamental question."

"This book" is *The Art of Human-Computer Interface Design* (Addison-Wesley, 1990, $26.95, several dozen authors), and the chirps you've just heard emerge from Brenda Laurel, its editor. Well, surprisingly often, what the user wants to do is find out what a program can do: Can this thing perhaps figure my taxes, as well as track income and outgo? Otherwise, the question makes more sense phrased differently: What does the user want to *accomplish*? (Generate a typescript; move facts in and out of a spreadsheet; get connected to BIX and capture a file.) Formulate that; then what the user must *do* is dictated by the software. And No Fumbling!



That is where the look and feel comes in. How lucidly, how gently, with how little distraction from a manual, does the screen guide my actions? Donald A. Norman (Director, Institute for Cognitive Science, University of California–San Diego) says, almost always, badly. In the book's essay "Why Interfaces Don't Work," he contrasts his son popping a cartridge into a Nintendo game slot (setup time: seconds) and the two of them getting the same game to run from a floppy disk on an Apple IIGS (setup time: 5 minutes). The Nintendo, you see, is a computer stripped of all save game-machine functions.

Likewise, using pencil and paper lets you set up an appointment scheduler faster than does the Macintosh program Focal Point; moreover, it's there when you need it (e.g., on the street). Pencil-and-paper offers a scheduler stripped of all save transparent I/O functions. I myself, with a computer next to my telephone, still find everyday use for a hand-size gizmo that does nothing but alphabetize

ILLUSTRATION: PAUL FISCH © 1990

and retrieve names linked to phone numbers. Unlike a book, it accepts limitless erasure. Unlike a program, it doesn't pester with an interface.

"Why doesn't the interface work?" Dr. Norman answers, "Because we still think of using the interface, because we talk of designing the interface, because we talk of improving the interface." Yet "an interface is an obstacle: it stands between a person and the system being used." Aha, "stands between." And we confront interfaces, those crusty headwaiters, out of historical accident: "Keyboards, simple pointing devices, and video displays are not the most appropriate ways to interact with many of the tasks we do today, but they are all the computer provides." Yes, design ought to "aid the task, not the interface to the task."

So runs the bleakest of overviews, one that, pursued to an ultimate, would seem to bury us under all manner of special-purpose hardware—Nintendos, pocket schedulers. No one, least of all Dr. Norman, really wants so much clutter. His alternative—"The computer of the future should be invisible"—is something he doesn't see a way to help us envisage. (It would just address The Task? How?)

Since Apple's Human Interface Group paid for the conferences from which the book emerged, it's unsurprising that its text is layered over an Apple core. Although the editor claims "a 50-50 mix of Apple and non-Apple authors," you'll note a pervading presumption that Mac marked the watershed between just typing commands (because I Said So; signed: Jehovah@CP/M) and doing something intuitive. That's the more remarkable seeing that the first Mac was born crippled. Remember? The hood was welded shut. You couldn't so much as add memory. SJobs@Apple knew what was good for you. Instructive today, in the light of lurid lawsuits ahead, to read what Alan Kay has to tell us about designing interfaces.

In his 1970s decade at Xerox-Palo Alto Research Center, Alan Kay conceived the Dynabook (a laptop on which you could "draw or write anywhere"). The Dynabook led to the Alto, "forerunner of Macintosh." He also thought up Smalltalk, "a very high-level object-oriented programming language used by nonprogrammers." And he "pioneered the use of icons instead of typed words for telling computers what to do next."

Kay's 16 pages sparkle with penetrations. User-interface design has been around since someone put a handle on a hand axe, "an extension of the *arm*, not just the fist." McLuhan's "Medium = Message" means you have to "internalize the medium so it can be 'subtracted' out to leave the message behind." Thus, the tools we use reshape us, and the printed book propels us "from the vividness of the now" into an abstract realm in which "ideas that don't have easy visualizations can be treated." And we acquire "a *doing* mentality, an *image* mentality, and a *symbolic* mentality," in roughly that order. Doing leads to the mouse, image leads to icons, and symbolic leads to a language like Smalltalk.

Kay also has hard words about the "Metaphor" metaphor. ("I don't want a screen that is much like my physical desk. It just gets messy.") "User illusion" is better: the illusion of *multiple* desks; the illusion of paper instantly erasable. As for "folders," "bins" would be better. A sheet is in one folder, or it isn't. That metaphor confines; is "folder" anything more than a picturesque way to say "filename"? But the same memo could be in the "memos" bin, also in the "memos-boss" bin, also in the "grrr" bin. DOS filenames could achieve that only at the cost of tedious recopying. Yes, "bin" does exude a certain insouciance.

But I'll break this off at Koko's behest. Koko (born 1971, with a potential span of more than 50 years) is the world's most studied gorilla, and bids fair to be its most pampered Mac user. She has an American Sign Language vocabulary of over 600 words. The pet of the Gorilla Foundation, she uses "a standard Mac II enclosed in a special gorilla-proof housing," constructed of ½-inch polycarbonate for bolting to the floor of her trailer. Apple's Vivarium Program has even designed a customized inch-thick touchscreen "to withstand the 2,000 pounds of force an excited gorilla can potentially generate."

The problem, you see, is that angry or excited gorillas tend to "run full speed and backhand the object of anger," and Koko's arm-swing is comparable to "a 10-pound shotput traveling at 100 miles per hour." No wonder Project Koko helped the team to "a better understanding of human-computer interfaces." Some users do get *mad*.

As the book went to press, Koko had already begun on "comprehension of spoken language," also "self-concept" (employing the sign "myself"), also "discrimination of human voices." She works with customized software called Lingo. She commands 5 megabytes of memory and a 40-MB hard disk drive.

"To empower any individual through the computer medium requires much thought and exploration." Amen. "Unforeseen areas of research on gorilla intelligence and culture" are to be hoped for. Can we see the human species as but "part of a continuum"? Nineteen now, Koko by the time she's 50 may aspire, even, to the Boston bench, where her opinions, punched out on that shatterproof screen, about command structures expressing command structures could give pause to both the *New York Times* and Lotus. ■

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

STOP BIT ■ Tom Thompson

SPARE ME THE DETAILS

Details, details—why can't the interface handle all that stuff?

Microcomputers, like BYTE itself, have come a long way in 15 years. Gone are the LEDs and front panels where intrepid souls used spring-loaded switches to toggle raw machine code into a few kilobytes of memory.

Today's microcomputer users have systems whose capabilities would boggle the imagination of those pioneers. They could hardly have imagined writing documents with any typeface or drawing illustrations on a screen with millions of colors.

The best part of this evolution is that, in the very best software, all that technology is hidden. Take a graphic designer; he or she may not (and should not) care that his or her computer uses 24 bits per pixel to represent those millions of colors. A graphic designer can use his or her computer as a graphics tool because those bits and op codes of yesterday don't get in the way.

That's why graphical user interfaces have been such a success—they allow people other than that legendary power user to use the microcomputer as a productive tool. Many folks would prefer to spend time getting the job done rather than mastering the peculiarities of every application they use. A GUI allows them to do this by providing a consistent interface so that every application behaves in a reasonable way.

Stop Bit is an open forum for informed opinion on topics related to personal computing. The opinions expressed are those of the author and not necessarily those of BYTE or its staff. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

The GUI concept has been around for a while now. Every time I hear that Windows 3.0 "has validated the graphical user interface," I have to suppress a chuckle. Windows 3.0 didn't validate the GUI; Microsoft climbed aboard that bandwagon because it made sense. Whether or not Windows 3.0 will offer the seamless interchange of data that Mac users enjoy remains to be seen. However, it's a first step in the right direction.

Looking ahead at what microcomputers will be doing in the next 15 years, though, I can see that a GUI is not enough. Why? Because even on a mature, well-developed interface like the Mac's, you can still get bogged down with details. Is that image file in PICT, TIFF, or a bit-mapped format? Is that document text-only, or do I need to fire up a filter to convert it into something I can use? Do I even have the filter for that type of file?

Apple seems to think that a voice interface will improve the situation. Voice control would certainly help the blind or disabled to use a computer, but I wonder if the folks who thought up voice control have ever seen a real workplace. I mean the kind of place where there are no private offices or cubicles, and most people wear Walkmans to drown out the racket. A voice-directed computer is going to work in this environment? And do you really want everyone to overhear you dictating your resumé into the computer?

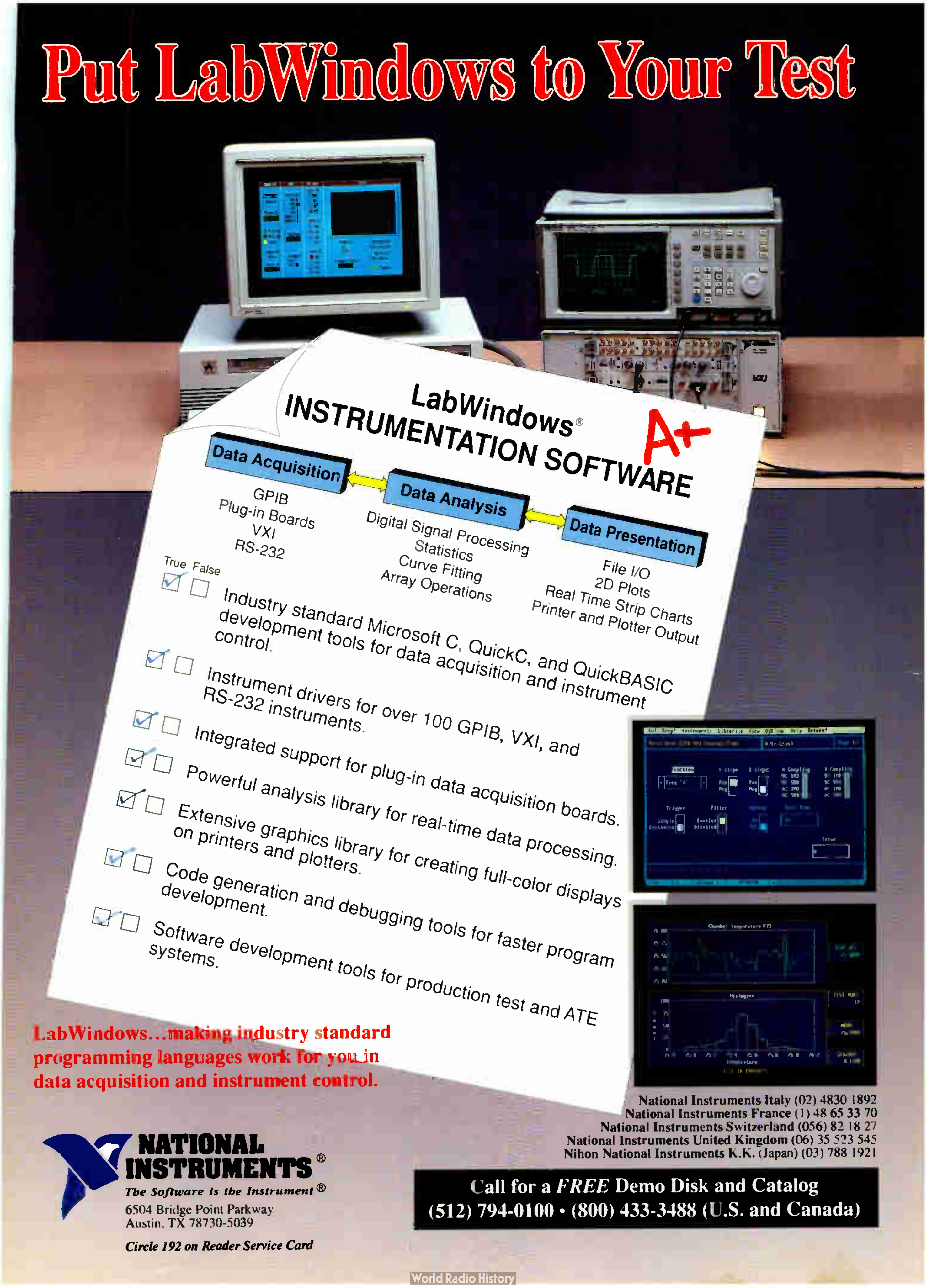
Lest anyone think I'm picking on Apple, you've got to admit that the people there did a number of things right on the Macintosh. For example, hooking a Mac to a network is simple; you just plug in a LocalTalk node, and the networked printers appear in the Chooser desk accessory. You insert a system software disk, launch an Installer application, and select AppleShare Workstation. Once that's done, you can see all the file servers on the network—and use them. No messing with network cards or setting jumpers. No network addresses to worry about—the Mac handles all that. Which brings me back to the question about the ideal interface, to which I answer: Why not let the computer handle all these details?

I'm talking about an interface where you type in plain questions and get real answers. In the movie *Outland*, Sean Connery, playing future cop on a mining station on Io, types in plain English questions. "Number of employees with criminal record?" A list of names appears. "How many for drug-related crimes?" Two names remain on the screen. Finally, he types "Transmit likeness," and mug shots of the two people appear. Connery used a plain old keyboard to enter his questions—there was no exotic technology involved, not even a window. Nor did our hero need to know where the database was on the computer, if it used Structured Query Language, or if the images were in TIFF. The computer fussed with the details—and gave him answers.

It's easy to become enamored of the latest microcomputer technology, especially when you work in this industry. But now that we've got all these high-powered processors running at 33 or 40 MHz and dealing with hundreds of megabytes of mass storage, can't we do better than run our old software faster? Can't we devote some of those clock cycles to handling messy details?

We need to remember that people buy microcomputers to get work done. They are not a productivity tool if you're tripping over details. Then the computer becomes part of the problem, not the solution. Is it too much to ask that computer makers make their machines solve problems? I want the *Outland* interface. And spare me the details, please. ■

Tom Thompson is a BYTE senior technical editor at large. You can reach him on BIX as "tom_thompson."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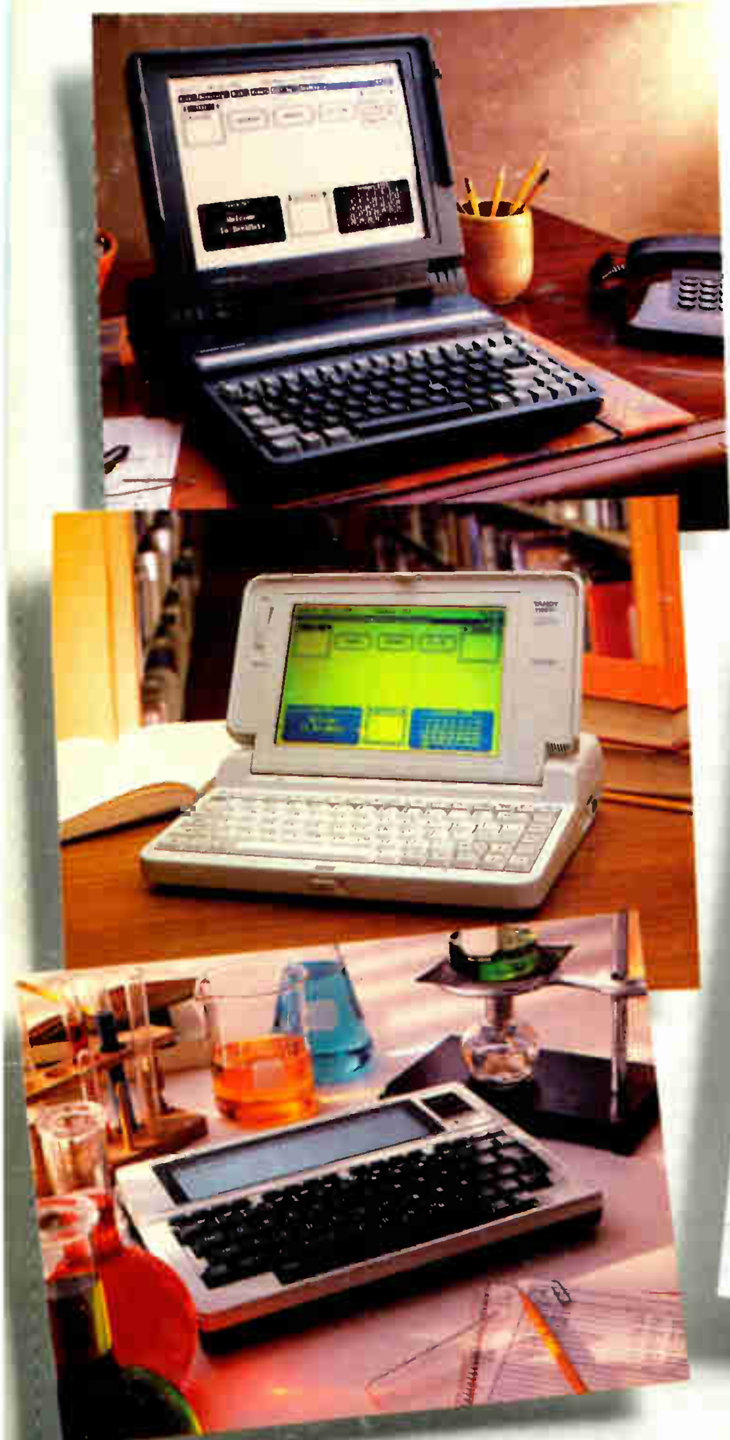

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